387 2-202.2

SUBMITTAL OF DRAFT FINAL LEACHATE/LINER COMPATIBILITY STUDY REPORT FOR THE ON-SITE DISPOSAL FACILITY

08/22/96

DOE-1262-96
DOE-FN EPAS
~~300~~ 425
REPORT

Department of Energy

Ohio Field Office
Fernald Area Office
P. O. Box 538705
Cincinnati, Ohio 45253-8705
(513) 648-3155

AUG 22 1996

DOE-1262-96

Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region 5 - SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

SUBMITTAL OF DRAFT FINAL LEACHATE/LINER COMPATIBILITY STUDY REPORT FOR THE ON-SITE DISPOSAL FACILITY

This letter submits the Draft Final Leachate/Liner Compatibility Study Report for your review. This report presents the results of a study designed to evaluate the leachate compatibility characteristics of High-Density Polyethylene (HDPE) geomembrane materials that are candidates for use as components of both the liner and final cover systems for the On-Site Disposal Facility (OSDF) at the Department of Energy, Fernald Environmental Management Project (DOE-FEMP).

If you have any questions about this report, please call Rod Warner at (513) 648-3156.

Sincerely,

Johnny Reising
Fernald Remedial Action
Project Manager

FEMP:Warner

Enclosure: As Stated

Recycled and Recyclable

cc w/enc:

R. L. Nace, EM-423/GTN
G. Jablonowski, USEPA-V, 5HRE-8J
R. Beaumier, TPSS/DERR, OEPA-Columbus
T. Schneider, OEPA-Dayton (3 copies total of enc.)
F. Bell, ATSDR
D. S. Ward, GeoTrans
R. Vandergrift, ODOH
S. McLellan, PRC
T. Hagen, FERMCO/65-2
J. Harmon, FERMCO/90
AR Coordinator/78

cc w/o enc:

J. Patterson, DOE-HQ
J. Jalovec, DOE-FEMP
S. Peterman, DOE-FEMP
J. Reising, DOE-FEMP
S. Garland, FERMCO, MS52-2
M. Hickey, FERMCO, MS52-2
U. Kumthekar, FERMCO, MS52-2
C. Little, FERMCO, MS2
T. Walsh, FERMCO, MS65-2

387 FOR INFORMATION ONLY

DRAFT FINAL

LEACHATE / LINER COMPATIBILITY STUDY FINAL REPORT

ON-SITE DISPOSAL FACILITY

REVISION B
AUGUST 1996

United States Department of Energy
Fernald Environmental Management Project
Fernald, Ohio

prepared by

GEOSYNTEC CONSULTANTS
1100 Lake Hearn Drive, NE, Suite 200
Atlanta, Georgia 30342

000003

under

Fernald Environmental Restoration Management Corporation
Subcontract 95PS005028

No. 27

387

DRAFT FINAL
LEACHATE/LINER COMPATIBILITY STUDY
FINAL REPORT

ON-SITE DISPOSAL FACILITY

Draft
Revision B
August 1996

draft

United States Department of Energy

Fernald Environmental Management Project
Fernald, Ohio

Prepared by

GeoSyntec Consultants
1100 Lake Hearn Drive, NE, Suite 200
Atlanta, Georgia 30342

Under

Fernald Environmental Restoration Management Corporation
Subcontract 95PS005028

000004

ACRONYM LIST

ARAR	Applicable or Relevant and Appropriate Requirement
ASL	Analytical Support Level
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Constituent of Concern
DOE	United States Department of Energy
ESCR	Environmental Stress Cracking Resistance
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
FTIR	Fourier Transform Infrared Spectrophotometer
FTMS	Federal Test Method Standards
GSL	Gundle-SLT Environmental
HDPE	High Density Polyethylene
HW	Hazardous Waste
IR	Infrared Spectroscopy
LCS	Leachate Collection System
LDS	Leak Detection System
LLCFR	Leachate/Liner Compatibility Final Report
LLCWP	Leachate/Liner Compatibility Work Plan
LTS	Leachate Transmission System
MSW	Municipal Solid Waste
MTL	Materials Testing Laboratory
NCTL	Notched Constant Tensile Load
NIST	National Institute of Standards and Technology
NST	National Seal Company, Inc.
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
OU2	Operable Unit 2
OU5	Operable Unit 5
QA/QC	Quality Assurance/Quality Control
ROD	Record of Decision
SCQ	Sitewide CERCLA Quality Assurance Project Plan
TDS	Total Dissolved Solids
VOC	Volatile Organic Compound

TABLE OF CONTENTS

List of Acronyms i

1. INTRODUCTION 1-1

1.1 Purpose of Report 1-1
1.2 Organization of Report 1-2

2. SUMMARY OF KEY POINTS FROM LLCWP 2-1

2.1 Overview 2-1
2.2 Selection of HDPE Geomembranes 2-1
2.3 Selection of Test Leachate 2-2
2.4 Review of Available Information 2-6
2.5 Procedures for Testing, Evaluation, and Reporting 2-8
2.6 Requirements for Quality Control and Quality Assurance 2-8

2.6.1 Overview 2-8
2.6.2 Perched Ground Water Sampling and Analysis 2-9
2.6.3 Laboratory Compatibility Testing Program 2-9

3. SUMMARY OF TEST RESULTS 3-1

3.1 Geomembranes Tested 3-1
3.2 Testing Participants 3-1
3.3 Experimental Details 3-2

3.3.1 Exposure Conditions 3-2
3.3.2 Exposure Cells 3-2
3.3.3 Temperature Control 3-2
3.3.4 Maintenance of Test Leachate 3-3
3.3.5 HDPE Coupons 3-3

draft

TABLE OF CONTENTS (continued)

3.3.6 Post-Exposure Preparation of Coupons 3-3
3.3.7 Baseline Tests 3-3

3.4 Test Methodologies 3-4

3.4.1 Overview 3-4
3.4.2 Evaluation of Data 3-4
3.4.3 USEPA Method 9090 Tests 3-5
3.4.4 Additional Tests 3-7

3.4.4.1 Surface Analysis 3-7
3.4.4.2 Stress Cracking Evaluation 3-7

3.5 Summary of Results 3-8
3.6 Recommendations for Design 3-11

4. CONCLUSIONS 4-1

APPENDIX A: CHEMICAL ANALYSES OF PERCHED GROUND WATER TEST LEACHATE
Part I: Summary Tables
Part II: Data Validation Summary Reports

APPENDIX B: GEOMEMBRANE/LEACHATE USEPA METHOD 9090 COMPATIBILITY TEST RESULTS

APPENDIX C: RESIN AND ROLL CERTIFICATIONS

draft

TABLE OF CONTENTS (continued)

APPENDIX D: FOURIER-TRANSFORM INFRARED SURFACE ANALYSIS RESULTS
Part I: Rationale, Results and Discussions, and Conclusions
Part II: Fourier-Transform Infrared Spectra

APPENDIX E: STRESS CRACKING RESISTANCE
Part I: Rationale, Results and Discussions, and Conclusions
Part II: Stress-Time Curves

draft

LIST OF TABLES

2-1 Summary Comparison of FEMP OU5 Perched Ground Water, and OSDF Test Leachate for Selected Chemical Constituents and Water Quality Parameters

2-2 Summary Comparison for Predominant Radionuclides in FEMP Type I Wells, Model COC Concentrations, and OSDF Test Leachate

3-1 FEMP Leachate/Liner Compatibility Testing Results Summary

draft

REPORT

1. INTRODUCTION

1.1 Purpose of Report

This report presents the results of a study designed to evaluate the leachate compatibility characteristics of high-density polyethylene (HDPE) geomembrane materials that are candidates for use as components of both the liner and final cover systems for the On-Site Disposal Facility (OSDF) at the Fernald Environmental Management Project (FEMP), located in Fernald, Ohio. The FEMP is undergoing remediation pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In order to address applicable or relevant and appropriate requirements (ARARs) derived from the Ohio Administrative Code (OAC) Chapter 3745-27 (Ohio Environmental Protection Agency (OEPA) Solid Waste Disposal Regulations), and identified in the *Final Record of Decision for Remedial Actions at Operable Unit 2* (OU2 ROD) [DOE, 1995a], a leachate/liner compatibility work plan (LLCWP) [GeoSyntec, 1996a] was developed. This report documents results of testing performed by the Fernald Environmental Restoration Management Corporation (FERMCO) and GeoSyntec Consultants (GeoSyntec) in accordance with the LLCWP and presents conclusions based upon those results.

The LLCWP comprised two main parts. Part I described the activities that were undertaken to compile available data and develop findings on the likely performance of HDPE geomembranes when exposed to OSDF leachate. The main elements of Part I included:

- developing a rationale for focusing the LLCWP on HDPE geomembranes;
- evaluating the likely chemical and radiological characteristics of leachate produced by the OSDF;
- discussing the results of a review of available information on the impacts of radiation and chemicals on HDPE geomembranes; and

- deriving conclusions and recommendations from the results of the information review.

Part II of the LLCWP described a testing program developed to provide adequate information for design of the OSDF and to satisfy the ARARs. Part II established the key components of the testing program, which included:

- collecting perched ground water from an on-site source at the FEMP;
- using this perched ground water as test leachate in the geomembrane immersion testing;
- fabricating geomembrane immersion cells;
- immersing candidate geomembrane specimens in the test leachate;
- testing the geomembrane specimens under pre-immersion and post-immersion conditions;
- analyzing the laboratory test results; and
- summarizing the results and developing the conclusions.

This report presents the results and findings from the testing program described in the LLCWP.

1.2 Organization of Report

This leachate/liner compatibility final report (LLCFR) is organized as follows:

- a summary of key points from the LLCWP regarding the selection of HDPE geomembranes for evaluation, the selection of an appropriate test leachate, the review of available information relevant to the chemical compatibility of

draft

HDPE geomembranes, and quality assurance/quality control requirements of the testing program is presented in Section 2;

- a summary of the chemical compatibility test results, including a brief description of the candidate geomembranes, study participants, experimental details, test methodologies, and characteristics of the properties tested is presented in Section 3; this section also includes a discussion of the results of environmental stress crack resistance testing of the candidate geomembrane materials; and

- conclusions based upon the results of the testing program are given in Section 4.

draft

2. SUMMARY OF KEY POINTS FROM LLCWP

2.1 Overview

The focus of the LLCWP was to: (i) establish a rationale for selecting candidate HDPE geomembrane materials for testing; (ii) establish a rationale and protocols for selecting, collecting, and analyzing on-site FEMP perched ground water to be used as test leachate; (iii) review information on leachate/liner compatibility, especially as it relates to conditions anticipated for the FEMP OSDF; and (iv) describe procedures for testing, evaluation, and reporting test results; and (v) present requirements for quality assurance and quality control of the testing program. Each of these items is briefly discussed below.

2.2 Selection of HDPE Geomembranes

As discussed in the LLCWP, geosynthetic components proposed for use in for the FEMP OSDF, and their associated polymeric materials, need to be evaluated for chemical and radiological leachate compatibility. This evaluation was initiated in the LLCWP and consisted of: (i) identifying each of the proposed geosynthetic components and describing its physical characteristics; (ii) outlining the primary function and composition of each geosynthetic component, and the status as to whether the particular geosynthetic component requires compatibility testing and evaluation; and (iii) providing a general description of the polymeric material that will be used for the selected geomembranes.

Based on the evaluation in the LLCWP, the critical elements of the liner system design from the standpoint of leachate compatibility were identified as the two 80-mil (2.0-mm) thick HDPE geomembranes. Therefore, the leachate/liner compatibility testing program focused on HDPE geomembranes. Other geosynthetic materials were not considered in the leachate/liner compatibility testing program.

draft

It was also noted in the LLCWP that the OSDF design requires the use of HDPE pipes in the leachate collection system (LCS), leak detection system (LDS), and leachate transmission system (LTS). Results of leachate compatibility tests on HDPE geomembranes can also be used to draw conclusions on the chemical and radiological compatibility characteristics of HDPE pipes. In particular, HDPE pipes should be more resistant to impacts from leachate than HDPE geomembranes in the OSDF because: (i) HDPE pipes are made from a higher density polymer resin than HDPE geomembranes and, as discussed in the LLCWP, the higher the polymer density, the greater the resistance of the polymer to radiological or chemical attack; and (ii) the HDPE pipe walls will be significantly thicker than the HDPE geomembranes.

2.3 Selection of Test Leachate

The likely composition of the leachate that will be generated within the OSDF was assessed in the LLCWP, and an appropriate analog to the anticipated OSDF leachate was developed. That analog was then used to select an on-site source of test leachate best matching the radiological and chemical characteristics of the OSDF leachate analog. The procedure for selecting an appropriate test leachate included: (i) characterizing the composition of the impacted material that will be disposed in the OSDF; (ii) reviewing information on leachate composition from other facilities; (iii) evaluating perched ground water from beneath the FEMP as an analog to OSDF leachate; and (iv) presenting the findings of the information review activities and developing a profile for the likely OSDF leachate composition.

The results of the technical information review identified leachate quality data that were relevant to establishing the characteristics of the anticipated OSDF leachate. However, the available data on leachate having the same radiological constituents as the impacted materials destined for the OSDF were limited, as were data from facilities with a materials-mix similar to that of the materials destined for the OSDF. The results of the LLCWP effort suggested that perched ground water from beneath the FEMP represents the best available analog to the anticipated OSDF leachate, particularly with respect to the potential radiological constituents of the leachate.

draft

Since OSDF leachate will be generated by the infiltration of water through the impacted materials placed in the OSDF, the product of present-day infiltration of surface water (primarily precipitation) through impacted on-site material at the FEMP (such as near surface soil and other media) could be considered an appropriate analog to the expected OSDF leachate. This analogy is based in part upon the current plan that about 80 percent of the impacted material to be placed in the OSDF will be soil excavated from the FEMP during remediation.

The soil component of the impacted material mix is important to the generation of leachate for two reasons. First, the mineralogic composition of impacted soil will influence leachate composition. Second, the soil at the FEMP has been variably impacted by infiltration of surface water from the former production area. Consequently, perched ground water in the existing overburden material beneath the former production area likely contains chemical and radiological constituents that will be present in the OSDF leachate. Further support for the use of impacted perched ground water as an analog to the OSDF test leachate is provided in the results of fate and transport modeling performed for the *Final Feasibility Study for Operable Unit 5* [DOE, 1995b].

Key conclusions from the LLCWP relating to the selection of an appropriate test leachate included:

- Radionuclides that could potentially affect HDPE have been found at the FEMP. However, the concentrations of radionuclides within the OSDF leachate are expected to be so low that the requisite properties of the HDPE geomembrane should not be affected. This expectation is supported by experiments in the fields of nuclear physics and nuclear engineering indicating that there should be only negligible effects upon HDPE for the energy levels and doses anticipated for the OSDF. In order to support this finding, chemical compatibility testing was conducted using perched ground water having the highest radioactivity available at the FEMP site as an analog for a "worst-case" OSDF leachate.

draft

- Based upon analogy with FEMP perched ground water, it is anticipated that the OSDF leachate will have a pH between 6 and 7, be mildly oxidizing, have major ion chemistry derived mainly from the soil destined for OSDF disposal, contain concentrations of VOCs below any threshold concentrations for HDPE impacted, and have very low levels of dissolved radionuclides. The perched ground water used as test leachate in the chemical compatibility testing also has these characteristics.

The FEMP perched ground water used as the test leachate was collected from the Plant 6 Clarifier Pit (designated location number 1614 by FERMCO), which is located in the basement of Plant 6. The Clarifier Pit is used to collect perched ground water that infiltrates into the basement of Plant 6. Chemical analyses conducted on a composite sample of the water collected from the Plant 6 Clarifier Pit and used as the test leachate included volatile and semivolatile organic compounds, metals, general water quality parameters, and radioisotopes. A complete list of the chemical analyses performed is provided in Table 6-2 of the LLCWP. The analytical laboratory results and data validation reports are given in Appendix A of this Leachate/Liner Compatibility Final Report (LLCFR).

To verify that the perched ground water used as the test leachate is a conservative analog to the anticipated OSDF leachate, the chemical data obtained for the test leachate have been compared to existing information on the ranges of chemical concentrations obtained from analyses of samples of perched ground water collected from locations throughout the FEMP. The results of this comparison are presented below.

- The concentrations of inorganic and organic constituents of concern (COC) in the test leachate are within, or exceed, the range of concentrations for COCs identified in FEMP perched ground water (Table 2-1) with the exception of phenol. This compound is present in the test leachate, but at concentrations less than the range for FEMP perched ground water. However, with respect to the absolute concentration of this constituent, phenol is not present in FEMP perched ground water at concentrations constituting a major contaminant at the FEMP [DOE, 1995c].

TABLE 2-1

SUMMARY COMPARISON OF FEMP OU5 PERCHED GROUND WATER, AND OSDF TEST LEACHATE FOR SELECTED CHEMICAL CONSTITUENTS AND WATER QUALITY PARAMETERS

Chemical Constituent and Water Quality Parameter[1]	FEMP Perched Ground Water Range[3]	OSDF Test Leachate
pH	6.9 - 7.7	7.2
Specific Conductance (μmho/cm)	470 - 1,170	3720
Total Dissolved Solids	433	
Total Organic Carbon	1.15 - 9	93
Chloride	1.4 - 50	69.1
Calcium	74.4 - 155	555
Magnesium	20.4 - 47.8	131
Sodium	5.7 - 56.3	138
Potassium	0.89 - 31.5	48.6
Sulfate	3 - 175	121
Fluoride	0.2 - 1.3	2.98
Nitrate/Nitrite-Nitrogen	0.012 - 0.3	336
Ammonia (N)	0.1 - 4.5	1.62
Alkalinity ($CaCO_3$)	313 - 430	960
Phosphorus	0.026 - 0.18	
Iron	0.25 - 6.4	
Filtered Iron	0.05 - 4.9	
Manganese	0.0025 - 0.22	0.870
Phenol	0.007 - 0.03	.0056
Nickel	0.021 - 0.026	0.117
Arsenic	0.004 - 0.12	0.0075
Barium	0.034 - 0.45	0.227
Cadmium	0.006 - 0.007	
Chromium	0.006 - 0.035	0.0176
Copper	0.035 - 0.03	0.085
Lead	0.0014 - 0.0087	0.002
Mercury	0.0004	0.0001
Selenium	ND	0.0076
Silver	0.011 - 0.052	0.0848
Zinc	0.01 - 0.044	0.0894
Tetrachloroethane (μg/l)	39 - 10,000	90
Trichloroethene (μg/l)	1 - 10,000	650

Notes: (1) mg/l, except pH and as indicated otherwise.
(2) Norstrom et al. [1991], except as indicated otherwise.
(3) Table 4-7 of DOE [1995c].
Empty box indicates no value was reported.

ND = none detected.
No value if below given detection limit.

- The concentration of total uranium in the test leachate exceeds the range of concentrations detected in FEMP perched ground water (Table 2-2). Concentrations of neptunium-237 and strontium-90 in the test leachate are generally less than, but within an order of magnitude of, the range of concentrations for FEMP perched ground water [DOE, 1995c].

- The total uranium concentrations and activities of technetium-99 and uranium-238 in the test leachate substantially exceed those of the modeled leachate concentration developed for the feasibility study (FS) for OU5 [DOE, 1995b]. The activities of neptunium-237 and strontium-90 in the test leachate are about two orders of magnitude lower than the modeled leachate (Table 2-2). In total, however, the radiological activity of the test leachate exceeds the radiological activity of the model leachate by approximately a factor of five.

Based on the above comparison, it is appropriate to consider the test leachate as representative of the "highest activity" FEMP perched ground water and as a conservative analog for OSDF leachate.

draft

2.4 Review of Available Information

The LLCWP contains the results of a review of available information regarding the potential for leachate containing chemical and radiological constituents anticipated for the OSDF leachate to impact HDPE geomembranes. The major impacted material constituents considered in the review of available information are volatile organic compounds and radionuclides. The conclusions of the information review are as follows:

- The concentrations of volatile organic compounds (VOCs) in the anticipated OSDF leachate are less than the concentrations of VOCs typically found in hazardous waste (HW) and municipal solid waste (MSW) landfills. The results of compatibility testing of HDPE geomembranes and HW and MSW

TABLE 2-2

SUMMARY COMPARISON FOR PREDOMINANT RADIONUCLIDES IN FEMP TYPE I WELLS[1], MODEL COC CONCENTRATIONS[2], AND OSDF TEST LEACHATE

Radionuclide	Unit of Measurement[3]	FEMP Type I Wells	Model COC Concentrations	OSDF Test Leachate
Technetium-99	pCi/L	15.8–6130	56.6	64262
Uranium-234	pCi/L	0.001–25000	-[6]	220000
Uranium-235/236	pCi/L	0.208–2490	-	29000
Uranium–238	pCi/L	0.300-39000	2240	240000
Uranium, total	μg/L	0.400–436000	6670	582000
Neptunium-237	pCi/L	0.626[5]	18.6	0.14
Strontium-90	pCi/L	1.01 - 7.68	37.9	0.33

Notes:
(1) After Table 5-3 of DOE [1995b] = OU5 FS.
(2) After Table H.1-1 of DOE [1995b].
(3) Analyses were performed on unfiltered samples.
(4) Unit equivalents: μg/L = ppb; pCi = 0.037 disintegrations/second.
(5) Neptunium-237 was detected in only one sample.
(6) No constituent activity value reported.

DRAFT

leachate have shown no measurable effect of leachate immersion on the mechanical properties of HDPE geomembranes.

- HDPE is likely insensitive to alpha- and beta-particle interaction at the low total doses and dose rates anticipated for the FEMP OSDF leachate. However, available data are very limited and FEMP OSDF-specific testing is needed to confirm this conclusion. The leachate/liner laboratory testing program described in this report was performed to generate the needed additional data.

2.5 Procedures for Testing, Evaluation, and Reporting

Parts II and III of the LLCWP presents detailed requirements for testing, evaluation, and reporting for the leachate/liner compatibility testing program. A summary of the testing and evaluation requirements is given in Section 3 of this report. This report has been prepared to satisfy the reporting requirements of the LLCWP.

draft

2.6 Requirements for Quality Control and Quality Assurance

2.6.1 Overview

The need for quality assurance/quality control (QA/QC) programs is identified in the *Sitewide CERCLA Quality Assurance Project Plan* (SCQ) [DOE, 1992]. The SCQ developed requirements for the internal control and independent review of implementation and effectiveness of project work plans (i.e., the LLCWP). Two main elements of the LLCWP were covered by QA/QC programs: (i) sampling and analysis of FEMP perched ground water; and (ii) the laboratory testing of geomembrane specimens. Overall implementation of the LLCWP is covered by the SCQ. The QA/QC program for analysis of perched ground water is covered under specific portions of the SCQ. QA/QC for testing of geomembrane specimens follows the GeoSyntec *Materials Testing Laboratory (MTL) Policies and Procedures Manual* [GeoSyntec, 1996b]. A summary of the QA/QC programs for the two main elements is provided below.

2.6.2 Perched Ground Water Sampling and Analysis

The quality assurance program for the sampling and analysis of the perched ground water followed FEMP analytical support levels (ASLs) B, C, and D, as required in the LLCWP. The ASL prescribes quality control checks for qualitative, semi-quantitative, and quantitive analyses. The quality elements of ASL C and D include: sample collection procedures; field QA/QC samples (i.e., duplicate and blank samples); laboratory QA/QC samples (matrix spike/matrix spike duplicates, calibration standards); and data validation.

Perched ground-water sample collection was performed by FERMCO personnel in accordance with the *Project Specific Plan for Sampling of Perched Ground-Water Leachate/Liner Compatibility Study* [FERMCO, 1996]. Field measurement of pH, specific conductance, total dissolved solids (TDS), and redox potential were conducted under ASL B protocols. Sampling and analysis for general water quality parameters, volatile organic compounds (VOCs), and phenols were conducted under ASL C protocols. Only sampling and analysis for radioisotopes followed ASL D protocols.

Validation of the analytical laboratory data was performed by FERMCO personnel. Copies of data validation summary reports are provided in Appendix A together with analytical laboratory data sheets. Based on the validation reports, the analytical data for the perched ground water with appropriate validation meet their respective ASL quality requirements and are of good quality.

2.6.3 Laboratory Compatibility Testing Program

Geomembrane specimen testing for this leachate/liner compatibility study was conducted in accordance with the GeoSyntec *MTL Policies and Procedures Manual.* Every employee at MTL is responsible for complying with this manual. The quality system in this manual consists of a number of control documents including: laboratory organization and personnel, quality assurance procedures, standard operating procedures, laboratory equipment identification, equipment documentation, personnel training and laboratory health and safety. In addition, procedures are prescribed for the following:

- identification and traceability;
- training of personnel;
- calibration of testing equipment;
- standardized test methods;
- inspection of test results and accountability; and
- statistical analysis.

Identification and Traceability

Each candidate geomembrane product was assigned an identification number traceable to the vendor. The identification numbers were issued chronologically by date and recorded on a product sample log. Pursuant to ASTM D 4873, identification included: (i) manufacturer; (ii) style number; (iii) roll number; and (iv) machine direction.

Training of Personnel

MTL personnel used for the testing program were trained as required by the MTL Procedures Manual. Training was in accordance with the GeoSyntec MTL Policies and Procedures Manual. Only personnel with demonstrated competence in specific test procedures and certified by GeoSyntec to conduct the tests were used. Certification is documented in training status logs of each employee and are retained in personnel records.

Calibration of Testing Equipment

Equipment used for testing was calibrated in accordance with the GeoSyntec MTL Policies and Procedures Manual. Calibration records are maintained for instrumentation requiring scheduled calibrations. Calibrations are conducted by independent sources and

draft

are traceable to National Institute of Standards and Technology (NIST). These include: ASTM E 74-91, Mil Std 45662A, ISO 9001, and ISO/IEC25.

Standardized Test Methods

Geomembrane testing conducted for the leachate/liner compatibility study was performed in accordance with ASTM and FTMS test procedures for all tests for which procedures exist. Laboratory data sheets contained in the appendices to this report show the test method used and, when applicable, special test conditions, if different from the standard-prescribed conditions.

Validation of Test Results and Accountability

Test results were recorded on raw data sheets, or were automatically entered in a database for computer automated tests. Original data sheets were initialed by the technician performing the test. The results are therefore traceable to the technician who performed the test. Laboratory report sheets which report test results also include the initials of technicians who conducted the tests, to provide accountability of the test results. Lastly, test results were reviewed and approved by the chemical compatibility department manager prior to acceptance.

Draft

3. SUMMARY OF TEST RESULTS

3.1 Geomembranes Tested

The following manufacturers of smooth 80-mil (2.0-mm) thick HDPE geomembrane provided samples that were tested in this leachate/liner compatibility study:

- Gundle-SLT Environmental (GSE) Lining Technology, Inc., Houston, Texas; GSE Lining Technology, Inc. provided two samples for testing, one manufactured using a blown film process (GSE-Gundle), the other manufactured using a cast extrusion process (GSE-SLT);
- National Seal Company, Inc. (NSC), Galesburg, Illinois (cast extrusion);
- Poly-Flex, Inc. (Poly-Flex), Grand Prairie, Texas (blown film); and
- Serrot Corp. (Serrot), Henderson, Nevada (cast extrusion).

Samples of each type of geomembrane were shipped by their respective manufacturers to the GeoSyntec MTL in Boca Raton, Florida. The resin and roll certifications for each geomembrane sample are provided in Appendix C.

3.2 Testing Participants

Personnel from both on-site and off-site facilities were involved in this leachate/liner compatibility study. FERMCO personnel provided on-site laboratory services which included test leachate collection, exposure monitoring, sample decontamination, coupon disposal, and test leachate disposal. Personnel from the GeoSyntec MTL provided off-site laboratory services which included USEPA Method 9090 testing on unexposed (baseline) and exposed geomembranes, infrared (IR) spectroscopy, and environmental stress crack resistance (ESCR) testing.

draft

3.3 Experimental Details

3.3.1 Exposure Conditions

Tests were conducted in accordance with USEPA Method 9090 on samples of the HDPE geomembranes exposed to FEMP perched ground water for time periods of up to 120 days. Samples were exposed at temperatures of 23°C (73°F) and 50°C (122°F). Specific details on exposure conditions are provided below. Details of this test method are given in the LLCWP.

3.3.2 Exposure Cells

Ten exposure cells (one for each geomembrane/temperature combination) were fabricated from stainless steel (Grade 304) steam table pans measuring 6 in. x 12 in. x 20 in. (150 mm x 300 mm x 500 mm) and lids measuring 12 in. x 20 in. (300 mm x 500 mm). Butyl rubber gaskets were adhered to the underside of the rim of each lid. The cells were hermetically sealed using a circumferential aluminum flange.

3.3.3 Temperature Control

The cells were fitted with Polystat Model H-12002-00 analog circulators, each circulator having constant temperature control from approximately 5°C (41°F) above ambient temperature to 100°C (212°F). To minimize effects of ambient temperature fluctuations in the laboratory, cooling coils were attached to each 23°C (73°F) circulator and connected in a closed loop to a Polystat Model 01238-00 cooling recirculator, to maintain the USEPA Method 9090-specified temperature of 23°C (73°F) in the cells during the exposure tests.

draft

3.3.4 Maintenance of Test Leachate

To minimize stagnation and stratification of the test leachate (i.e., perched ground water) in the exposure cells, the test leachate was continuously circulated using the Polystat analog circulators. In addition, the test leachate in the exposure cells was replaced with fresh perched ground water after every exposure period. The perched ground water was stored in the laboratory in HDPE drums during the exposure test.

3.3.5 HDPE Coupons

Four coupons measuring 5.5 in. x 10.6 in. (140 mm x 270 mm) were prepared for each exposure period/temperature combination for a total of 16 coupons per exposure cell (30, 60, 90, and 120 days). Each coupon was individually numbered according to manufacturer, exposure period, coupon number, and sample tracking number. The mass, thickness, length, and width of each coupon were measured and recorded prior to exposure to the test leachate.

draft

3.3.6 Post-Exposure Preparation of Coupons

After retrieval from the exposure cells, the exposed coupons were rinsed in a soap solution to remove excess test leachate and any residual solid constituents. In addition, the coupons were cleaned in a 90-minute ultrasonic wash using a 10 percent solution of laboratory detergent and water to remove any material surfically imbedded in the coupons. To maintain consistency in the treatment of the exposed and unexposed coupons, the unexposed coupons were also treated to the same wash at every exposure period.

3.3.7 Baseline Tests

As a means of quality control in the post-exposure test results, baseline tests were conducted on unexposed coupons after every exposure period concurrently with the

testing of exposed coupons. These samples are hereinafter referred to as the control samples.

3.4 Test Methodologies

3.4.1 Overview

The HDPE geomembrane samples were tested for compatibility with the test leachate using the USEPA Method 9090, and surface analysis by infrared spectrophotometry. Stress crack resistance of the HDPE geomembranes was assessed using the Notched Constant Tensile Load (NCTL) test performed in accordance with ASTM D 5397.

draft

3.4.2 Evaluation of Data

The results from the USEPA Method 9090 tests on the five geomembrane sample types were assessed for the following data characteristics.

- *Data consistency.* If an effect in a property (i.e., reduction in strength) was noted at one time period due to exposure to leachate, a similar effect was expected at subsequent time periods.

- *Relationship between tensile strength and elongation.* The inverse relationship of tensile strength and elongation was expected to be maintained, i.e., an increase in yield strength was expected to be accompanied by a reduction in yield strain.

- *Inter-test correlation.*

  - The results of physical property tests (i.e., mass, thickness, dimensions, volatiles loss, thickness, specific gravity) were expected to undergo similar changes. For example, an increase in mass indicates that the

geomembrane has absorbed leachate constituents. Consequently, thickness and dimensions should also increase, since the geomembrane swells slightly when it absorbs leachate constituents.

- The mechanical strength properties (i.e., hardness, yield stress, break stress, modulus of elasticity, initial tearing strength, puncture strength, and Mullen burst strength) were expected to undergo similar changes. For example, if yield strength increases because of leachate, then hardness, break stress, modulus of elasticity, initial tearing strength puncture resistance, and Mullen burst strength were expected to increase. Likewise, yield and break elongation were expected to decrease.

- The results of physical property tests were expected to correlate with the results of mechanical property tests. As mentioned above, increases in the physical properties generally indicate that a geomembrane has absorbed constituents of leachate, which experience has shown causes strength to decrease and elongation to increase. Conversely, reductions in physical properties would be expected to be accompanied by increases in strength and reductions in elongation.

draft

3.4.3 USEPA Method 9090 Tests

The following tests, conducted in accordance with respective American Society for Testing and Materials (ASTM) or Federal Test Method Standard (FTMS) standards, were used to evaluate properties of the HDPE geomembranes after 0, 30, 60, 90, and 120 days of exposure to the test leachate:

- *Mass: USEPA Method 9090* - "Compatibility Test for Wastes and Membrane Liners";

- *Dimensions: USEPA Method 9090* - "Compatibility Test for Wastes and Membrane Liners";

- *Thickness: ASTM D 374C* - "Standard Test Method for Thickness of Solid Electrical Insulation";

- *Density/Specific Gravity: ASTM D 792* - "Standard Test Methods for Specific Gravity and Density of Plastics by Displacement";

- *Volatile Loss: ASTM D 3030 (SW 870)* - "Standard Test Method for Volatile Matter (including water) of Vinyl Chloride Resins";

- *Extractables Content: ASTM D 3421 (SW 870)* - "Recommended Practice for Extraction and Analysis of Plasticizer Mixtures from Vinyl Chloride Plastics";

- *Hardness: ASTM D 2240* - "Standard Test Method for Rubber Property -- Durometer Hardness";

- *Tensile Properties: ASTM D 638* -- "Standard Test Method for Tensile Properties of Plastics";

- *Initial Tear Resistance: ASTM D 1004* - "Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting";

- *Puncture Resistance: FTMS 101C* - "Puncture Resistance and Method 2065 Elongation Tests"; and

- *Bursting Strength (Hydrostatic Resistance): ASTM D 3786* - "Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method."

draft

3.4.4 Additional Tests

3.4.4.1 Surface Analysis

Surface analyses of the candidate geomembranes were conducted using a Fourier transform infrared spectrophotometer (FTIR). Surface analysis of the geomembranes was conducted on samples exposed to the test leachate for 60 and 120 days at 23°C (73°F) and 50°C (122°F). In addition, the surface of the control (unexposed) samples was evaluated following the 60- and 120-day exposure period.

Sample preparation for surface analysis of the geomembranes was performed using ASTM D 2663, "Standard Test Methods for Carbon Black - Dispersion in Rubbers." Spectral energy band identification was performed using ASTM D 276, "Standard Test Methods for Identification of Fibers in Textiles," and "Absorption Spectroscopy of Organic Molecules," [Parikh, 1974].

draft

3.4.4.2 Stress Cracking Evaluation

The stress cracking resistance of the candidate geomembranes was evaluated only on the unexposed samples using ASTM D 5397, "Standard Test Method for Evaluation of the Stress Cracking Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test." In this test, dogbone-shaped test specimens are notched in their central region and subjected to tensile loads at various percentages of their yield strength while being immersed in a 50°C (122°F) constant temperature bath for up to 2,000 hours. A solution consisting of 10 percent wetting agent (Igepal CO-630) and 90 percent water is used for the test immersion. The time to failure at the various stress levels provides an indication of the stress cracking potential of the geomembrane. Stress cracking may be defined as an external or internal crack in a plastic caused by tensile stresses less than the short-term tensile strength of the plastic. The design life of a semi-crystalline geomembrane, such as one manufactured from HDPE, is related to the stress crack resistance of the material. Results of the stress cracking tests are provided in this report.

3.5 Summary of Results

The results of the USEPA Method 9090 compatibility testing program have been summarized in Table 3-1. Detailed descriptions and laboratory data sheets for the various tests are provided in the appendices. From these results, the following key observations have been made regarding the interaction between the test leachate and the five candidate HDPE geomembranes:

- within the accuracy of the test measurements and inherent variability of HDPE resin, mass, thickness, dimensions, and specific gravity of the geomembranes were constant during the 120-day exposure test, indicating that the candidate geomembranes and test leachate did not physically or chemically interact to a measurable extent;

- hardness, stress and strain at yield, and stress and strain at break exhibited limited inter-test variability; however, no statistical trend in property variation was identified, and any trend indicative of physical or chemical interaction were not observed; these results suggest that the candidate geomembrane did not physically or chemically interact with the test leachate;

- within the inherent variability in materials, test procedures, test interpretation methods, initial tear resistance, modulus of elasticity, puncture resistance, and Mullen burst strength results were generally constant;

- test results for volatile loss and extractables content are inconclusive due to test interference; and

- NSC and GSE-Gundle geomembranes were generally more uniform in their tested properties than the Serrot, GSE-SLT and Poly-Flex geomembranes.

Results of the USEPA Method 9090 tests indicates that the five candidate HDPE geomembranes tested did not measurably interact with the test leachate. Infrared surface analysis results (spectra), presented in Appendix D of this report, did not reveal any indication of geomembrane surface oxidation. The results in Appendix D support the

draft

TABLE 3-1
FEMP LEACHATE/LINER COMPATIBILITY TESTING RESULTS SUMMARY

Test	Appendix	Result	Interpretation
Physical Properties			
Mass	B.2.1	Geomembrane mass remained essentially constant during USEPA 9090 exposure.	Extractable content increase most likely due to moisture, not test leachate did not measurably affect geomembrane mass.
Thickness	B.2.2	Geomembrane thickness remained essentially constant during USEPA 9090 exposure.	Extractable content increase most likely due to moisture, not test leachate did not measurably affect geomembrane thickness.
Dimensions	B.2.3	Geomembrane dimensions remained essentially constant during USEPA 9090 exposure.	Extractable content increase most likely due to moisture, not test leachate did not measurably affect geomembrane dimensions.
Specific Gravity	B.2.4	Geomembrane density remained essentially constant during USEPA 9090 exposure.	Extractable content increase most likely due to moisture, not test leachate did not measurably affect geomembrane density.
Volatiles Loss	B.2.5	Geomembrane volatile losses are variably higher than control values.	Extractable content increase most likely due to moisture, not test leachate interaction.
Extractables Content	B.2.6	Geomembrane extractables content are variably higher than control values.	Extractable content increase most likely due to ultrasonic cleaning, not test leachate interaction.
Mechanical Properties			
Stress and Strain at Yield	B.2.7	Mean values of exposed specimens are within one standard deviation of control value means. No identifiable trend in inter-test variability.	Test leachate did not measurably affect geomembrane stress and strain at yield.
Stress and Strain at Break	B.2.8	Mean values of exposed specimens are within one standard deviation of control value means with only a few outliers (expected for properties at break). No identifiable trend in inter-test variability.	Test leachate did not measurably affect geomembrane stress and strain at break.

Draft

TABLE 3-1 (continued)

Test	Appendix	Result	Interpretations
Modulus of Elasticity	B.2.9	Inter-test variability is significant with no discernable statistical trend in the test results.	Scatter in data due to material and experimental variability, not test leachate interaction.
Initial Tearing Resistance	B.2.10	Inter-test variability is significant with no discernable statistical trend in the test results.	Scatter in data due to material and experimental variability, not test leachate interaction.
Hardness	B.2.11	Geomembrane hardness remained essentially constant during USEPA 9090 exposure.	Test leachate did not measurably affect geomembrane hardness.
Puncture Resistance	B.2.12	Mean values of exposed specimens are within one standard deviation of control value means with only a few outliers (expected for puncture resistance). No identifiable trend in inter-test variability.	Test leachate did not measurably affect geomembrane puncture resistance.
Mullen Burst Strength	B.2.13	Inter-test variability is significant with no discernable trend in the test results.	Scatter in data due to material and experimental variability, not leachate interaction.
Surface Analysis (IR)	D	There are no observed differences between exposed and control sample spectra or carbonyl band development.	Test leachate did not measurable oxidize the geomembranes.
Stress Cracking	E	Preliminary results show that GSE-SLT and NSC geomembranes have greater stress crack resistance than other types of tested geomembranes.	A time-to-rupture at 900 psi (6.2 MPa) of greater than 500 hours should be specified for HDPE geomembranes used in FEMP OSDF.

Draft

000033

387

conclusion that immersion in the test leachate did not measurable affect the HDPE geomembranes.

The results of the stress crack resistance testing performed on the five candidate geomembranes are presented in Appendix E of this report. The results reveal significant variability in stress crack resistance behavior between candidate geomembranes, with the GSE-SLT and NSC HDPE geomembranes exhibiting greater resistance to stress cracking than other types of geomembranes. A high level of geomembrane stress crack resistance is desired for the FEMP OSDF geomembranes so as to obtain the maximum possible design life for these materials.

Draft

3.6 Recommendations for Design

The results of the USEPA Method 9090 tests indicate that all five candidate HDPE geomembranes are compatible with the test leachate. Therefore, in terms of ranking the performance of the geomembranes in the USEPA Method 9090 tests, they are generally equivalent. However, the stress cracking tests indicate that the geomembranes have different stress cracking resistance, as discussed in Section 3.5, when evaluated in accordance with ASTM D 5397. Based on the stress cracking resistance test results, it is recommended that the OSDF construction specification for HDPE geomembranes include a requirement that the selected geomembrane exhibit a time-to-rupture at a tensile stress of 900 psi (6.2 MPa) of greater than 500 hours when tested in accordance with ASTM D 5397.

4. CONCLUSIONS

The principal findings of this leachate/liner compatibility test program regarding the radiological/chemical compatibility of the HDPE geomembranes and test leachate are as follows:

- All five candidate geomembranes performed similarly in the USEPA Method 9090 tests. There were no measurable or discernable affects to the physical and mechanical properties of the geomembranes as the result of 120 days of immersion in the test leachate.

- The surface molecular structure of the geomembranes was not modified, as determined by infrared surface spectroscopy, by 120 days of immersion in the test leachate.

- Based on the environmental NCTL test results presented in this report, a minimum recommended time-to-rupture at a tensile stress of 900 psi (6.2 MPa), when tested in accordance with ASTM D 3597, of 500 hours is recommended as a requirement for HDPE geomembranes used in the OSDF liner or final cover systems.

In conclusion, the HDPE geomembranes proposed for use in the OSDF liner and final cover systems exhibit a high degree of compatibility with the test leachate. There is no indication that the OSDF in-service conditions will cause degradation to commercially-available HDPE geomembrane products. The NCTL test results provide data to allow development of a HDPE geomembrane specification that will result in the use of geomembrane materials having a high level of resistance to environmental stress cracking.

Draft

REFERENCES

American Society for Testing and Materials, *Annual Book of ASTM standards*, Volumes 7.01, 7.02, 8.01, 8.02, 8.03, 9.01, and 10.01, 1993.

Dudzik, B.E. and Tisinger, L.G., "An Evaluation of Chemical Compatibility Test Results of High Density Polyethylene Geomembrane Exposed to Industrial Waste Leachate," *Geosynthetic Testing for Waste Containment Applications*, Robert M. Koerner, Editor, ASTM STP 1081, American Society for Testing and Materials, Philadelphia, 1990, pp. 37-54.

FERMCO, *Sitewide CERCLA Quality Assurance Project Plan* (RM-0017), Fernald Environmental Management Project, 1994.

FERMCO, *Project Specific Plan for Sampling of Perched Ground Water for the OSDF Leachate/Liner Compatibility Study* (WBS. #20.03.11), 1996.

GeoSyntec Consultants, *Leachate/Liner Compatibility Work Plan: On-Site Disposal Facility*, Fernald Environmental Management Project, Revision C, February, 1996a.

GeoSyntec Consultants, *Materials Testing Laboratory, Policies and Procedures Manual*, Revision 1, April 1996b.

Norstrom, J., Williams, C., and Pabor, P., "Properties of Leachate From Construction/ Demolition Waste Landfills," *Proceedings: Fourteenth Annual Madison Waste Conference*, September 25-26, 1991, pp. 357-366.

Parikh, V.M., *"Absorption Spectroscopy of Organic Molecules,"* Addison Wesley, Philippines, 1974.

draft

Soo, P., Arora, H., Swyler, K.J., Becker, W., and Sobel, E., *The Effects of Environment and Gamma Irradiation on the Mechanical Properties of High Density Polyethylene Topical Report*, Office of Nuclear Regulatory Research, NUREG/CR-4607 BNL-NUREG-51991 AN, March 1986, 86 p.

U.S. Department of Energy, the *Final Record of Decision for Remedial Actions at Operable Unit 2*, Fernald Environmental Management Project, DOE Fernald Office, Fernald, Ohio, 1995a.

U.S. Department of Energy, *Final Feasibility Study Report for Operable Unit 5*, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald, Ohio, 1995b.

U.S. Department of Energy, *Final Remedial Investigation Report for Operable Unit 5*, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald, Ohio, 1995c.

U.S. Department of Energy, *Site-Wide CERCLA Quality Assurance Project Plan*, Fernald Environmental Management Project, 1992.

U.S. Environmental Protection Agency, *Methods for Chemical Analysis of Water and Wastes*, EPA-600, 1983.

U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, SW-846, Third Ed., 1987.

draft

APPENDIX A

APPENDIX A

PERCHED GROUND WATER TEST LEACHATE CHEMICAL ANALYSES

Part I: Summary Tables
Part II: Data Validation Summary Reports

draft

Part I: Summary Tables

draft

TABLE A-1

RADIONUCLIDE DATA SUMMARY TABLE

Radionuclide	Units	Result	Uncertainty	Qualifier	MDC
Cesium 137	pCi/L	4.34	1.48	J	2.23
Gross Alpha	pCi/L	340000	4800	-	193
Gross Beta	pCi/L	330000	3700	-	673
Neptunium 237	pCi/L	0.14	0.1	J	0.14
Plutonium 238	pCi/L	-	0.035	U	0.07
Plutonium 239/240	pCi/L	-	0.031	U	0.058
Radium 226	pCi/L	-	0.25	U	0.46
Radium 228	pCi/L	-	4.09	UJ	6.81
Strontium 90	pCi/L	-	0.17	U	0.29
Technetium 99	pCi/L	64262	4568	-	34000
Thorium 228	pCi/L	0.212	0.046	-	0.039
Thorium 230	pCi/L	0.763	0.078	J	0.022
Thorium 232	pCi/L	-	0.026	U	0.034
Total Thorium	mg/L	-	0.24	U	0.312
Total Uranium	mg/L	582000	41000	-	29.3
Uranium 234	pCi/L	220000	12000	J	2500
Uranium 235/236	pCi/L	29000	4900	J	2300
Uranium 238	pCi/L	240000	13000	J	1300

Notes:
Data from FEMP Radionuclide Qualifier Sheet, FERMCO ID. 200212369.
MDC = Method Detection Concentraion.
J = estimated results.
U = non-detected.
UJ = non-detected estimate.
(-) = no data qualifier.
pCi/L = picocuries per liter.
µg/L = micrograms per liter.
duplicate (split) ID = 200212392.
field blank ID = 200212379.

TABLE A-2

INORGANIC (METALS) DATA SUMMARY TABLE

Analyte	Units	Result	Qualifier	MDL
Aluminum	µg/L	-	U	75.0
Antimony	µg/L	-	UJ	4.0
Arsenic	µg/L	7.5	U	3.0
Barium	µg/L	-	-	9.0
Beryllium	µg/L	15.6	-	1.0
Cadmium	µg/L	1.4	U	1.0
Calcium	µg/L	555000	-	138
Chromium	µg/L	17.6	-	6.0
Cobalt	µg/L	56.1	-	9.0
Copper	µg/L	805	-	11
Iron	µg/L	-	U	40.5
Lead	µg/L	-	U	2.0
Magnesium	µg/L	131000	-	82
Manganese	µg/L	870	-	6.0
Mercury	µg/L	-	U	0.10
Nickel	µg/L	117	-	19
Potassium	µg/L	48600	-	98
Selenium	µg/L	7.6	J	5.0
Silver	µg/L	84.8	-	1.0
Sodium	µg/L	138000	-	170
Thallium	µg/L	-	UJ	5.0
Vanadium	µg/L	-	UJ	2.0
Zinc	µg/L	89.4	-	13.0
Cyanide	µg/L			

Notes:
Data from I-10033 Perched Water Inorganic/Conventional Data Validation Summary Report, FERMCO ID. 200212364.
MDL = Method Detection Limit.
pCi/L = picocuries per liter.
J = estimated results.
U = non-detected.
UJ = non-detected estimate.
(-) = no data qualifier.
µg/L = micrograms per liter.
duplicate (split) ID = 200212387.
field blank ID = 200212374.

TABLE A-3

INORGANIC (WATER QUALITY) DATA SUMMARY TABLE

Sample ID	Analyte	Method	Units	Result	Qualifier	MDL	Duplicate Id	Field Blank ID
200212361	TOX (Total Organic Halides)	9020A	µg/L	611	J	5	200212384	200212371
200212362	TOC (Total Organic Carbon)	9060	mg/L	93	J	10	200212385	200212372
200212365	Phenols	420.2	µg/L	5.6	-	5	200212388	200212375
200212366	Sulfides	376.1	mg/L	-	U	1	200212389	200212376
200212367	Alkalinity	310.1	mg/L	960	-	2	200212390	200212377
200212367	Sulfate	300.0	mg/L	121	-	2	200212390	200212377
200212367	Chloride	300.0	mg/L	69.1	-	1	200212390	200212377
200212367	Fluoride	340.2	µmhos/cm	2.98	J	0.25	200212390	200212377
200212367	Conductivity	120.1	µg/L	3720	-	na	200212390	200212377
200212368	Total Phosphates	365.1	mg/L	-	U	10	200212391	200212378
200212368	Nitrate/Nitrite-Nitrogen	353.1	mg/L	336	-	10	200212391	200212378
200212368	Ammonia	350.1	mg/L	1.62	-	0.06	200212391	200212378
200212368	TKN (Total Kjeldahl Nitrogen)	351.2	mg/L	3.97	-	0.5	200212391	200212378
200212368	TON (Total Organic Nitrogen)	351.2	mg/L	2.35	-	0.1	200212391	200212378

Notes:
Data from I-10033 Perched Water Inorganic/Conventional Data Validation Summary Report, FERMCO Sample IDs given in table.
MDL = Method Detection Limit.
J = estimated results.
U = non-detected.
(-) = no data qualifier.
na = does not apply.
µg/L = micrograms per liter.
mg/L = milligrams per liter.
µmhos/cm = micromhos per centimeter.
mho = ohm^{-1}.
pCi/L = picocuries per liter.

000042

382

TABLE A-4

VOLATILE ORGANIC DATA SUMMARY TABLE

Compound	Units	Result	Qualifier	MDL
Chloromethane	µg/L	-	U	10
Bromomethane	µg/L	-	U	10
Vinyl Chloride	µg/L	-	U	10
Chloroethane	µg/L	-	U	10
Methylene Chloride	µg/L	-	U	10
Acetone	µg/L	-	U	10
Carbon Disulfide	µg/L	-	U	10
1,1-Dichloroethene	µg/L	7	J	10
1,1-Dichloroethane	µg/L	2.0	J	10
Trans-1,2-Dichloroethene	µg/L	-	U	10
Cis-1,2-Dichloroethene	µg/L	5	J	10
Chloroform	µg/L	-	U	10
1,2-Dichloroethane	µg/L	-	J	10
2-Butanone	µg/L	-	U	10
1,1,1-Trichloroethane	µg/L	-	J	10
Carbon Tetrachloride	µg/L	-	U	10
Vinyl Acetate	µg/L	-	U	10
Bromodichloromethane	µg/L	-	U	10
1,2-Dichloropropane	µg/L	-	U	10
Cis-1,3-Dichloropropane	µg/L	-	U	10
Trichloroethene	µg/L	650	-	10
Dibromochloromethane	µg/L	-	U	10
1,1,2-Trichloroethane	µg/L	-	U	10
Benzene	µg/L	-	U	10
Trans-1,3-Dichloropropene	µg/L	-	U	10
Bromoform	µg/L	-	U	10
4-Methyl-2-Pentanone	µg/L	-	U	10
2-Hexanone	µg/L	-	U	10
Tetrachloroethene	µg/L	90	-	10
1,1,2,2-Tetrachloroethane	µg/L	-	U	10
Toluene	µg/L	-	U	10
Chlorobenzene	µg/L	-	U	10
Ethylbenzene	µg/L	-	U	10
Styrene	µg/L	-	U	10
Xylenes (total)	µg/L	-	U	10

Notes:
Data from I-10033 Perched Water Organic Data Validation Summary Report, FERMCO ID. 200212360.
MDL = Method Detection Limit.
J = estimated results.
U = non-detected.
(-) = no data qualifier.
µg/L = micrograms per liter.
pCi/L = picocuries per liter.
duplicate (split) ID = 200212383.
field blank ID = 200212370.
trip blank ID = 200212439.

TABLE A-5

SEMI- VOLATILE ORGANIC DATA SUMMARY TABLE

Compound	Units	Result	Qualifier	MDL
Phenol	µg/L	-	U	20
Bis(2-Chloroethyl)Ether	µg/L	-	U	20
2-Chlorophenol	µg/L	-	U	20
1,3-Dichlorobenzene	µg/L	-	U	20
1,4-Dichlorobenzene	µg/L	-	U	20
1,2-Dichlorobenzene	µg/L	-	U	20
2-Methylphenol	µg/L	-	U	20
Bis(2-Chloroisopropyl)Ether	µg/L	-	U	20
4-Methylphenol	µg/L	-	U	20
N-Nitroso-Di-N-Propylamine	µg/L	-	U	20
Hexachloroethane	µg/L	-	U	20
Nitrobenzene	µg/L	-	U	20
Isophorone	µg/L	-	U	20
2-Nitrophenol	µg/L	-	U	20
2,4-Dimethylphenol	µg/L	-	U	20
Bis(2-Chloroethoxy)Methane	µg/L	-	U	20
2,4-Dichlorophenol	µg/L	-	U	20
1,2,4-Trichlorobenzene	µg/L	-	U	20
Naphthalene	µg/L	-	U	20
4-Chloroaniline	µg/L	-	U	20
Hexachlorobutadiene	µg/L	-	U	20
4-Chloro-3-Methylphenol	µg/L	-	U	20
2-Methylnaphthalene	µg/L	-	U	20
Hexachlorocyclopentadiene	µg/L	-	U	20
2,4,6-Trichlorophenol	µg/L	-	U	20
2,4,5-Trichlorophenol	µg/L	-	U	50
2-Chloronaphthalene	µg/L	-	U	20
2-Nitroaniline	µg/L	-	U	50
Dimethylphthalate	µg/L	-	U	20
Acenaphthylene	µg/L	-	U	20
2,6-Dinitrotoluene	µg/L	-	U	20
3-Nitroaniline	µg/L	-	U	50
Acenaphthene	µg/L	-	U	20
2,4-Dinitrophenol	µg/L	-	R	50
4-Nitrophenol	µg/L	-	U	50
Dibenzofuran	µg/L	-	U	20
2,4-Dinitrotoluene	µg/L	-	U	20
Diethylphthalate	µg/L	-	U	20
4-Chlorophenyl-Phenyl Ether	µg/L	-	U	20
Fluorene	µg/L	-	U	20
4-Nitroaniline	µg/L	-	U	50
Tributylphosphate	µg/L	6	J	20

TABLE A-5

SEMI- VOLATILE ORGANIC DATA SUMMARY TABLE (continued)

COMPOUND	UNITS	RESULT	QUALIFIER	MDL
4,6-Dinitro-2-Methylphenol	µg/L	-	U	50
N-Nitrosodiphenylamine	µg/L	-	U	20
4-Bromophenyl-Phenylether	µg/L	-	U	20
Hexachlorobenzene	µg/L	-	U	20
Pentachlorophenol	µg/L	-	UJ	50
Phenanthrene	µg/L	-	U	20
Anthracene	µg/L	-	U	20
Carbazole	µg/L	-	U	20
Di-N-Butylphthalate	µg/L	-	U	20
Fluoranthene	µg/L	-	U	20
Pyrene	µg/L	-	U	20
Butylbenzylphthalate	µg/L	-	U	20
3,3'-Dichlorobenzidine	µg/L	-	U	20
Benzo(A)Anthracene	µg/L	-	U	20
Chrysene	µg/L	-	U	20
Bis(2-Ethylhexyl)Phthalate	µg/L	-	U	20
Di-N-Octylphthalate	µg/L	-	UJ	20
Benzo(B)Fluoranthene	µg/L	-	UJ	20
Benzo(K)Fluoranthene	µg/L	-	UJ	20
Benzo(A)Pyrene	µg/L	-	UJ	20
Indeno(1,2,3-Cd)Pyrene	µg/L	-	UJ	20
Dibenzo(A,H)Anthracene	µg/L	-	UJ	20
Benzo(G,H,I)Perylene	µg/L	-	UJ	20

Notes:
Data from I-10033 Perched Water Organic Data Validation Summary Report, FERMCO ID. 200212363.
MDL = Method Detection Limit.
J = estimated results.
U = non-detected.
UJ = non-detected estimate.
R = rejected.
µg/L = micrograms per liter.
pCi/L = picocuries per liter.
duplicate (split) ID = 200212386.
field blank ID = 200212373.

Part II: Data Validation Summary Reports

draft

11.1.1 Comments Section [Release Number 1000010033]

A. SCOPE

200212369, 200212392, 200212379.

Three (03) liquid samples, were analyzed for Cesium-137 by gamma isotopic, Radium-228 by gas flow proportional (GPC), Technetium-99 by liquid scintillation analysis and ICP/MS, Radium-226 by radon emanation and scintillation counting (Lucas cells), Strontium-90 by gas flow proportional (GPC). Uranium-iso (U-234, U-235/U-236, U-238), Neptunium (Np-237) Plutonium-iso (Pu-238, Pu-239/Pu-240 and Thorium-iso (Th-228, Th-230, Th-232) was analyzed alpha spec., Total Thorium was calculated from Th-232 and U-Total was analyzed by KPA. The data set included one field blank (sample 200212379) and samples 200212369 and 200212392 were indicated as field duplicate samples, which were noted on the "Release Tracking Worksheet".

The resultant radiological data were validated at ASL level D and evaluated in accordance with the FEMP Radiochemistry Data Validation Checklist in order to determine the accuracy, precision, and overall acceptability of the data. This assessment was limited to an evaluation of those radiochemical data, and supporting documentation, that were provided as part of the Release number 1000010033.

B. SUPPORTING DOCUMENTATION

The following documents are included in this package, and provide the supplemental information necessary to support qualification of data contained in this radiological package:

- The Radiochemistry Data Validation Checklist
- Case Narrative
- Laboratory Sample Results Summary Report
- Sample Traffic Reports
- Release Tracking Worksheet
- The Radiochemistry Data Validation Summary Report

C. DATA QUALIFYING CODES

Based on evaluation of the radioanalytical data in this package, the following codes were assigned to the calculated results:

J	Estimated Result
N	Tentatively Identified
R	Unusable Data (reject)
U	Non-detect, MDC > Results
UJ	Non-detect estimated (Detection limits elevated)
-	No Data Qualifier for Positive Result
Z	Result not used, sample re-analyzed

D. GENERAL VALIDATION FINDINGS

All positively detected results (i.e., those greater than the MDC) are considered to be identified (i.e., a quantified estimation) and have not been qualified. In those cases where the blank activity (laboratory and/or field blanks) exceeded the sample activity, and the sample activity is greater than the MDC, the results have been qualified "U" (non-detect). The maximum blank concentration was used to evaluate the presence/absence of sample contamination.

Several problems were noted in the initial review of this data set. High levels of Technetium-99 and Uranium-iso in samples 200212369 and 200212392 yield reanalyses of the samples by the laboratory. Ra-228 in samples 200212369 and 200212392 exhibited HAMDCs above the 3.0 pCi/L requirement the samples were reanalyzed several times to eliminate possible interference. Gross alpha/beta in sample 200212379 was reanalyzed due to failure to meet HAMDCs. Tc-99 in samples 200212369 and 200212392 were reported by ICP/MS, due to alpha interference. Pu-iso samples were reanalyzed due to poor tracer yields, only the reanalyses were reported.

All samples were analyzed within the required hold time. A matrix spike (MS) was performed for Alpha Isotopic, Gamma spec., liquid scintillation, and Kpa.

No discrepancies were found in the comparison between the chain of custody (COC) and the three liquid samples analyzed by the laboratory. All samples results were reported in units of pCi/L, with the exception of U-total and Th-total, which were reported in units of ug/L.

E. DATA QUALIFICATION SUMMARY

For those radionuclides and/or measurements that deviated from the acceptance criteria set forth in the referenced procedural guidance, an assessment of the acceptability of the data (e.g., accuracy, precision), and any associated data qualifiers, are provided below. Excluding these nuclides/measurements, all other results were either unqualified (-), or qualified as non-detects (U) and are reported at the MDC (unless otherwise noted), since the data were acceptably within the radiochemistry validation guidelines and laboratory criteria described in this checklist.

<u>Cesium-137</u>

The positive results for Cesium-137 in samples 200212369, 200212392, have been qualified estimated and flagged "J". This is attributed to poor duplicate precision indicated in the field duplicates of these samples (RER=2.87) The results were coded D[F].

<u>Gross Alpha /Gross Beta</u>
Sample 200212379 was reanalyzed by the laboratory, due to elevated HAMDCs. The initial results were flagged "Z" and the results were reported from the reanalyses (RE-1).

Gross Alpha /Gross Beta

Blank contamination was exhibited in the field blank of sample 200212379 (gross alpha 3.42 pCi/L and gross beta 6.07 pCi/L) and the method blank (gross alpha 0.020 pCi/L). No samples were impacted.

The positive results for Gross Alpha /Gross Beta in sample 200212379 was qualified estimated and flagged "J". This is attributed to poor duplicate precision indicated in the laboratory duplicates of sample 20021379 (Gross Alpha RER=3.42/Gross Beta RER=2.04) The results were coded D.

Neptunium -237

The positive results for Neptunium-237 in sample 200212369 have been qualified estimated and flagged "J". This is attributed to poor duplicate precision indicated in the field duplicates of samples 20021369 and 200212392 (RER=2.11) The results were coded D.

The positive results for Neptunium-237 in sample 200212369 was considered estimated and qualified (J), because of the uncertainty associated with the elevated error (TPUs), the samples have been coded (EE).

The positive results for Neptunium-237 in sample 200212369 was considered estimated, and qualified (J) because of the uncertainty associated with high matrix spike recovery (104.1%), sample were coded (HR[M]).

Radium-228

The detection limits for Radium-228 in samples 200212369, 200212392 exceeded the HAMDC. The detection limits for these samples have been qualified estimated and flagged "UJ". The results were code Result < MDC > HAMDC.

Strontium-90

Strontium-90 exhibited field contamination in the field blank (field blank sample 200212379). were qualified undetected (U). The positive results for sample 200212369, less than or equal to the contamination, were qualified undetected (U), because of the uncertainty associated with blank contamination associated with the field blank and are code (B[F]).

The positive results for Strontium-90 in samples 200212369, 200212379 were considered estimated and qualified (J), because of the uncertainty associated with the elevated error (TPUs), the samples have been coded (EE).

Technetium-99

The positive results for Technetium-99 in samples 200212369 and 200212392 were reanalyzed by ICP-MS, the results were reported from the reanalyses. The evaluated Tc-99 was accepted in terms of ICP-MS validation criteria.

Thorium-230

The laboratory was noted to exhibited Thorium-230 laboratory contamination and/or field contamination exhibited in the field blank (field blank sample 200212379). The positive results for samples 200212369, 200212392 and 200212379, less than or equal to five times (5X) the contamination, were qualified estimated,(J) because of the uncertainty associated with blank contamination associated with the laboratory and/or field blank and are coded (B/F[B]).

Thorium-232

The laboratory was noted to exhibited Thorium-232 blank contamination in the laboratory blank. The positive results for Samples 200212369, 200212392, 200212379, less than or equal to the contamination, were qualified undetected (U), because of the uncertainty associated with blank contamination associated with the method blank and are coded (B).

The positive results for Thorium-232 in samples 200212369, 200212392, 200212379, were considered estimated and qualified (J), because of the uncertainty associated with the elevated error (TPUs), the samples have been coded (EE).

Total Thorium

The reported values for Total Thorium were calculated using the Th-232 values. The Thorium-232 qualification were applied to the Total thorium results.

The laboratory was noted to exhibited Thorium-232 blank contamination in the laboratory blank. The positive results for Total Thorium in samples 200212369, 200212392, 200212379, less than or equal to the contamination, were qualified undetected (U), because of the uncertainty associated with blank contamination associated with the method blank and are coded (B).

The positive results for Total Thorium in samples 200212369, 200212392, 200212379, were considered estimated and qualified (J), because of the uncertainty associated with the elevated error (TPUs), the samples have been coded (EE).

Uranium-Total

The positive results for Uranium-Total in sample 200212379 was qualified estimated and flagged "J". This is attributed to poor duplicate precision indicated in the laboratory duplicates of sample 20021379 (RER=6.50) The results were coded D.

Uranium-iso

The positive results for Uranium-234, Uranium-235/236, and Uranium-238 in all samples were considered estimated, and qualified (J) because of the uncertainty associated with high matrix spike recovery noted for Uranium-234 and Uranium-238 matrix spiked sample 200212379, all samples were coded (HR [M]).

The positive results for Uranium-234, Uranium-235/236, Uranium-238 in sample 200212379 were considered estimated and qualified (J), because of the uncertainty associated with the elevated error (TPUs), the samples have been coded (EE).

Review by: _____ Date 04/24/96

Concurred by: V.R. Gi _____ Date 4/30/96

ATTACHMENT C

FERMCO ENVIRONMENTAL

FEMP RADIONUCLIDE QUALIFIER SHEET

FERMCO ID. 200212369 LAB ID 96-A3405 MATRIX WATER RELEASE 1000010033

RADIONUCLIDE	SUFFIX	UNITS	RESULTS	UNCERTAINTY	TPU	QUAL	MDC	VALIDATION COMMENTS
CESIUM 137		pCi/L	4.340	1.480	1.700	J	2.230	D[F]
GROSS ALPHA		pCi/L	340000.000	4800.000	42000.000	-	193.000	
GROSS BETA		pCi/L	330000.000	3700.000	71000.000	-	673.000	
NEPTUNIUM 237		pCi/L	0.140	0.100	0.110	J	0.140	D[F], EE, HR[M]
PLUTONIUM 238		pCi/L	0.000	0.035	0.035	U	0.070	Result<MDC
PLUTONIUM 239/240		pCi/L	0.011	0.031	0.031	U	0.058	Result<MDC
RADIUM 226		pCi/L	0.070	0.250	0.250	U	0.460	Result<MDC
RADIUM 228		pCi/L	5.314	4.090	4.170	UJ	6.810	Result<MDC>HAMDC
STRONTIUM 90		pCi/L	0.330	0.170	0.180	U	0.290	EE, B[F]
TECHNETIUM 99		pCi/L	64262.000	4568.000	4568.000	-	34000.000	
THORIUM 228		pCi/L	0.212	0.046	0.090	-	0.039	
THORIUM 230		pCi/L	0.763	0.078	0.288	J	0.022	B, B[F]
THORIUM 232		pCi/L	0.051	0.026	0.032	U	0.034	EE, B
TOTAL THORIUM		ug/L	0.468	0.240	0.294	U	0.312	EE, B
TOTAL URANIUM		ug/L	582000.000	41000.000	41000.000	-	29.300	
URANIUM 234		pCi/L	220000.000	12000.000	100000.000	J	2500.000	HR[M]
URANIUM 235/236		pCi/L	29000.000	4900.000	14000.000	J	2300.000	HR[M]
URANIUM 238		pCi/L	240000.000	13000.000	110000.000	J	1300.000	HR[M]

Signature: [illegible] Date: 4/26/96

Concurred by: [illegible] Date: 4.30.96

Definition of Qualifiers/Suffixes

J = estimated results
R = unusable (reject) data
U = non-detected
UJ = non-detected estimate
N = tentatively identified (see narrative)
Z = sample re-analyzed
(-) = no data qualifier
N/R = data not reproted
N/A = analyte not analyzed
RA = Data Re-assessment
RE = Data Re-analyzed

Comment Codes

QC/FV QC (Review/Field Validation)
HT (Hold Time)
B/FB (Blank/Field Blank Contamination)
D/FD (Poor Lab/Field duplicate precision)
H/LR (High or Low spike recovery)
EE (Elevated uncertainty)
IC/CC (Calibration Deficiency)
H/LY (High or Low Yield recovery)
R (Field Rinsate sample)

BLANK CORRECTED

SDG: 7290

Accu-Labs® Research, Inc.

30-Apr-96

All units are per liter unless noted otherwise

ANALYTE	FERMCO ID	ALR	MATRIX	ALIQUOT	UNITS	BLANK	SAR	CU	TPU	MDC	HAMDC	DATE
URANIUM 238	200212369	96-A3405	WATER	0.0001	pCi/L	0.0	240000	13000	1E+05	1000	0.2	3/14/96
URANIUM 235/236	200212369	96-A3405	WATER	0.0001	pCi/L	0.0	29000	5000	14000	3000	0.2	3/14/96
URANIUM 234	200212369	96-A3405	WATER	0.0001	pCi/L	0.11	220000	12000	1E+05	3000	0.2	3/14/96
TOTAL URANIUM	200212369	96-A3405	WATER	0.001	ug/L	0.03	580000		42000	29.3	0.1	3/14/96
TOTAL THORIUM	200212369	96-A3405	WATER	1	ug/L	0.61	-0.14	0.47	0.47	0.77	0.2	3/21/96
THORIUM 232	200212369	96-A3405	WATER	1	pCi/L	0.07	-0.02	0.05	0.05	0.08	0.2	3/21/96
THORIUM 230	200212369	96-A3405	WATER	1	pCi/L	0.22	0.54	0.15	0.25	0.21	0.2	3/21/96
THORIUM 228	200212369	96-A3405	WATER	1	pCi/L	0	0.21	0.05	0.09	0.05	0.2	3/21/96
TECHNETIUM 99	200212369	96-A3405	WATER	1	pCi/L	-540	64000		4600	34000	15	3/21/96
STRONTIUM 90	200212369	96-A3405	WATER	1	pCi/L	0.22	0.17	0.54	0.54	0.9	1	3/20/96
RADIUM 228	200212369	96-A3405	WATER	0.5	pCi/L	-0.13	5.6	4.3	4.4	7.2	3	3/14/96
RADIUM 226	200212369	96-A3405	WATER	0.5	pCi/L	-0.02	0.1	0.34	0.34	0.61	1	3/18/96
PLUTONIUM 239/240	200212369	96-A3405	WATER	1	pCi/L	-0.01	0.02	0.03	0.03	0.06	0.5	3/20/96
PLUTONIUM 238	200212369	96-A3405	WATER	1	pCi/L	-0.01	0.01	0.04	0.04	0.08	0.5	3/20/96
NEPTUNIUM 237	200212369	96-A3405	WATER	0.5	pCi/L	0.02	0.11	0.1	0.11	0.13	0.5	3/22/96
GROSS BETA	200212369	96-A3405	WATER	0.001	pCi/L	0.22	280000	3700	60000	930	4	3/8/96
GROSS ALPHA	200212369	96-A3405	WATER	0.001	pCi/L	0.04	330000	4800	66000	340	2	3/8/96
CESIUM 137	200212369	96-A3405	WATER	0.5	pCi/L	0.91	2.5	4.1	4.2	3.4	4	3/18/96

UNCORRECTED RESULTS

30-Apr-96

All aliquots are per liter unless noted otherwise

FERMCO ID	LAB ID	MATRIX	ALIQUOT	ANALYTE	UNITS	RESULT	CU	TPU	SDLC
200212369	96-A3405	WATER	0.0001	URANIUM 238	pCi/L	240000	13000	110000	1300
200212369	96-A3405	WATER	0.0001	URANIUM 235/236	pCi/L	29000	4900	14000	2300
200212369	96-A3405	WATER	0.0001	URANIUM 234	pCi/L	220000	12000	100000	2500
200212369	96-A3405	WATER	0.001	TOTAL URANIUM	ug/L	580000		41000	29.3
200212369	96-A3405	WATER	1	TOTAL THORIUM	ug/L	0.47	0.24	0.29	0.31
200212369	96-A3405	WATER	1	THORIUM 232	pCi/L	0.05	0.03	0.03	0.03
200212369	96-A3405	WATER	1	THORIUM 230	pCi/L	0.76	0.08	0.29	0.02
200212369	96-A3405	WATER	1	THORIUM 228	pCi/L	0.21	0.05	0.09	0.04
200212369	96-A3405	WATER	1	TECHNETIUM 99	pCi/L	64000		4600	34000
200212369	96-A3405	WATER	1	STRONTIUM 90	pCi/L	0.39	0.17	0.18	0.29
200212369	96-A3405	WATER	0.5	RADIUM 226	pCi/L	5.3	4.1	4.2	6.8
200212369	96-A3405	WATER	0.5	RADIUM 228	pCi/L	0.07	0.25	0.25	0.46
200212369	96-A3405	WATER	1	PLUTONIUM 239/240	pCi/L	0.01	0.03	0.03	0.06
200212369	96-A3405	WATER	1	PLUTONIUM 238	pCi/L	0	0.04	0.04	0.07
200212369	96-A3405	WATER	0.5	NEPTUNIUM 237	pCi/L	0.14	0.1	0.11	0.14
200212369	96-A3405	WATER	0.001	GROSS BETA	pCi/L	330000	3700	71000	670
200212369	96-A3405	WATER	0.001	GROSS ALPHA	pCi/L	340000	4800	42000	193
200212369	96-A3405	WATER	0.5	CESIUM 137	pCi/L	4.3	1.6	1.7	2.2

7290 4

10

ATTACHMENT C

FERMCO ENVIRONMENTAL

FEMP RADIONUCLIDE QUALIFIER SHEET

FERMCO ID. 200212392 LAB ID 96-A3406 MATRIX WATER RELEASE 1000010033

RADIONUCLIDE	SUFFIX	UNITS	RESULTS	UNCERTAINTY	TPU	QUAL	MDC	VALIDATION COMMENTS
CESIUM 137		pCi/L	8.530	1.780	2.370	J	2.460	D[F]
GROSS ALPHA		pCi/L	320000.000	4700.000	36000.000	-	410.000	
GROSS BETA		pCi/L	340000.000	3800.000	75000.000	-	660.000	
NEPTUNIUM 237		pCi/L	-0.010	0.090	0.090	U	0.250	Result<MDC
PLUTONIUM 238		pCi/L	0.020	0.030	0.031	U	0.051	Result<MDC
PLUTONIUM 239/240		pCi/L	0.014	0.020	0.021	U	0.034	Result<MDC
RADIUM 226		pCi/L	0.190	0.260	0.260	U	0.450	Result<MDC
RADIUM 228		pCi/L	4.910	5.890	5.940	UJ	9.880	Result<MDC>HAMDC
STRONTIUM 90		pCi/L	0.050	0.200	0.200	U	0.340	Result<MDC
TECHNETIUM 99		pCi/L	65056.000	3555.000	3600.000	-	34000.000	
THORIUM 228		pCi/L	0.241	0.054	0.114	-	0.039	
THORIUM 230		pCi/L	0.674	0.083	0.294	J	0.019	B, B[F]
THORIUM 232		pCi/L	0.060	0.030	0.039	U	0.037	EE, B
TOTAL THORIUM		ug/L	0.551	0.278	0.361	U	0.338	EE, B
TOTAL URANIUM		ug/L	585000.000	42000.000	42000.000	-	29.300	
URANIUM 234		pCi/L	160000.000	9200.000	65000.000	J	2200.000	HR[M]
URANIUM 235/236		pCi/L	30000.000	4300.000	12000.000	J	1100.000	HR[M]
URANIUM 238		pCi/L	210000.000	10000.000	82000.000	J	1200.000	HR[M]

Signature: [illegible] Date: 4/24/96

Concurred by: V.L. Gn Date: 4-30-96

Definition of Qualifiers/Suffixes

J = estimated results
R = unusable (reject) data
U = non-detected
UJ = non-detected estimate
N = tentatively identified (see narrative)
Z = sample re-analyzed
(-) = no data qualifier
N/R = data not reproted
N/A = analyte not analyzed
RA = Data Re-assessment
RE = Data Re-analyzed

Comment Codes

QC/FV QC (Review/Field Validation)
HT (Hold Time)
B/FB (Blank/Field Blank Contamination)
D/FD (Poor Lab/Field duplicate precision)
H/LR (High or Low spike recovery)
EE (Elevated uncertainty)
IC/CC (Calibration Deficiency)
H/LY (High or Low Yield recovery)
R (Field Rinsate sample)

BLANK CORRECTED

SDG: 7290

Accu-Labs® Research, Inc.

30-Apr-96

All units are per liter unless noted otherwise

ANALYTE	FERMCO ID	ALR	MATRIX	ALIQUOT	UNITS	BLANK	SAR	CU	TPU	MDC	HAMDC	DATE
URANIUM 238	200212392	96-A3406	WATER	0.0001	pCi/L	0.0	210000	10000	82000	1000	0.2	3/14/96
URANIUM 235/236	200212392	96-A3406	WATER	0.0001	pCi/L	0.0	30000	4300	12000	2000	0.2	3/14/96
URANIUM 234	200212392	96-A3406	WATER	0.0001	pCi/L	0.11	160000	9300	64000	3000	0.2	3/14/96
TOTAL URANIUM	200212392	96-A3406	WATER	0.001	ug/L	0.03	585000		42000	29.3	0.1	3/14/96
TOTAL THORIUM	200212392	96-A3406	WATER	1	ug/L	0.61	-0.06	0.5	0.51	0.82	0.2	3/21/96
THORIUM 232	200212392	96-A3406	WATER	1	pCi/L	0.07	-0.01	0.06	0.06	0.09	0.2	3/21/96
THORIUM 230	200212392	96-A3406	WATER	1	pCi/L	0.22	0.45	0.16	0.25	0.23	0.2	3/21/96
THORIUM 228	200212392	96-A3406	WATER	1	pCi/L	0	0.24	0.06	0.12	0.05	0.2	3/21/96
TECHNETIUM 99	200212392	96-A3406	WATER	1	pCi/L	-540	65000		3600	34000	15	3/21/96
STRONTIUM 90	200212392	96-A3406	WATER	1	pCi/L	0.22	-0.11	0.55	0.55	0.92	1	3/20/96
RADIUM 228	200212392	96-A3406	WATER	0.5	pCi/L	-0.13	5.2	6.1	6.1	10	3	3/14/96
RADIUM 226	200212392	96-A3406	WATER	0.5	pCi/L	-0.02	0.23	0.35	0.35	0.61	1	3/18/96
PLUTONIUM 239/240	200212392	96-A3406	WATER	1	pCi/L	-0.01	0.02	0.02	0.02	0.04	0.5	3/20/96
PLUTONIUM 238	200212392	96-A3406	WATER	1	pCi/L	-0.01	0.03	0.04	0.04	0.07	0.5	3/20/96
NEPTUNIUM 237	200212392	96-A3406	WATER	0.5	pCi/L	0.02	-0.04	0.1	0.01	0.22	0.5	3/22/96
GROSS BETA	200212392	96-A3406	WATER	0.001	pCi/L	0.22	290000	3800	62000	920	4	3/8/96
GROSS ALPHA	200212392	96-A3406	WATER	0.001	pCi/L	0.04	320000	4700	61000	490	2	3/8/96
CESIUM 137	200212392	96-A3406	WATER	0.5	pCi/L	0.91	6.7	4	4.2	3.5	4	3/18/96

UNCORRECTED RESULTS

30-Apr-96

All aliquots are per liter unless noted otherwise

FERMCO ID	LAB ID	MATRIX	ALIQUOT	ANALYTE	UNITS	RESULT	CU	TPU	IDLC
200212392	96-A3406	WATER	0.0001	URANIUM 238	pCi/L	210000	10000	82000	1200
200212392	96-A3406	WATER	0.0001	URANIUM 235/236	pCi/L	30000	4300	12000	1100
200212392	96-A3406	WATER	0.0001	URANIUM 234	pCi/L	160000	9200	65000	2200
200212392	96-A3406	WATER	0.001	TOTAL URANIUM	ug/L	585000		42000	29.3
200212392	96-A3406	WATER	1	TOTAL THORIUM	ug/L	0.56	0.28	0.36	0.34
200212392	96-A3406	WATER	1	THORIUM 232	pCi/L	0.06	0.03	0.04	0.04
200212392	96-A3406	WATER	1	THORIUM 230	pCi/L	0.67	0.08	0.29	0.02
200212392	96-A3406	WATER	1	THORIUM 228	pCi/L	0.24	0.05	0.11	0.04
200212392	96-A3406	WATER	1	TECHNETIUM 99	pCi/L	65000		3600	34000
200212392	96-A3406	WATER	1	STRONTIUM 90	pCi/L	0.05	0.2	0.2	0.34
200212392	96-A3406	WATER	0.5	RADIUM 228	pCi/L	4.9	5.9	5.9	9.9
200212392	96-A3406	WATER	0.5	RADIUM 226	pCi/L	0.19	0.26	0.26	0.46
200212392	96-A3406	WATER	1	PLUTONIUM 239/240	pCi/L	0.01	0.02	0.02	0.03
200212392	96-A3406	WATER	1	PLUTONIUM 238	pCi/L	0.02	0.03	0.03	0.05
200212392	96-A3406	WATER	0.5	NEPTUNIUM 237	pCi/L	-0.01	0.09	0.09	0.25
200212392	96-A3406	WATER	0.001	GROSS BETA	pCi/L	340000	3800	75000	660
200212392	96-A3406	WATER	0.001	GROSS ALPHA	pCi/L	320000	4700	38000	410
200212392	96-A3406	WATER	0.5	CESIUM 137	pCi/L	8.5	1.8	2.4	2.5

7290. 4

11

ATTACHMENT C

FERMCO ENVIRONMENTAL

FEMP RADIONUCLIDE QUALIFIER SHEET

FERMCO ID. 200212379 LAB ID 96-A3407 MATRIX WATER RELEASE 1000010033

RADIONUCLIDE	SUFFIX	UNITS	RESULTS	UNCERTAINTY	TPU	QUAL	MDC	VALIDATION COMMENTS
CESIUM 137		pCi/L	0.000	0.780	0.780	U	1.360	Result<MDC
GROSS ALPHA		pCi/L	10.000	155.000	155.000	Z	302.000	Sample reanalyzed
GROSS ALPHA	RE-1	pCi/L	3.420	0.720	0.830	J	0.460	D
GROSS BETA	RE-1	pCi/L	6.070	1.020	1.290	J	1.300	D
GROSS BETA		pCi/L	115.000	380.000	381.000	Z	654.000	Sample reanalyzed
NEPTUNIUM 237		pCi/L	0.034	0.031	0.033	U	0.046	Result<MDC
PLUTONIUM 238		pCi/L	0.002	0.023	0.023	U	0.044	Result<MDC
PLUTONIUM 239/240		pCi/L	0.000	0.010	0.009	U	0.023	Result<MDC
RADIUM 226		pCi/L	0.120	0.190	0.190	U	0.320	Result<MDC
RADIUM 228		pCi/L	0.470	1.390	1.390	U	2.380	Result<MDC
STRONTIUM 90		pCi/L	0.820	0.410	0.420	J	0.660	EE
TECHNETIUM 99		pCi/L	2.840	2.410	3.110	U	3.960	Result<MDC
THORIUM 228		pCi/L	0.003	0.028	0.028	U	0.053	Result<MDC
THORIUM 230		pCi/L	0.313	0.050	0.129	J	0.019	B
THORIUM 232		pCi/L	0.029	0.019	0.022	U	0.025	EE, B
TOTAL THORIUM		ug/L	0.262	0.172	0.199	U	0.225	EE, B
TOTAL URANIUM		ug/L	0.526	0.020	0.020	J	0.029	D
URANIUM 234		pCi/L	0.320	0.110	0.170	J	0.030	EE, HR[M]
URANIUM 235/236		pCi/L	0.170	0.090	0.110	J	0.030	EE, HR[M]
URANIUM 238		pCi/L	0.130	0.070	0.090	J	0.030	EE, HR[M]

Signature: J. E. Cho Date: 4/24/96

Concurred by: V. R. Gaj Date: 4.30.96

Definition of Qualifiers/Suffixes

J = estimated results
R = unusable (reject) data
U = non-detected
UJ = non-detected estimate
N = tentatively identified (see narrative)
Z = sample re-analyzed
(-) = no data qualifier
N/R = data not reproted
N/A = analyte not analyzed
RA = Data Re-assessment
RE = Data Re-analyzed

Comment Codes

QC/FV QC (Review/Field Validation)
HT (Hold Time)
B/FB (Blank/Field Blank Contamination)
D/FD (Poor Lab/Field duplicate precision)
H/LR (High or Low spike recovery)
EE (Elevated uncertainty)
IC/CC (Calibration Deficiency)
H/LY (High or Low Yield recovery)
R (Field Rinsate sample)

BLANK CORRECTED

SDG: 7290

Accu-Labs® Research, Inc.

30-Apr-96

All units are per liter unless noted otherwise

ANALYTE	FERMCO ID	ALR	MATRIX	ALIQUOT UNITS	BLANK	SAR	CU	TPU	MDC	HAMDC	DATE
URANIUM 238	200212379	96-A3407	WATER	1 pCi/L	0.0	0.13	0.08	0.1	0.08	0.2	3/16/96
URANIUM 235/236	200212379	96-A3407	WATER	1 pCi/L	0.0	0.17	0.11	0.13	0.14	0.2	3/16/96
URANIUM 234	200212379	96-A3407	WATER	1 pCi/L	0.11	0.21	0.16	0.18	0.22	0.2	3/16/96
TOTAL URANIUM	200212379	96-A3407	WATER	0.005 ug/L	0.03	0.5		0.06	0.029	0.1	3/14/96
TOTAL THORIUM	200212379	96-A3407	WATER	1 ug/L	0.61	-0.35	0.44	0.46	0.76	0.2	3/21/96
THORIUM 232	200212379	96-A3407	WATER	1 pCi/L	0.07	-0.04	0.05	0.05	0.08	0.2	3/21/96
THORIUM 230	200212379	96-A3407	WATER	1 pCi/L	0.22	0.09	0.14	0.14	0.22	0.2	3/21/96
THORIUM 228	200212379	96-A3407	WATER	1 pCi/L	0	0.003	0.03	0.03	0.06	0.2	3/21/96
TECHNETIUM 99	200212379	96-A3407	WATER	0.25 pCi/L	1.3	1.5	6.3	6.3	15	15	3/13/96
STRONTIUM 90	200212379	96-A3407	WATER	1 pCi/L	0.22	0.61	0.77	0.77	1.3	1	3/19/96
RADIUM 228	200212379	96-A3407	WATER	0.5 pCi/L	-0.13	0.74	2	2	3.4	3	3/14/96
RADIUM 226	200212379	96-A3407	WATER	0.5 pCi/L	-0.02	0.15	0.3	0.3	0.53	1	3/18/96
PLUTONIUM 239/240	200212379	96-A3407	WATER	1 pCi/L	-0.01	0.01	0.01	0.01	0.03	0.5	3/19/96
PLUTONIUM 238	200212379	96-A3407	WATER	1 pCi/L	-0.01	0.01	0.03	0.04	0.06	0.5	3/19/96
NEPTUNIUM 237	200212379	96-A3407	WATER	0.5 pCi/L	0.02	0.002	0.05	0.05	0.08	0.5	3/21/96
GROSS BETA	200212379	96-A3407	WATER	0.5 pCi/L	0.24	5.3	1.3	1.4	1.8	4	3/14/96
GROSS ALPHA	200212379	96-A3407	WATER	0.5 pCi/L	0.47	2.9	0.86	0.93	0.97	2	3/14/96
CESIUM 137	200212379	96-A3407	WATER	1 pCi/L	0.91	-0.91	1.8	1.8	1.9	4	3/18/96

UNCORRECTED RESULTS

30-Apr-96

All aliquots are per liter unless noted otherwise

FERMCO ID	LAB ID	MATRIX	ALIQUOT	ANALYTE	UNITS	RESULT	CU	TPU	IDLC
200212379	96-A3407	WATER	1	URANIUM 238	pCi/L	0.13	0.07	0.09	0.03
200212379	96-A3407	WATER	1	URANIUM 235/236	pCi/L	0.17	0.09	0.11	0.03
200212379	96-A3407	WATER	1	URANIUM 234	pCi/L	0.32	0.11	0.17	0.03
200212379	96-A3407	WATER	0.005	TOTAL URANIUM	ug/L	0.53		0.02	0.029
200212379	96-A3407	WATER	1	TOTAL THORIUM	ug/L	0.26	0.17	0.2	0.23
200212379	96-A3407	WATER	1	THORIUM 232	pCi/L	0.03	0.02	0.02	0.02
200212379	96-A3407	WATER	1	THORIUM 230	pCi/L	0.31	0.06	0.13	0.02
200212379	96-A3407	WATER	1	THORIUM 228	pCi/L	0.003	0.03	0.03	0.05
200212379	96-A3407	WATER	0.25	TECHNETIUM 99	pCi/L	2.8	2.4	3.1	4
200212379	96-A3407	WATER	1	STRONTIUM 90	pCi/L	0.82	0.41	0.42	0.68
200212379	96-A3407	WATER	0.5	RADIUM 228	pCi/L	0.47	1.4	1.4	2.4
200212379	96-A3407	WATER	0.5	RADIUM 226	pCi/L	0.12	0.19	0.19	0.32
200212379	96-A3407	WATER	1	PLUTONIUM 239/240	pCi/L	0	0.01	0.01	0.02
200212379	96-A3407	WATER	1	PLUTONIUM 238	pCi/L	0.002	0.02	0.02	0.04
200212379	96-A3407	WATER	0.5	NEPTUNIUM 237	pCi/L	0.03	0.03	0.03	0.05
200212379	96-A3407	WATER	0.5	GROSS BETA	pCi/L	6.1	1	1.3	1.3
200212379	96-A3407	WATER	0.5	GROSS ALPHA	pCi/L	3.4	0.72	0.83	0.46
200212379	96-A3407	WATER	1	CESIUM 137	pCi/L	0	0.78	0.78	1.4

FEMP WATER SAMPLE COLLECTION LOG

CONTROL NO.: GWM00483 PAGE 2 OF 4

PREPARED BY (NAME): [redacted] BADGE NO: 70653 DATE: 1/30/96

REVIEWED BY (NAME): [redacted] BADGE NO: 10174 DATE: 2/21/96

PROJECT NO. / RUFS WBS NO.: 26.03.11 CHARGE NO.: 2CC03

PROJECT NAME: PDI

SAMPLE TEAM LEAD NAME: [redacted]

BADGE NO.: 70653

SAMPLING TEAM LETTER: D

SAMPLE COLLECTION TEAM MEMBER NAMES: [redacted] BADGE NO. 70655

N/A

SAMPLE LOCATION: CLARIFIER PIT DRUMS S-39

SAMPLE DESCRIPTION: ☐ HYDROPUNCH SAMPLE ☐ LYSIMETER ☐ MONITORING WELL SAMPLE ☐ SURFACE WATER SAMPLE ☒ OTHER

FACTS SAMPLE ID NO. / FILTERED STATUS

☒ SAMPLE	☒ FB	☐ RINSATE
200212390	200212382	N
200212360 - 69	200212370 - 79	A
200212357	200212359	
	☐ MS	☒ DUP
	N	200212381
	A	200212383 - 92
		200212358
N		
A		
☐ SPLIT		
☒ TB 200212439		

SAMPLING EQUIPMENT LIST

NAME	MANUFACTURER / SERIAL NO.	NAME	TYPE
WATER LEVEL INDICATOR	N/A	BAILER	TEFLON
OTHER	N/A	SAMPLING HOSE	TYGON
OTHER	N/A	PUMP	VARISTALTIC
OTHER	N/A	FILTER KIT	N/A
LYSIMETER	N/A	LYSIMETER	N/A

P.I.D. UNITS	N/A	BACKGROUND	N/A	BREATHING ZONE	N/A	DOWNHOLE	N/A
BETA GAMMA METER UNITS	N/A	BACKGROUND	N/A	WELL	N/A	[redacted]	

REFERENCE POINT: ☐ ~~TOC~~ N/A ☐ ~~TOW~~ WELL MATERIAL: ☐ ~~PVC~~ ☐ ~~STEEL~~ N/A ☐ ~~STAINLESS STEEL~~ REPORTED TOTAL DEPTH (ft): N/A

WELL DIAMETER FOR VOLUME CONVERSION: ☐ ~~2 in = 0.163 gal/ft~~ ☐ 4 in = 0.653 gal/ft N/A ☐ ~~6 in = 1.469 gal/ft~~ ☐ ~~8 in = 2.611 gal/ft~~

STANDARD PURGE SAMPLE COLLECTION DATA

☐ ~~Packer~~ N/A WATER LEVEL (ft) PURGE ~~25 GALLONS~~

☐ ~~No Packer~~ N/A

_ TOTAL DEPTH (ft) = _ WATER LEVEL (ft) = _ WATER COLUMN (ft) (gal/ft) = _ 1 PURGE VOLUME (gal) x 3 = _ TOTAL PURGE VOLUME (gal)

WATER QUALITY DATA

	TIME	pH S.U.	Spec. Cond. (mS/cm)	TURBIDITY (NTU)	D.O. (mg/L)	TEMP. (°C)
Volume 1			N/A			
Volume 2						
Volume 3 / Pre-Sample	1609	7.21	11.6	8	3.80	20.6

MAXIMUM PURGE RATE (gal/min.): N/A

ACTUAL PURGE VOLUME (gal.): N/A

DATE / TIME SAMPLED: 1/30/96 / 1609

SAMPLE DEPTH (ft): N/A

COLLECTION DATA

☐ HYDROPUNCH ☐ LYSIMETER ☐ ~~MICRO-PURGE~~ N/A ☐ SURFACE WATER SAMPLE

WATER QUALITY DATA

	TIME	pH S.U.	Spec. Cond. (mS/cm)	TURBIDITY (NTU)	D.O. (mg/L)	TEMP. (°C)
Pre-sampling						

WATER LEVEL (ft):

SCREEN LENGTH (ft): 000058

MICRO-PURGE VOLUME: ☐ (gal.) ☐ (mL)

MAXIMUM PURGE RATE: ☐ (gal/min) ☐ (mL/min) ACTUAL PURGE VOLUME: ☐ (gal.) ☐ (mL) SAMPLE DEPTH (ft): DATE / TIME SAMPLED:

FORM [redacted]-3808

INORGANIC/CONVENTIONAL DATA VALIDATION SUMMARY REPORT

Release # 1-10033 (2CCD3)
ASL B

Special Comments: (When Necessary - Initial & Date.) Note: All sample numbers are abbreviated. They all begin with "200". Perched Water Clarifier Pit

Sample #(s)	Analyte(s)	Final Results	DV Qual*	Qualifier Logic (Deficiencies, SOW problems, etc.)
212361	TOX	611 µg/L	J	The result was qualified estimated due to field duplicate imprecision and a low matrix spike recovery.
212362	TOC	93 mg/L	J	The result was qualified estimated due to field duplicate imprecision.
212365	All Analytes			No results were qualified.
212366	All Analytes			No results were qualified.
212367	Fluoride	2.98 mg/L	J	The result was qualified estimated due to field duplicate imprecision.
212368	Phosphate	93.4 µg/L	U	The result was qualified undetected due to field blank contamination, and should be considered biased high.
212371	All Analytes			No results were qualified.
212372	All Analytes			No results were qualified.
212375	All Analytes			No results were qualified.
212376	All Analytes			No results were qualified.
212377	All Analytes			No results were qualified.
212378	All Analytes			No results were qualified.

Validator: James P. Cross (James P. Cross) Date: 3/14/96

Concurred by: [signature] Date: 3/21/96

QC Check of Subcontractor Submissions by: N/A Date:

* - Final Data Validation Qualifiers assigned based upon the relevant factor(s) that were indicated.

000059

382

FORM I -3808

INORGANIC/CONVENTIONAL DATA VALIDATION SUMMARY REPORT

Release # 1-10033 (2CCD3)
ASL B

Special Comments: (When Necessary - Initial & Date.)
Note: All sample numbers are abbreviated. They all begin with "200". Perched Water Clarifier Pit

Sample #(s)	Analyte(s)	Final Results	DV Qual*	Qualifier Logic (Deficiencies, SOW problems, etc.)
212384	TOX	417 µg/L	J	The result was qualified estimated due to field duplicate imprecision and a low matrix spike recovery.
212385	TOC	9.68 mg/L	J	The result was qualified estimated due to field duplicate imprecision.
212388	All Analytes			No results were qualified.
212389	All Analytes			No results were qualified.
212390	Fluoride	2.19 mg/L	J	The result was qualified estimated due to field duplicate imprecision.
212391	Phosphate	122 µg/L	U	The result was qualified undetected due to field blank contamination, and should be considered biased high.

000030

Validator: (James P. Cross) Date: 3/14/96

Concurred by: Date: 3/21/96

QC Check of Subcontractor Submissions by: N/A Date:

* - Final Data Validation Qualifiers assigned based upon the relevant factor(s) that were indicated.

382

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER - 9602005-12A
FERMCO SITE ID - 20021236
DATE RECEIVED - 02/01/96
DATE SAMPLED - 01/30/96

REPORT DATE - 02/29/96
MATRIX - WATER
RELEASE NUMBER - 10033

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	CONC (UG/L)	ASLB Val Qual	DATE ANALYZED
9020A	TOX	5	611	J	02/09/96

3/21/96

000081

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER - 9602005-13A
FERMCO SITE ID - 200212362
DATE RECEIVED - 02/01/96
DATE SAMPLED - 01/30/96

REPORT DATE - 02/29/96
MATRIX - WATER
RELEASE NUMBER - 10033

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	Result CONC (MG/L)	ASLB Val/Qual	DATE ANALYZED	
9060	TOC	10	93	J	02/23/96	1:10 dil

3/24/96

000062

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER -	9602006-16A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212365	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	CONC (UG/L)		DATE ANALYZED
420.2	PHENOLS	5	5.6	—	02/07/96

3/24/96

000063

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER - 9602005-17A
FERMCO SITE ID - 200212366
DATE RECEIVED - 02/01/96
DATE SAMPLED - 01/30/96

REPORT DATE - 02/29/96
MATRIX - WATER
RELEASE NUMBER - 10033

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	Result ASLB Val. Qual	CONC (MG/L)	DATE ANALYZED
376.1	SULFIDES	1	U	ND	02/05/96

JDS 3/21/96

000064

J 3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER - 9602005-18A
FERMCO SITE ID - 200212367
DATE RECEIVED - 02/01/96
DATE SAMPLED - 01/30/96

REPORT DATE - 02/29/96
MATRIX - WATER
RELEASE NUMBER - 10033

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO. - INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	CONC (MG/L)		DATE ANALYZED	
310.1	ALKALINITY	2	960	—	02/13/96	
300.0	SULFATE	2	121	—	02/02/96	1:20 dil
300.0	CHLORIDE	1	69.1	—	02/02/96	1:20 dil
340.2	FLUORIDE	0.25	2.96	J	02/09/96	1:5 dil
120.1	CONDUCTIVITY (uMHOS/cm)	-	3720	—	02/21/96	

3/21/96

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER - 9602005-19A
FERMCO SITE ID - 200212368
DATE RECEIVED - 02/01/96
DATE SAMPLED - 01/30/96

REPORT DATE - 02/29/96
MATRIX - WATER
RELEASE NUMBER - 10033

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO. - INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	UNITS	CONC		DATE ANALYZED	
365.1	TOT. PHOSPHATES	10	UG/L	93.4	U	02/14/96	
353.1	NO3/NO2-N	10	MG/L	336	—	02/05/96	1:1000 dil
350.1	AMMONIA	0.06	MG/L	1.62	—	02/05/96	1:2 dil
351.2	TKN	0.5	MG/L	3.97	—	02/14/96	1:5 dil
351.2	TON	0.1	MG/L	2.35	—	02/14/96	

3/24/96

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER -	9602005-21A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212371	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT (Less/+)	Val. Qual. (ASLB)	CONC (UG/L)	DATE ANALYZED
9020A	TOX	5	U	ND	02/09/96

3/24/96

000067

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER - 9602005-22A
FERMCO SITE ID - 200212372
DATE RECEIVED - 02/01/96
DATE SAMPLED - 01/30/96

REPORT DATE - 02/29/96
MATRIX - WATER
RELEASE NUMBER - 10033

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	CONC (MG/L)	DATE ANALYZED
9060	TOC	1	ND	02/23/96

3/21/96

000068

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602005-25A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212375	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	Result ASLB Vol. Conf	CONC (UG/L)	DATE ANALYZED
420.2	PHENOLS	5	4	ND	02/07/96

3/21/96

000003

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER -	9602006-26A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212376	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	Result ASLB	CONC (MG/L)	DATE ANALYZED
376.1	SULFIDES	1	4	ND	02/05/96

3/24/96

000070

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER -	9602005-27A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212377	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	Result CONC (MG/L)	ASCB Validation	DATE ANALYZED
310.1	ALKALINITY	2	ND	U	02/13/96
300.0	SULFATE	0.1	ND	U	02/02/96
300.0	CHLORIDE	0.05	ND	U	02/02/96
340.2	FLUORIDE	0.05	ND	U	02/09/96
120.1	CONDUCTIVITY (uMHOS/cm)	-	2.8	U	02/21/96

3/24/96

000071

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER -	9602006-28A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212378	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	UNITS	CONC (Results)	ASLB Val Qual	DATE ANALYZED
365.1	TOT. PHOSPHATES	10	UG/L	56.9	—	02/14/96
353.1	NO3/NO2-N	0.01	MG/L	ND	U	02/05/96
350.1	AMMONIA	0.03	MG/L	ND	U	02/05/96
351.2	TKN	0.1	MG/L	ND	U	02/14/96
351.2	TON	0.1	MG/L	ND	U	02/14/96

3/21/96

000072

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602005-02A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212384	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	CONC (UG/L) Result	ASLB	DATE ANALYZED
9020A	TOX	5	417	J	02/09/96

DB 3/21/96

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER - 9602005-03A
FERMCO SITE ID - 2002123R5
DATE RECEIVED - 02/01/96
DATE SAMPLED - 01/30/96

REPORT DATE - 02/29/96
MATRIX - WATER
RELEASE NUMBER - 10033

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	Result CONC (MG/L)	ASLB Val. Qual.	DATE ANALYZED
9060	TOC	1	9.68	J	02/23/96

3/21/96

000071

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602005-06A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212388	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	Result CONC (UG/L)	ASLB	DATE ANALYZED
420.2	PHENOLS	5	8.8	—	02/07/96

3/14/96

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER -	9602005-07A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212389	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	ASLB Result Validation	CONC (MG/L)	DATE ANALYZED
376.1	SULFIDES	1	U	ND	02/05/96

3/4/96

000076

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER -	9602005-08A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212390	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	RESULT CONC (MG/L)	ASLB Val Qual	DATE ANALYZED	
310.1	ALKALINITY	2	940	—	02/13/96	
300.0	SULFATE	2	120	—	02/02/96	1:20 dil
300.0	CHLORIDE	1	68.6	—	02/02/96	1:20 dil
340.2	FLUORIDE	0.05	2.19	J	02/09/96	
120.1	CONDUCTIVITY (uMHOS/cm)	-	3710	—	02/21/96	

3/21/96

000077 3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

387

TCT SAMPLE NUMBER -	9602005-09A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212391	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO. - INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	UNITS	Results CONC	ASLB JDA	DATE ANALYZED	
365.1	TOT. PHOSPHATES	10	UG/L	122	U	02/14/96	
353.1	NO3/NO2-N	10	MG/L	338	—	02/05/96	1:1000 dil
350.1	AMMONIA	0.03	MG/L	1.69	—	02/05/96	
351.2	TKN	0.5	MG/L	4.02	—	02/14/96	1:5 dil
351.2	TON	0.1	MG/L	2.33	—	02/14/96	

3/14/96

000078

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602005-28A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212378	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	UNITS	CONC	DATE ANALYZED
365.1	TOT. PHOSPHATES	10	UG/L	56.9	02/14/96
353.1	NO3/NO2-N	0.01	MG/L	ND	02/05/96
350.1	AMMONIA	0.03	MG/L	ND	02/05/96
351.2	TKN	0.1	MG/L	ND	02/14/96
351.2	TON	0.1	MG/L	ND	02/14/96

3/21/96

000079

3/14/96

FERMCO QC ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602005-12A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212961	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96	QC SAMPLE -	MATRIX SPIKE

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	TRUE VALUE	FOUND CONC (UG/L)	SAMPLE CONC (UG/L)	% REC	DATE ANALYZED
9020A	TOX	500	950	611	68	02/09/96

3/21/96

000060

3/14/96

387

field dup of 212384

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602006-12A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212361	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	CONC (UG/L)	DATE ANALYZED
9020A	TOX	5	611	02/09/96

3/21/96

000081

3/14/96

387 field dup of 212385

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602006-13A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212362	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	CONC (MG/L)	DATE ANALYZED	
9060	TOC	10	93	02/23/96	1:10 dil

3/24/96

000082

3/14/96

387 field dup of 212390

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602005-18A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212367	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO. - INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	CONC (MG/L)	DATE ANALYZED	
310.1	ALKALINITY	2	960	02/13/96	
300.0	SULFATE	2	121	02/02/96	1:20 dil
300.0	CHLORIDE	1	69.1	02/02/96	1:20 dil
340.2	FLUORIDE	0.25	2.96	02/09/96	1:5 dil
120.1	CONDUCTIVITY (uMHOS/cm)	-	3720	02/21/96	

3/21/96

000083

gr 3/14/96

387 field dup of 212361

FERMCO TOTAL ANALYSIS
96FM-10033

TCT SAMPLE NUMBER -	9602006-02A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212384	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	CONC (UG/L)	DATE ANALYZED
9020A	TOX	5	417	02/09/96

3/2/96

000087

3/14/96

P- 387 field dup of 212362

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602006-03A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212365	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	CONC (MG/L)	DATE ANALYZED
9060	TOC	1	3.68	02/23/96

3/21/96

000085

3/14/96

FERMCO TOTAL ANALYSIS
93PM-10033

387 field dup of 212367

TCT SAMPLE NUMBER -	9602006-06A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212390	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

QC BATCH NO.- INORG - 10033
DILUTION FACTOR - 1

METHODS	PARAMETER	DETECTION LIMIT	CONC (MG/L)	DATE ANALYZED	
310.1	ALKALINITY	2	940	02/13/96	
300.0	SULFATE	2	120	02/02/96	1:20 dil
300.0	CHLORIDE	1	68.6	02/02/96	1:20 dil
340.2	FLUORIDE	0.05	2.19	02/09/96	
120.1	CONDUCTIVITY (uMHOS/cm)	-	3710	02/21/96	

DB 3/21/96

000085

fr 3/14/97

FORM I[illegible]-3808

INORGANIC/CONVENTIONAL DATA VALIDATION SUMMARY REPORT

Release # 1-10033
2CCD3
ASL C
(Reported Measurement Units): µg/L

Special Comments: Note: All sample numbers are abbreviated. They all begin with "2000". Perched Water Clarifier Pit
(When Necessary - Initial & Date.)

Sample #(s)	Analyte(s)	Final Results	DV Qual*	Qualifier Logic (Deficiencies, SOW problems, etc.)
212364	Antimony	4.0	UJ	The result was qualified estimated due to a low matrix spike recovery, and should be considered biased low.
	Arsenic	7.5	U	The result was qualified undetected due to laboratory blank contamination, and should be considered biased high.
	Cadmium	1.4	U	The result was qualified undetected due to laboratory blank contamination, and should be considered biased high.
	Iron	366	U	The result was qualified undetected due to laboratory blank contamination, and should be considered biased high.
	Mercury	0.10	U	The result was qualified undetected due to laboratory blank contamination, and should be considered biased high.
	Selenium	7.6	J	The result was qualified estimated due duplicate and field duplicate imprecision.
	Thallium	5.0	UJ	The result was qualified estimated due to a low matrix spike recovery, and should be considered biased low.
	Vanadium	2.0	UJ	The result was qualified estimated due to a low matrix spike recovery, and should be considered biased low.
212374	Calcium	138	U	The result was qualified undetected due to laboratory blank contamination, and should be considered biased high.
	Iron	40.5	U	The result was qualified undetected due to laboratory blank contamination, and should be considered biased high.

Validator: (James P. Cross) Date: 03/13/96

Concurred by: Date: 3/15/96

QC Check of Subcontractor Submissions by: Date:

* - Final Data Validation Qualifiers assigned based upon the relevant factor(s) that were indicated.

000048

2 8 3

FORM F[illegible]-3808

INORGANIC/CONVENTIONAL DATA VALIDATION SUMMARY REPORT

Release # 1-10033
2CCD3
ASL C
(Reported Measurement Units): µg/L

Special Comments: Note: All sample numbers are abbreviated. They all begin with "2000".
(When Necessary - Initial & Date.) Perched Water Clarifier Pit

Sample #(s)	Analyte(s)	Final Results	DV Qual*	Qualifier Logic (Deficiencies, SOW problems, etc.)
212387	Aluminum	485	U	The result was qualified undetected due to laboratory blank contamination, and should be considered biased high.
	Antimony	4.0	UJ	The result was qualified estimated due to a low matrix spike recovery, and should be considered biased low.
	Arsenic	9.7	U	The result was qualified undetected due to laboratory blank contamination, and should be considered biased high.
	Iron	334	U	The result was qualified undetected due to laboratory blank contamination, and should be considered biased high.
	Selenium	17.7	J	The result was qualified estimated due duplicate and field duplicate imprecision.
	Thallium	5.0	UJ	The result was qualified estimated due to a low matrix spike recovery, and should be considered biased low.
	Vanadium	2.0	UJ	The result was qualified estimated due to a low matrix spike recovery, and should be considered biased low.

000085

Validator: (James P. Cross) Date: 03/13/96

Concurred by: Date: 3/18/96

QC Check of Subcontractor Submissions by: Date:

* - Final Data Validation Qualifiers assigned based upon the relevant factor(s) that were indicated.

383

ENVIROFORMS/INORGANIC CLP 387

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

212364

Lab Name: TCT St. Louis Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 2I2383

Matrix (soil/water): WATER Lab Sample ID: 960200515A

Level (low/med): LOW Date Received: 02/01/96

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

ASLC Val. Qual.

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	75.0	U	*	P	U
7440-36-0	Antimony	4.0	U	N	P	UJ
7440-38-2	Arsenic	7.5	B		P	U
7440-39-3	Barium	227	-		P	-
7440-41-7	Beryllium	15.6	-		P	-
7440-43-9	Cadmium	1.4	B		P	U
7440-70-2	Calcium	555000	-		P	-
7440-47-3	Chromium	17.6	-		P	-
7440-48-4	Cobalt	56.1	-		P	-
7440-50-8	Copper	805	-		P	-
7439-89-6	Iron	366	-		P	U
7439-92-1	Lead	2.0	U		P	U
7439-95-4	Magnesium	131000	-		P	-
7439-96-5	Manganese	870	-		P	-
7439-97-6	Mercury	0.10	B		CV	U
7440-02-0	Nickel	117	-		P	-
7440-09-7	Potassium	48600	-		A	-
7782-49-2	Selenium	7.6	-	N*	P	J
7440-22-4	Silver	84.8	-		P	-
7440-23-5	Sodium	138000	-		P	-
7440-28-0	Thallium	5.0	U	N	P	UJ
7440-62-2	Vanadium	2.0	U	N	P	UJ
7440-66-6	Zinc	89.4	-		P	-
	Cyanide		-			

Color Before: YELLOW Clarity Before: CLOUDY Texture:

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:

3/11/96

3/13/96

FORM I - IN

387

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

212374

Lab Name: TCT St. Louis Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 2I2383

Matrix (soil/water): WATER Lab Sample ID: 960200524A

Level (low/med): LOW Date Received: 02/01/96

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

ASLC

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	75.0	U	*	P	U
7440-36-0	Antimony	4.0	U	N	P	U
7440-38-2	Arsenic	3.0	U		P	U
7440-39-3	Barium	9.0	U		P	U
7440-41-7	Beryllium	1.0	U		P	U
7440-43-9	Cadmium	1.0	U		P	U
7440-70-2	Calcium	138	B		P	U
7440-47-3	Chromium	6.0	U		P	U
7440-48-4	Cobalt	9.0	U		P	U
7440-50-8	Copper	11.0	U		P	U
7439-89-6	Iron	40.5	B		P	U
7439-92-1	Lead	2.0	U		P	U
7439-95-4	Magnesium	82.0	U		P	U
7439-96-5	Manganese	6.0	U		P	U
7439-97-6	Mercury	0.10	U		CV	U
7440-02-0	Nickel	19.0	U		P	U
7440-09-7	Potassium	98.0	U		A	U
7782-49-2	Selenium	5.0	U	N*	P	U
7440-22-4	Silver	1.0	U		P	U
7440-23-5	Sodium	170	U		P	U
7440-28-0	Thallium	5.0	U	N	P	U
7440-62-2	Vanadium	2.0	U	N	P	U
7440-66-6	Zinc	13.0	U		P	U
	Cyanide					

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

3/15/96

FORM I - IN 000090

3/13/96

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

212387

Lab Name: TCT St. Louis Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 2I2383

Matrix (soil/water): WATER Lab Sample ID: 960200505A

Level (low/med): LOW Date Received: 02/01/96

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

ASLC
Val. Final

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	485		*	P	U
7440-36-0	Antimony	4.0	U	N	P	UJ
7440-38-2	Arsenic	9.7	B		P	U
7440-39-3	Barium	216			P	
7440-41-7	Beryllium	14.7			P	
7440-43-9	Cadmium	1.0	U		P	U
7440-70-2	Calcium	534000			P	
7440-47-3	Chromium	17.9			P	
7440-48-4	Cobalt	62.9			P	
7440-50-8	Copper	764			P	
7439-89-6	Iron	334			P	
7439-92-1	Lead	2.0	U		P	U
7439-95-4	Magnesium	126000			P	
7439-96-5	Manganese	825			P	
7439-97-6	Mercury	0.10	U		CV	U
7440-02-0	Nickel	108			P	
7440-09-7	Potassium	48800			A	
7782-49-2	Selenium	17.7		N*	P	UJ
7440-22-4	Silver	82.4			P	
7440-23-5	Sodium	131000			P	
7440-28-0	Thallium	5.0	U	N	P	UJ
7440-62-2	Vanadium	2.0	U	N	P	UJ
7440-66-6	Zinc	81.0			P	
	Cyanide					

Color Before: YELLOW Clarity Before: CLOUDY Texture:

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:

3/15/96

3/13/96

FORM I - IN

000031

ENVIROFORMS/INORGANIC CLP

3
BLANKS

Lab Name: TCT St. Louis Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 2I2383

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
Aluminum	75.0	U	75.0	U	75.0	U			108.600	B	P
Antimony	3.8	B	4.0	U	4.0	U			4.000	U	P
Arsenic	3.0	U	4.7	B	3.0	U			3.000	U	P
Barium	9.0	U	9.0	U	9.0	U			9.000	U	P
Beryllium	1.0	U	1.0	U	1.0	U			1.000	U	P
Cadmium	1.3	B	4.0	B	1.0	U			1.000	U	P
Calcium	40.0	U	40.0	U	40.0	U			97.900	B	P
Chromium	6.0	U	6.0	U	6.0	U			6.000	U	P
Cobalt	9.0	U	9.0	U	9.0	U			9.000	U	P
Copper	11.0	U	11.0	U	11.0	U			11.000	U	P
Iron	38.0	U	38.0	U	38.0	U			93.000	B	P
Lead	2.0	U	2.0	U	2.0	U			-2.140	B	P
Magnesium	82.0	U	82.0	U	82.0	U			82.000	U	P
Manganese	6.0	U	6.0	U	6.0	U			6.000	U	P
Mercury	0.1	B	0.1	B	0.1	B			0.100	U	CV
Nickel	19.0	U	19.0	U	19.0	U			19.000	U	P
Potassium	98.0	U	98.0	U					98.000	U	A
Selenium	5.0	U	5.0	U	5.0	U			5.000	U	P
Silver	1.0	U	1.0	U	1.0	U			1.000	U	P
Sodium	170.0	U	170.0	U	170.0	U			170.000	U	P
Thallium	5.0	U	5.0	U	5.0	U			5.000	U	P
Vanadium	2.2	B	2.0	U	2.0	U			2.000	U	P
Zinc	13.0	U	13.0	U	13.0	U			13.000	U	P
Cyanide											

FORM III - IN

ENVIROFORMS/INORGANIC CLP

387

5A
SPIKE SAMPLE RECOVERY

SAMPLE NO.

212387S

Lab Name: TCT St. Louis Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 2I2383

Matrix (soil/water): WATER Level (low/med): LOW
% Solids for Sample: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit %R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R	Q	M
Aluminum	75-125	2182.6667		485.2000		2000.00	84.9		P
Antimony	75-125	316.8300		4.0000	U	500.00	63.4	N	P
Arsenic	75-125	46.4600		9.6900	B	40.00	91.9		P
Barium	75-125	2243.0000		215.5667		2000.00	101.4		P
Beryllium	75-125	58.2700		14.7400		50.00	87.1		P
Cadmium	75-125	42.7600		1.0000	U	50.00	85.5		P
Calcium									NR
Chromium	75-125	212.2333		17.8667		200.00	97.2		P
Cobalt	75-125	543.6667		62.8667		500.00	96.2		P
Copper	75-125	1019.0000		763.7333		250.00	102.1		P
Iron	75-125	1312.0000		334.2333		1000.00	97.8		P
Lead	75-125	15.3200		2.0000	U	20.00	76.6		P
Magnesium									NR
Manganese	75-125	1331.3333		825.4667		500.00	101.2		P
Mercury									NR
Nickel	75-125	601.1667		108.2333		500.00	98.6		P
Potassium									NR
Selenium	75-125	19.9700		17.6600		10.00	23.1	N	P
Silver	75-125	127.3000		82.4100		50.00	89.8		P
Sodium									NR
Thallium	75-125	35.2900		5.0000	U	50.00	70.6	N	P
Vanadium	75-125	360.5600		2.0000	U	500.00	72.1	N	P
Zinc	75-125	571.4667		81.0000		500.00	98.1		P
Cyanide									NR

Comments:

3/13/96

FORM V (PART 1) - IN

000093

3/13/96

ENVIROFORMS/INORGANIC CLP

6
DUPLICATES

SAMPLE NO.

212387D

Lab Name: TCT St. Louis Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 2I2383

Matrix (soil/water): WATER Level (low/med): LOW

% Solids for Sample: 0.0 % Solids for Duplicate: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Aluminum	200.0	485.2000		270.0667		57.0	*	P
Antimony		4.0000	U	4.0000	U			P
Arsenic		9.6900	B	4.8000	B	67.5		P
Barium	200.0	215.5667		223.8667		3.8		P
Beryllium	5.0	14.7400		14.9900		1.7		P
Cadmium		1.0000	U	1.2200	B	200.0		P
Calcium		534400.0000		539300.0000		0.9		P
Chromium	10.0	17.8667		20.4667		13.6		P
Cobalt	50.0	62.8667		57.3333		9.2		P
Copper		763.7333		779.1667		2.0		P
Iron	100.0	334.2333		336.4000		0.6		P
Lead		2.0000	U	2.0000	U			P
Magnesium		125766.6600		127200.0000		1.1		P
Manganese		825.4667		841.0000		1.9		P
Mercury								
Nickel	40.0	108.2333		110.1000		1.7		P
Potassium	5000.0	48750.0000		47500.0000		2.6		A
Selenium	5.0	17.6600		9.5900		59.2	*	P
Silver		82.4100		86.0400		4.3		P
Sodium		131366.6600		133633.3300		1.7		P
Thallium		5.0000	U	5.0000	U			P
Vanadium		2.0000	U	2.0000	U			P
Zinc	20.0	81.0000		84.0333		3.7		P
Cyanide								

3/15/96

3/13/96

FORM VI - IN

field dup of 387

212387

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

212364

Lab Name: TCT St. Louis Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 2I2383

Matrix (soil/water): WATER Lab Sample ID: 960200515A

Level (low/med): LOW Date Received: 02/01/96

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	75.0	U	*	P	
7440-36-0	Antimony	4.0	U	N	P	
7440-38-2	Arsenic	7.5	B		P	4
7440-39-3	Barium	227	-		P	
7440-41-7	Beryllium	15.6			P	
7440-43-9	Cadmium	1.4	B		P	4
7440-70-2	Calcium	555000	-		P	
7440-47-3	Chromium	17.6	-		P	
7440-48-4	Cobalt	56.1	-		P	
7440-50-8	Copper	805	-		P	
7439-89-6	Iron	366	-		P	4
7439-92-1	Lead	2.0	U		P	
7439-95-4	Magnesium	131000	-		P	
7439-96-5	Manganese	870	-		P	
7439-97-6	Mercury	0.10	B		CV	4
7440-02-0	Nickel	117	-		P	
7440-09-7	Potassium	48600	-		A	
7782-49-2	Selenium	7.6	-	N*	P	
7440-22-4	Silver	84.8	-		P	
7440-23-5	Sodium	138000	-		P	
7440-28-0	Thallium	5.0	U	N	P	
7440-62-2	Vanadium	2.0	U	N	P	
7440-66-6	Zinc	89.4	-		P	
	Cyanide		-			

Color Before: YELLOW Clarity Before: CLOUDY Texture:

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:

3/1/96

3/12/96

FORM I - IN

387 field dup of 212364

ENVIROFORMS/INORGANIC CL

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

212387

Lab Name: TCT St. Louis Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 2I2383

Matrix (soil/water): WATER Lab Sample ID: 960200505A

Level (low/med): LOW Date Received: 02/01/96

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	485		*	P	4
7440-36-0	Antimony	4.0	U	N	P	
7440-38-2	Arsenic	9.7	B		P	4
7440-39-3	Barium	216			P	
7440-41-7	Beryllium	14.7			P	
7440-43-9	Cadmium	1.0	U		P	
7440-70-2	Calcium	534000			P	
7440-47-3	Chromium	17.9			P	
7440-48-4	Cobalt	62.9			P	
7440-50-8	Copper	764			P	
7439-89-6	Iron	334			P	4
7439-92-1	Lead	2.0	U		P	
7439-95-4	Magnesium	126000			P	
7439-96-5	Manganese	825			P	
7439-97-6	Mercury	0.10	U		CV	
7440-02-0	Nickel	108			P	
7440-09-7	Potassium	48800			A	
7782-49-2	Selenium	17.7		W*	P	
7440-22-4	Silver	82.4			P	
7440-23-5	Sodium	131000			P	
7440-28-0	Thallium	5.0	U	N	P	
7440-62-2	Vanadium	2.0	U	N	P	
7440-66-6	Zinc	81.0			P	
	Cyanide					

Color Before: YELLOW Clarity Before: CLOUDY Texture:

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:

3/15/96

000096

FORM I - IN

3/13/96

ORGANIC DATA VALIDATION SUMMARY REPORT

Release # I-10033 Perched Water Matrix Water Units: UG/L ASL level C
Plan # 20.03.11
Charge No.2CCD3

Sample #(s)	Analyte(s)	Final Results	DV Qual*	Qualifier Logic (Deficiencies, SOW problems).
212360 (VOA)	Methylene Chloride	10	U	Method blank contamination is present
212360DL(VOA)	All the target compounds were qualified Z, because usable data were reported from the initial analysis.			
212370 (VOA)	Methylene Chloride	10	U	Method blank contamination is present
	Acetone	32	U	Method blank contamination is present
212383 (VOA)	Vinyl Chloride	10	UJ	Continuing calibration %D > 25%.
	Chloroethane	10	UJ	Continuing calibration %D > 25%
	Methylene Chloride	10	U	Method blank contamination is present
	Acetone	12	U	Method blank contamination is present
212383DL(VOA)	All the target compounds were qualified Z, because usable data were reported from the initial analysis.			
212439 (VOA)	Methylene Chloride	10	U	Method blank contamination is present
	Acetone	60	U	Method blank contamination is present

000097

Validator: Abdul A. Abdi Date: 3/27/96

Concurred by: Date: 3/27/96

QC Check of Subcontractor Deliverable by: Date:

Qualifier Codes Entered by: Date:

Qualifier Codes Approved by: Date:

* - Final Data Validation Qualifiers assigned based upon the relevant factor(s) that were indicated.

387

ORGANIC DATA VALIDATION SUMMARY REPORT

Release # I-10033 Perched Water Matrix Water Units: UG/L ASL level C
Plan # 20.03.11
Charge No.2CCD3

Sample #(s)	Analyte(s)	Final Results	DV Qual*	Qualifier Logic (Deficiencies, SOW problems).
212363 (BNA)	2,4-Dinitrophenol	50	R	Initial calibration %RSD > 50%.
	Pentachlorophenol	50	UJ	Continuing calibration %D > 25%.
	bis(2-Ethylhexyl)phthalate	20	U	Field blank contamination is present
	Benzo(b)fluoranthene	20	UJ	Continuing calibration %D > 25% and IS6 was outside QC limits.
	All the target compounds quantitated off of IS6 (Di-n-octylphthalate through Benzo(g,g,i)perylene) were qualified estimated.			
212373 (BNA)	2,4-Dinitrophenol	50	R	Initial calibration %RSD > 50%.
	Pentachlorophenol	50	UJ	Continuing calibration %D > 25%.
	Benzo(b)fluoranthene	20	UJ	Continuing calibration %D > 25% .
212386 (BNA)	3-Nitroaniline	50	UJ	Initial calibration %RSD > 30%.
	Carbazole	20	UJ	Continuing calibration %D > 25%.
	3,3'-Dichlorobenzidine	20	R	Continuing calibration %D > 50% .
	bis(2-Ethylhexyl)phthalate	20	U	Field blank contamination is present.

Note: *Where no specific qualifier logic statement accompanies a "J" qualifier, this is indicative of a laboratory EPA qualification for a result that is below the CRQL. The result should be considered estimated for this reason.*

Validator: Abdul A. Abdi Date: 3/27/96

Concurred by: [illegible] Date: 3/27/96

QC Check of Subcontractor Deliverable by: [illegible] Date:

Qualifier Codes Entered by: Date:

Qualifier Codes Approved by: Date:

* - Final Data Validation Qualifiers assigned based upon the relevant factor(s) that were indicated.

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212360

Lab Name: TCL-ST. LOUIS Contract: 434286

Lab Code: TCL Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-11A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9651

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	A&C
74-87-3	Chloromethane	10	U	U
74-83-9	Bromomethane	10	U	U
75-01-4	Vinyl chloride	10	U	U
75-00-3	Chloroethane	10	U	U
75-09-2	Methylene Chloride	3	BJ	U
67-64-1	Acetone	10	U	U
75-15-0	Carbon Disulfide	10	U	U
75-35-4	1,1-Dichloroethene	7	J	J
75-34-3	1,1-Dichloroethane	2	J	J
156-60-5	trans-1,2-Dichloroethene	10	U	U
156-59-2	cis-1,2-Dichloroethene	5	J	J
67-66-3	Chloroform	10	U	U
107-06-2	1,2-Dichloroethane	2	J	J
78-93-3	2-Butanone	10	U	U
71-55-6	1,1,1-Trichloroethane	7	J	J
56-23-5	Carbon Tetrachloride	10	U	U
108-05-4	Vinyl Acetate	10	U	U
75-27-4	Bromodichloromethane	10	U	U
78-87-5	1,2-Dichloropropane	10	U	U
10061-01-5	cis-1,3-Dichloropropene	10	U	U
79-01-6	Trichloroethene	650	E	E
124-48-1	Dibromochloromethane	10	U	U
79-00-5	1,1,2-Trichloroethane	10	U	U
71-43-2	Benzene	10	U	U
10061-02-6	trans-1,3-Dichloropropene	10	U	U
75-25-2	Bromoform	10	U	U
108-[illegible]	4-Methyl-2-pentanone	10	U	U
591-[illegible]	2-Hexanone	10	U	U
127-[illegible]	Tetrachloroethene	90		
79-[illegible]	1,1,2,2-Tetrachloroethane	10	U	U
108-[illegible]	Toluene	10	U	U
108-90-7	Chlorobenzene	10	U	U
100-41-4	Ethylbenzene	10	U	U
100-42-5	Styrene	10	U	U

FORM I VOA 3/90 Rev

3/27/96

000099 3/27/96 AM

387

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212360

Lab Name: TCF-ST. LOUIS Contract: 434286

Lab Code: TCF Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-11A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9651

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
1330-20-7	Xylene (total)	10	U	U

FORM I VOA-2 3/90 Rev

3/16/96

000100

3/14/96

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212360

Lab Name: TCT-ST. LOUIS Contract: 436286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-11A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9651

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 1 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L

ASL C.

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	COLUMN BLEED	21.93	13	J R
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I VOA-TIC 3/90 Rev

3/14/96

000101

3/14/96 AP 1S

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212360 DL

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-11A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9659

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 5

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASL C.
74-87-3	Chloromethane	50	U	Z
74-83-9	Bromomethane	50	U	
75-01-4	Vinyl chloride	50	U	
75-00-3	Chloroethane	50	U	
75-09-2	Methylene Chloride	50	U	
67-64-1	Acetone	43	BJ	
75-15-0	Carbon Disulfide	50	U	
75-35-4	1,1-Dichloroethene	50	U	
75-34-3	1,1-Dichloroethane	50	U	
156-60-5	trans-1,2-Dichloroethene	50	U	
156-59-2	cis-1,2-Dichloroethene	50	U	
67-66-3	Chloroform	50	U	
107-06-2	1,2-Dichloroethane	50	U	
78-93-3	2-Butanone	50	U	
71-55-6	1,1,1-Trichloroethane	50	U	
56-23-5	Carbon Tetrachloride	50	U	
108-05-4	Vinyl Acetate	50	U	
75-27-4	Bromodichloromethane	50	U	
78-87-5	1,2-Dichloropropane	50	U	
10061-01-5	cis-1,3-Dichloropropene	50	U	Z
79-01-6	Trichloroethene	510		Z 3/20/96 AT
124-48-1	Dibromochloromethane	50	U	Z
79-00-5	1,1,2-Trichloroethane	50	U	
71-43-2	Benzene	50	U	
10061-02-6	trans-1,3-Dichloropropene	50	U	
75-25-2	Bromoform	50	U	
108-10-1	4-Methyl-2-pentanone	50	U	
591-78-6	2-Hexanone	50	U	
127-18-4	Tetrachloroethene	66		
79-34-5	1,1,2,2-Tetrachloroethane	50	U	
108-88-3	Toluene	50	U	
108-90-7	Chlorobenzene	50	U	
100-41-4	Ethylbenzene	50	U	
100-42-5	Styrene	50	U	Z

FORM I VOA 3/90 Rev

3/21/96

000102 3/14/96 AT

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212360 DL

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-11A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9659

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 5

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
1330-20-7	Xylene (total)	50	U

ASLC

FORM I VOA-2 3/90 Rev

3/15/96

000103

3/14/96

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212370

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-20A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9654

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
74-87-3	Chloromethane	10	U	U
74-83-9	Bromomethane	10	U	
75-01-4	Vinyl chloride	10	U	
75-00-3	Chloroethane	10	U	U
75-09-2	Methylene Chloride	2	BJ	10 U
67-64-1	Acetone	32	B	
75-15-0	Carbon Disulfide	10	U	U
75-35-4	1,1-Dichloroethene	10	U	
75-34-3	1,1-Dichloroethane	10	U	
156-60-5	trans-1,2-Dichloroethene	10	U	
156-59-2	cis-1,2-Dichloroethene	10	U	
67-66-3	Chloroform	10	U	
107-06-2	1,2-Dichloroethane	10	U	U
78-93-3	2-Butanone	10		
71-55-6	1,1,1-Trichloroethane	1	J	J
56-23-5	Carbon Tetrachloride	10	U	U
108-05-4	Vinyl Acetate	10	U	
75-27-4	Bromodichloromethane	10	U	
78-87-5	1,2-Dichloropropane	10	U	
10061-01-5	cis-1,3-Dichloropropene	10	U	
79-01-6	Trichloroethene	10	U	
124-48-1	Dibromochloromethane	10	U	
79-00-5	1,1,2-Trichloroethane	10	U	
71-43-2	Benzene	10	U	
10061-02-6	trans-1,3-Dichloropropene	10	U	
75-25-2	Bromoform	10	U	
108-[illegible]	4-Methyl-2-pentanone	10	U	
591-[illegible]	2-Hexanone	10	U	
127-[illegible]	Tetrachloroethene	10	U	
79-[illegible]	1,1,2,2-Tetrachloroethane	10	U	
108-[illegible]	Toluene	10	U	
108-90-7	Chlorobenzene	10	U	
100-41-4	Ethylbenzene	10	U	
100-42-5	Styrene	10	U	U

FORM I VOA 3/90 Rev

3/18/96

3/14/96 KA

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212370

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-20A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9654

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASL C
1330-20-7	Xylene (total)	10	U	U

FORM I VOA-2 3/90 Rev

DPS 3/18/96

000107

3/14/96 AA

387

EPA SAMPLE NO.

Field Blank

212370

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-20A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9654

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 0

CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L

ASLC

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I VOA-TIC 3/90 Rev

DJB 3/18/96

000106

3/14/96 AA

387

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212383

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9681

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/09/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
74-87-3	Chloromethane	10	U	U
74-83-9	Bromomethane	10	U	U
75-01-4	Vinyl chloride	10	U	U
75-00-3	Chloroethane	10	U	U
75-09-2	Methylene Chloride	3	J	U
67-64-1	Acetone	12		U
75-15-0	Carbon Disulfide	10	U	U
75-35-4	1,1-Dichloroethene	5	J	U
75-34-3	1,1-Dichloroethane	1	J	U
156-60-5	trans-1,2-Dichloroethene	10	U	U
156-59-2	cis-1,2-Dichloroethene	3	J	U
67-66-3	Chloroform	10	U	U
107-06-2	1,2-Dichloroethane	2	J	U
78-93-3	2-Butanone	10	U	U
71-55-6	1,1,1-Trichloroethane	7	J	U
56-23-5	Carbon Tetrachloride	10	U	U
108-05-4	Vinyl Acetate	10	U	U
75-27-4	Bromodichloromethane	10	U	U
78-87-5	1,2-Dichloropropane	10	U	U
10061-01-5	cis-1,3-Dichloropropene	10	U	U
79-01-6	Trichloroethene	550	E	
124-48-1	Dibromochloromethane	10	U	U
79-00-5	1,1,2-Trichloroethane	10	U	U
71-43-2	Benzene	10	U	U
10061-02-6	trans-1,3-Dichloropropene	10	U	U
75-25-2	Bromoform	10	U	U
108-10-1	4-Methyl-2-pentanone	10	U	U
591-[illegible]	2-Hexanone	10	U	U
127-[illegible]	Tetrachloroethene	75		
79-3[illegible]	1,1,2,2-Tetrachloroethane	2	J	U
108-[illegible]	Toluene	10	U	U
108-90-7	Chlorobenzene	10	U	U
100-41-4	Ethylbenzene	10	U	U
100-42-5	Styrene	10	U	U

FORM I VOA 3/90 Rev

3/27/96

000107

66

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212383

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9681

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/09/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
1330-20-7	Xylene (total)	10	U	U

FORM I VOA-2 3/90 Rev

3/18/96

3/14/96 AA

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212383

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCF Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9681

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/09/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

ASLC

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I VOA-TIC 3/90 Rev

3/16/96
3/14/96

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212383 DL

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9658

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 5

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASL C
74-87-3	Chloromethane	50	U	
74-83-9	Bromomethane	50	U	
75-01-4	Vinyl chloride	50	U	
75-00-3	Chloroethane	50	U	
75-09-2	Methylene Chloride	8	BJ	
67-64-1	Acetone	50	U	
75-15-0	Carbon Disulfide	50	U	
75-35-4	1,1-Dichloroethene	5	J	
75-34-3	1,1-Dichloroethane	50	U	
156-60-5	trans-1,2-Dichloroethene	50	U	
156-59-2	cis-1,2-Dichloroethene	50	U	
67-66-3	Chloroform	50	U	
107-06-2	1,2-Dichloroethane	50	U	
78-93-3	2-Butanone	50	U	
71-55-6	1,1,1-Trichloroethane	5	J	
56-23-5	Carbon Tetrachloride	50	U	
108-05-4	Vinyl Acetate	50	U	
75-27-4	Bromodichloromethane	50	U	
78-87-5	1,2-Dichloropropane	50	U	
10061-01-5	cis-1,3-Dichloropropene	50	U	
79-01-6	Trichloroethene	530		3/20/5
124-48-1	Dibromochloromethane	50	U	
79-00-5	1,1,2-Trichloroethane	50	U	
71-43-2	Benzene	50	U	
10061-02-6	trans-1,3-Dichloropropene	50	U	
75-25-2	Bromoform	50	U	
108-[illegible]	4-Methyl-2-pentanone	50	U	
591-[illegible]	2-Hexanone	50	U	
127-[illegible]	Tetrachloroethene	72		
79-34-[illegible]	1,1,2,2-Tetrachloroethane	50	U	
108-88-3	Toluene	50	U	
108-90-7	Chlorobenzene	50	U	
100-41-4	Ethylbenzene	50	U	
100-42-5	Styrene	50	U	

FORM I VOA 3/90 Rev

3/21/96
3/14/96

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212383 DL

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9658

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 5

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASL C
1330-20-7	Xylene (total)	50	U	Z

FORM I VOA-2 3/90 Rev

3/15/96

3/14/96 MA

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212383 DL

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9658

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 5

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 2

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

ASL C

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	COLUMN BLEED	16.91	74	J
2.	COLUMN BLEED	21.97	190	J
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I VOA-TIC 3/90 Rev

3/14/96

000112

3/14/96

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Trip Blank
212439

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-10A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9650

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
74-87-3	Chloromethane	10	U	U
74-83-9	Bromomethane	10	U	U
75-01-4	Vinyl chloride	10	U	U
75-00-3	Chloroethane	10	U	U
75-09-2	Methylene Chloride	2	BJ	U
67-64-1	Acetone	60	B	U
75-15-0	Carbon Disulfide	10	U	U
75-35-4	1,1-Dichloroethene	10	U	U
75-34-3	1,1-Dichloroethane	10	U	U
156-60-5	trans-1,2-Dichloroethene	10	U	U
156-59-2	cis-1,2-Dichloroethene	10	U	U
67-66-3	Chloroform	10	U	U
107-06-2	1,2-Dichloroethane	10	U	U
78-93-3	2-Butanone	6	J	U
71-55-6	1,1,1-Trichloroethane	10	U	U
56-23-5	Carbon Tetrachloride	10	U	U
108-05-4	Vinyl Acetate	10	U	U
75-27-4	Bromodichloromethane	10	U	U
78-87-5	1,2-Dichloropropane	10	U	U
10061-01-5	cis-1,3-Dichloropropene	10	U	U
79-01-6	Trichloroethene	10	U	U
124-48-1	Dibromochloromethane	10	U	U
79-00-5	1,1,2-Trichloroethane	10	U	U
71-43-2	Benzene	10	U	U
10061-02-6	trans-1,3-Dichloropropene	10	U	U
75-25-2	Bromoform	10	U	U
108-10-1	4-Methyl-2-pentanone	10	U	U
591-7[illegible]	2-Hexanone	10	U	U
127-1[illegible]	Tetrachloroethene	10	U	U
79-3[illegible]	1,1,2,2-Tetrachloroethane	10	U	U
108-88-3	Toluene	10	U	U
108-90-7	Chlorobenzene	10	U	U
100-41-4	Ethylbenzene	10	U	U
100-42-5	Styrene	10	U	U

FORM I VOA 3/90 Rev

3/18/96

3/19/96 AA

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Trip Blank
212439

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-10A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9650

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
1330-20-7	Xylene (total)	10	U	U

FORM I VOA-2 3/90 Rev

3/18/96

3/19/96 AA

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Trip Blank
212439

Lab Name: TCF-ST. LOUIS Contract: 434286

Lab Code: TCF Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-10A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9650

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 3

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

ASLC

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 1120214	UNDECANE	24.89	8	JN
2.	Unknown	26.08	6	J
3. 112403	DODECANE	27.39	10	JN
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

MW 3.1.96

FORM I VOA-TIC 3/90 Rev

3/18/96

3/14/96

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212363

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-14A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5314

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASL C
108-95-2	Phenol	20	U	
111-44-4	bis(2-Chloroethyl)Ether	20	U	U
95-57-8	2-Chlorophenol	20	U	
541-73-1	1,3-Dichlorobenzene	20	U	
106-46-7	1,4-Dichlorobenzene	20	U	
95-50-1	1,2-Dichlorobenzene	20	U	
95-48-7	2-Methylphenol	20	U	
108-60-1	bis(2-Chloroisopropyl)ether	20	U	
106-44-5	4-Methylphenol	20	U	
621-64-7	N-Nitroso-di-n-propylamine	20	U	
67-72-1	Hexachloroethane	20	U	
98-95-3	Nitrobenzene	20	U	
78-59-1	Isophorone	20	U	
88-75-5	2-Nitrophenol	20	U	
105-67-9	2,4-Dimethylphenol	20	U	
111-91-1	bis(2-Chloroethoxy)methane	20	U	
120-83-2	2,4-Dichlorophenol	20	U	
120-82-1	1,2,4-Trichlorobenzene	20	U	
91-20-3	Naphthalene	20	U	
106-47-8	4-Chloroaniline	20	U	
87-68-3	Hexachlorobutadiene	20	U	
59-50-7	4-Chloro-3-methylphenol	20	U	
91-57-6	2-Methylnaphthalene	20	U	
77-47-4	Hexachlorocyclopentadiene	20	U	
88-06-2	2,4,6-Trichlorophenol	20	U	
95-95-4	2,4,5-Trichlorophenol	50	U	
91-58-7	2-Chloronaphthalene	20	U	
88-74-4	2-Nitroaniline	50	U	
131-11-3	Dimethylphthalate	20	U	
208-96-8	Acenaphthylene	20	U	
606-20-2	2,6-Dinitrotoluene	20	U	
99-09-2	3-Nitroaniline	50	U	
83-32-9	Acenaphthene	20	U	U

3/27/96

3/21/96

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212363

Lab Name: TCL-ST. LOUIS Contract: 434286

Lab Code: TCF Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-14A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5314

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	AS2 C
51-28-5	2,4-Dinitrophenol	50	U	R
100-02-7	4-Nitrophenol	50	U	U
132-64-9	Dibenzofuran	20	U	
121-14-2	2,4-Dinitrotoluene	20	U	
84-66-2	Diethylphthalate	20	U	
7005-72-3	4-Chlorophenyl-phenyl ether	20	U	
86-73-7	Fluorene	20	U	
100-01-6	4-Nitroaniline	50	U	U
126-73-8	Tributylphosphate	6	J	J
534-52-1	4,6-Dinitro-2-methylphenol	50	U	U
86-30-6	N-Nitrosodiphenylamine	20	U	
101-55-3	4-Bromophenyl-phenylether	20	U	
118-74-1	Hexachlorobenzene	20	U	U
87-86-5	Pentachlorophenol	50	U	UJ
85-01-8	Phenanthrene	20	U	U
120-12-7	Anthracene	20	U	
86-74-8	Carbazole	20	U	
84-74-2	Di-n-butylphthalate	20	U	
206-44-0	Fluoranthene	20	U	
129-00-0	Pyrene	20	U	
85-68-7	Butylbenzylphthalate	20	U	
91-[illegible]	3,3'-Dichlorobenzidine	20	U	
56-[illegible]	Benzo(a)anthracene	20	U	
21[illegible]	Chrysene	20	U	U
11[illegible]	bis(2-Ethylhexyl)phthalate	5	J	20U
11[illegible]	Di-n-octylphthalate	20	U	UJ
205-[illegible]	Benzo(b)fluoranthene	20	U	
207-08-9	Benzo(k)fluoranthene	20	U	
50-32-8	Benzo(a)pyrene	20	U	
193-39-5	Indeno(1,2,3-cd)pyrene	20	U	
53-70-3	Dibenzo(a,h)anthracene	20	U	
191-24-2	Benzo(g,h,i)perylene	20	U	UJ

5/27/96 RA

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212363

Lab Name: TCT-ST.LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-14A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5314

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

Number TICs found: 19

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

ASL C

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	79016	Ethene, trichloro-	4.58	98	J N
2.	127184	Ethene, tetrachloro-	7.13	39	J N
3.		Unknown	8.74	18	J
4.		Unknown	19.16	19	J
5.		Unknown	19.72	37	J
6.		Unknown	20.26	26	J
7.		Unknown	21.94	34	J
8.		Unknown	22.55	250	J
9.		Unknown	22.61	27	J
10.		Unknown	22.96	53	J
11.		Unknown	23.07	510	J
12.		Unknown	23.22	970	J
13.		Unknown	23.49	180	J
14.		Unknown	23.56	280	J
15.		Unknown	23.73	1200	J
16.		Unknown	24.04	210	J
17.		Unknown	24.24	870	J
18.		Unknown	24.55	83	J
19.	2605676	Acetic acid, (triphenylphosp	30.97	15	J N
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

MW 3.11.96

3/27/96

3/21/96

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212373

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-23A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5313

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

ASL C

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
108-95-2	Phenol	20	U
111-44-4	bis(2-Chloroethyl)Ether	20	U
95-57-8	2-Chlorophenol	20	U
541-73-1	1,3-Dichlorobenzene	20	U
106-46-7	1,4-Dichlorobenzene	20	U
95-50-1	1,2-Dichlorobenzene	20	U
95-48-7	2-Methylphenol	20	U
108-60-1	bis(2-Chloroisopropyl)ether	20	U
106-44-5	4-Methylphenol	20	U
621-64-7	N-Nitroso-di-n-propylamine	20	U
67-72-1	Hexachloroethane	20	U
98-95-3	Nitrobenzene	20	U
78-59-1	Isophorone	20	U
88-75-5	2-Nitrophenol	20	U
105-67-9	2,4-Dimethylphenol	20	U
111-91-1	bis(2-Chloroethoxy)methane	20	U
120-83-2	2,4-Dichlorophenol	20	U
120-82-1	1,2,4-Trichlorobenzene	20	U
91-20-3	Naphthalene	20	U
106-47-8	4-Chloroaniline	20	U
87-68-3	Hexachlorobutadiene	20	U
59-50-7	4-Chloro-3-methylphenol	20	U
91-[illegible]	2-Methylnaphthalene	20	U
77-[illegible]	Hexachlorocyclopentadiene	20	U
88-[illegible]	2,4,6-Trichlorophenol	20	U
95-[illegible]	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	20	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethylphthalate	20	U
208-96-8	Acenaphthylene	20	U
606-20-2	2,6-Dinitrotoluene	20	U
99-09-2	3-Nitroaniline	50	U
83-32-9	Acenaphthene	20	U

3/27/96

3/21/96

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212373

Lab Name: ~~TCR~~ ST. LOUIS Contract: 434286

Lab Code: ~~TCR~~ Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-23A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5313

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASL C
51-28-5	2,4-Dinitrophenol	50	U	R
100-02-7	4-Nitrophenol	50	U	U
132-64-9	Dibenzofuran	20	U	
121-14-2	2,4-Dinitrotoluene	20	U	
84-66-2	Diethylphthalate	20	U	
7005-72-3	4-Chlorophenyl-phenyl ether	20	U	
86-73-7	Fluorene	20	U	
100-01-6	4-Nitroaniline	50	U	
126-73-8	Tributylphosphate	20	U	
534-52-1	4,6-Dinitro-2-methylphenol	50	U	
86-30-6	N-Nitrosodiphenylamine	20	U	
101-55-3	4-Bromophenyl-phenylether	20	U	
118-74-1	Hexachlorobenzene	20	U	U
87-86-5	Pentachlorophenol	50	U	UJ
85-01-8	Phenanthrene	20	U	U
120-12-7	Anthracene	20	U	
86-74-8	Carbazole	20	U	
84-74-2	Di-n-butylphthalate	20	U	
206-44-0	Fluoranthene	20	U	
129-00-0	Pyrene	20	U	
85-68-7	Butylbenzylphthalate	20	U	
91-94-1	3,3'-Dichlorobenzidine	20	U	
56-[illegible]	Benzo(a)anthracene	20	U	
21[illegible]	Chrysene	20	U	U
11[illegible]	bis(2-Ethylhexyl)phthalate	5	J	UJ
117-[illegible]	Di-n-octylphthalate	20	U	U
205-[illegible]	Benzo(b)fluoranthene	20	U	UJ
207-08-9	Benzo(k)fluoranthene	20	U	U
50-32-8	Benzo(a)pyrene	20	U	
193-39-5	Indeno(1,2,3-cd)pyrene	20	U	
53-70-3	Dibenzo(a,h)anthracene	20	U	
191-24-2	Benzo(g,h,i)perylene	20	U	U

FORM I SV-2 3/90 Rev

3/21/96

000120

3/21/96

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Blank
212373

Lab Name: TCF-ST.LOUIS Contract: 434286

Lab Code: TCF Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-23A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5313

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

ASL C

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I SV-TIC 3/90 Rev

3/21/96

3/21/96 RT

387

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212386

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-04A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5370

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/05/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

ASLC

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	
108-95-2	Phenol	20	U	U
111-44-4	bis(2-Chloroethyl)Ether	20	U	
95-57-8	2-Chlorophenol	20	U	
541-73-1	1,3-Dichlorobenzene	20	U	
106-46-7	1,4-Dichlorobenzene	20	U	
95-50-1	1,2-Dichlorobenzene	20	U	
95-48-7	2-Methylphenol	20	U	
108-60-1	bis(2-Chloroisopropyl)ether	20	U	
106-44-5	4-Methylphenol	20	U	
621-64-7	N-Nitroso-di-n-propylamine	20	U	
67-72-1	Hexachloroethane	20	U	
98-95-3	Nitrobenzene	20	U	
78-59-1	Isophorone	20	U	
88-75-5	2-Nitrophenol	20	U	
105-67-9	2,4-Dimethylphenol	20	U	
111-91-1	bis(2-Chloroethoxy)methane	20	U	
120-83-2	2,4-Dichlorophenol	20	U	
120-82-1	1,2,4-Trichlorobenzene	20	U	
91-20-3	Naphthalene	20	U	
106-47-8	4-Chloroaniline	20	U	
87-68-3	Hexachlorobutadiene	20	U	
59-50-7	4-Chloro-3-methylphenol	20	U	
91-57-6	2-Methylnaphthalene	20	U	
77-47-4	Hexachlorocyclopentadiene	20	U	
88-06-2	2,4,6-Trichlorophenol	20	U	
95-95-4	2,4,5-Trichlorophenol	50	U	
91-58-7	2-Chloronaphthalene	20	U	
88-74-4	2-Nitroaniline	50	U	
131-11-3	Dimethylphthalate	20	U	
208-96-8	Acenaphthylene	20	U	
606-20-2	2,6-Dinitrotoluene	20	U	U
99-09-2	3-Nitroaniline	50	U	UJ
83-32-9	Acenaphthene	20	U	U

FORM I SV-1 3/90 Rev

3/27/96

3/27/96

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212386

Lab Name: TCF-ST. LOUIS Contract: 434286

Lab Code: TCZ Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-04A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5370

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/05/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASL C
51-28-5	2,4-Dinitrophenol	50	U	U
100-02-7	4-Nitrophenol	50	U	
132-64-9	Dibenzofuran	20	U	
121-14-2	2,4-Dinitrotoluene	20	U	
84-66-2	Diethylphthalate	20	U	
7005-72-3	4-Chlorophenyl-phenyl ether	20	U	
86-73-7	Fluorene	20	U	
100-01-6	4-Nitroaniline	50	U	
126-73-8	Tributylphosphate	20	U	
534-52-1	4,6-Dinitro-2-methylphenol	50	U	
86-30-6	N-Nitrosodiphenylamine	20	U	
101-55-3	4-Bromophenyl-phenylether	20	U	
118-74-1	Hexachlorobenzene	20	U	
87-86-5	Pentachlorophenol	50	U	
85-01-8	Phenanthrene	20	U	
120-12-7	Anthracene	20	U	U
86-74-8	Carbazole	20	U	UJ
84-74-2	Di-n-butylphthalate	20	U	U
206-44-0	Fluoranthene	20	U	
129-00-0	Pyrene	20	U	
85-68-7	Butylbenzylphthalate	20	U	U
91-94-1	3,3'-Dichlorobenzidine	20	U	R
56-55-3	Benzo(a)anthracene	20	U	U
218-01-9	Chrysene	20	U	U
117-[illegible]-7	bis(2-Ethylhexyl)phthalate	5	J	20U
117-[illegible]	Di-n-octylphthalate	20	U	U
205-[illegible]	Benzo(b)fluoranthene	20	U	
207-[illegible]	Benzo(k)fluoranthene	20	U	
50-32-8	Benzo(a)pyrene	20	U	
193-39-5	Indeno(1,2,3-cd)pyrene	20	U	
53-70-3	Dibenzo(a,h)anthracene	20	U	
191-24-2	Benzo(g,h,i)perylene	20	U	U

3/27/96

3/21/96

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212386

Lab Name: TCT-ST.LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-04A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5370

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 Date Analyzed: 03/05/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

Number TICs found: 22

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

ASLC

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	75854	2-Butanol, 2-methyl-	4.74	17	JB N
2.	563804	3-Methyl-2-butanone	5.12	15	JB N
3.	1569502	3-Pentan-2-ol	5.70	17	J N
4.	79016	Ethene, trichloro-	6.13	85	J N
5.	127184	Ethene, tetrachloro-	8.78	35	J N
6.	25013165	Phenol, (1,1-dimethylethyl)-	20.80	45	J N
7.		Unknown	21.06	12	J
8.		Unknown	22.18	11	J
9.		Isomer of tetrachlorophenol	22.52	12	J
10.		Unknown	23.96	9	J
11.		Unknown	24.52	59	J
12.		Unknown	24.93	18	J
13.		Unknown	25.04	130	J
14.		Unknown	25.21	570	J
15.		Unknown	25.47	38	J
16.		Unknown	25.56	75	J
17.		Unknown	25.75	1200	J
18.		Unknown	26.02	47	J
19.		Unknown	26.12	15	J
20.		Unknown	26.24	680	J
21.		Unknown	26.54	19	J
22.		Phosphine oxide, triphenyl-	33.53	9	JB N
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

R
R
R
JN
R

AW 3-11-96

FORM I SV-TIC 3/90 Rev

3/27/96

3/27/96

387 213383

7A

VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Instrument ID: 59702E Calibration Date: 02/09/96 Time: 08:13

Lab File ID: >E9668 Init. Calib. Date(s): 02/07/96

Heated Purge: (Y/N) N Init. Calib. Times: 10:23 12:42

GC Column: DB624 ID: 0.53 (mm)

COMPOUND	RRF	RRF050	MIN RRF	%D	MAX %D
Chloromethane	.711	.868		22.2	
Bromomethane	1.144	1.343	.100	17.4	25.0
Vinyl chloride	.768	1.052	.100	36.9	25.0
Chloroethane	.514	.676		31.6	
Methylene Chloride	1.174	1.341		14.2	
Acetone	.240	.283		17.8	
Carbon Disulfide	2.790	3.457		23.9	
1,1-Dichloroethene	1.005	1.169	.100	16.3	25.0
1,1-Dichloroethane	1.947	2.332	.200	19.8	25.0
trans-1,2-Dichloroethene	1.142	1.362		19.2	
cis-1,2-Dichloroethene	1.241	1.426		14.9	
Chloroform	2.350	2.737	.200	16.5	25.0
1,2-Dichloroethane	1.278	1.496	.100	17.0	25.0
2-Butanone	.380	.426		12.3	
1,1,1-Trichloroethane	.662	.726	.100	9.6	25.0
Carbon Tetrachloride	.676	.740	.100	9.5	25.0
Vinyl Acetate	.482	.534		10.8	
Bromodichloromethane	.778	.770	.200	1.0	25.0
1,2-Dichloropropane	.366	.390		6.5	
cis-1,3-Dichloropropene	.647	.648	.200	.1	25.0
Trichloroethene	.493	.501	.300	1.6	25.0
Dibromochloromethane	1.214	1.171	.100	3.6	25.0
1,1,2-Trichloroethane	.503	.501	.100	.3	25.0
Benzene	.847	.970	.500	14.6	25.0
trans-1,3-Dichloropropene	.553	.601	.100	8.6	25.0
Bromoform	1.114	1.000	.100	10.2	25.0
4-Methyl-2-pentanone	.360	.369		2.6	
2-Hexanone	.230	.259		12.5	
Tetrachloroethene	.543	.526	.200	3.1	25.0
1,1,2,2-Tetrachloroethane	.816	.890	.500	9.1	25.0
Toluene	1.039	1.050	.400	1.1	25.0
Chlorobenzene	1.051	1.109	.500	5.5	25.0
Ethylbenzene	.405	.430	.100	6.2	25.0
Styrene	.866	.937	.300	8.3	25.0
Xylene (total)	.509	.548	.300	7.7	25.0

All other compounds must meet a minimum RRF of 0.010.

FORM VII VOA 3/90

3/18/96

3/19/96 AK

000125

157

7A-1
VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Instrument ID: 59702E Calibration Date: 02/09/96 Time: 08:13

Lab File ID: >E9668 Init. Calib. Date(s): 02/07/96

Heated Purge: (Y/N) N Init. Calib. Times: 10:23 12:42

GC Column: DB624 ID: 0.53 (mm)

Surrogate

COMPOUND	RRF	RRF050	MIN RRF	%D	MAX %D
Toluene-d8	.971	.869		10.5	
4-Bromofluorobenzene	.698	.620	.200	11.2	25.0
1,2-Dichloroethane-d4	1.051	1.125		7.0	

All other compounds must meet a minimum RRF of 0.010.

FORM VII VOA-2 3/90

3/6/96

3/14/96

387

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Trip Blank
212439

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-10A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9650

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
74-87-3	Chloromethane	10	U	U
74-83-9	Bromomethane	10	U	U
75-01-4	Vinyl chloride	10	U	U
75-00-3	Chloroethane	10	U	U
75-09-2	Methylene Chloride	2	BJ	U
67-64-1	Acetone	60	B	U
75-15-0	Carbon Disulfide	10	U	U
75-35-4	1,1-Dichloroethene	10	U	U
75-34-3	1,1-Dichloroethane	10	U	U
156-60-5	trans-1,2-Dichloroethene	10	U	U
156-59-2	cis-1,2-Dichloroethene	10	U	U
67-66-3	Chloroform	10	U	U
107-06-2	1,2-Dichloroethane	10	U	U
78-93-3	2-Butanone	6	J	U
71-55-6	1,1,1-Trichloroethane	10	U	U
56-23-5	Carbon Tetrachloride	10	U	U
108-05-4	Vinyl Acetate	10	U	U
75-27-4	Bromodichloromethane	10	U	U
78-87-5	1,2-Dichloropropane	10	U	U
10061-01-5	cis-1,3-Dichloropropene	10	U	U
79-01-6	Trichloroethene	10	U	U
124-48-1	Dibromochloromethane	10	U	U
79-00-5	1,1,2-Trichloroethane	10	U	U
71-43-2	Benzene	10	U	U
10061-02-6	trans-1,3-Dichloropropene	10	U	U
75-25-2	Bromoform	10	U	U
108-10-1	4-Methyl-2-pentanone	10	U	U
591-78-6	2-Hexanone	10	U	U
127-18-4	Tetrachloroethene	10	U	U
79-34-5	1,1,2,2-Tetrachloroethane	10	U	U
108-88-3	Toluene	10	U	U
108-90-7	Chlorobenzene	10	U	U
100-41-4	Ethylbenzene	10	U	U
100-42-5	Styrene	10	U	U

FORM I VOA 3/90 Rev

3/14/96

3/14/96 AA

105

387

1A-2

VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

Trip Blank

212439

Lab Name: TCR-ST. LOUIS Contract: 434286

Lab Code: TCR Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-10A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9650

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
[illegible]-7	Xylene (total)	10	U	U

FORM I VOA-2 3/90 Rev

3/18/96

000128

3/18/96 MA

387

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Trip Blank
212439

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-10A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9650

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 3 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L

ASLC

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 1120214	UNDECANE	24.89	8	JN
2.	Unknown	26.08	6	J
3. 112403	DODECANE	27.39	10	JN
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

JN
JN
JN

MW 3.1.96

FORM I VOA-TIC 3/90 Rev

3/15/96

3/14/96

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

387
EPA SAMPLE NO.
Field Blank
212370

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-20A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9654

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
74-87-3	Chloromethane	10	U	U
74-83-9	Bromomethane	10	U	U
75-01-4	Vinyl chloride	10	U	U
75-00-3	Chloroethane	10	U	U
75-09-2	Methylene Chloride	2	BJ	10U
67-64-1	Acetone	32	B	U
75-15-0	Carbon Disulfide	10	U	U
75-35-4	1,1-Dichloroethene	10	U	U
75-34-3	1,1-Dichloroethane	10	U	U
156-60-5	trans-1,2-Dichloroethene	10	U	U
156-59-2	cis-1,2-Dichloroethene	10	U	U
67-66-3	Chloroform	10	U	U
107-06-2	1,2-Dichloroethane	10	U	U
78-93-3	2-Butanone	10		U
71-55-6	1,1,1-Trichloroethane	1	J	5U
56-23-5	Carbon Tetrachloride	10	U	U
108-05-4	Vinyl Acetate	10	U	U
75-27-4	Bromodichloromethane	10	U	U
78-87-5	1,2-Dichloropropane	10	U	U
10061-01-5	cis-1,3-Dichloropropene	10	U	U
79-01-6	Trichloroethene	10	U	U
124-48-1	Dibromochloromethane	10	U	U
79-00-5	1,1,2-Trichloroethane	10	U	U
71-43-2	Benzene	10	U	U
10061-02-6	trans-1,3-Dichloropropene	10	U	U
75-25-2	Bromoform	10	U	U
108-10-1	4-Methyl-2-pentanone	10	U	U
591-78-6	2-Hexanone	10	U	U
127-18-4	Tetrachloroethene	10	U	U
79-34-5	1,1,2,2-Tetrachloroethane	10	U	U
108-88-3	Toluene	10	U	U
108-90-7	Chlorobenzene	10	U	U
100-41-4	Ethylbenzene	10	U	U
100-42-5	Styrene	10	U	U

FORM I VOA 3/90 Rev

3/16/96

3/14/96 KA

000130

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212370

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-20A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9654

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
1330-20-7	Xylene (total)	10	U	U

FORM I VOA-2 3/90 Rev

3/15/96

3/14/96 AA

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Blank
212370

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-20A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9654

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 0 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L

ASLC

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I VOA-TIC 3/90 Rev

3/18/96

3/14/96 AT

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

VBLK3682

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: MSA3682

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9648

Level: (low/med) LOW Date Received:

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	3	BJ
67-64-1	Acetone	13	B
75-15-0	Carbon Disulfide	10	U
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
156-60-5	trans-1,2-Dichloroethene	10	U
156-59-2	cis-1,2-Dichloroethene	10	U
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
108-05-4	Vinyl Acetate	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	10	U
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	10	U
108-10-1	4-Methyl-2-pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	10	U
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-88-3	Toluene	10	U
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U

FORM I VOA 3/90 Rev

3/14/96

3/14/96

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

VBLK3682

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: MSA3682

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9648

Level: (low/med) LOW Date Received:

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
1330-20-7	Xylene (total)	10	U

FORM I VOA-2 3/90 Rev

3/14/96

000134

3/14/96 AA

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

387
EPA SAMPLE NO.

VBLK3682

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: MSA3682

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9648

Level: (low/med) LOW Date Received:

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 2

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	22.04	140	JB
2.	Unknown	29.14	8	JB
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I VOA-TIC 3/90 Rev

3/18/96

000135

3/19/96 KK

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

VBLK3683

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: MSA3683

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9657

Level: (low/med) LOW Date Received:

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	2	BJ
67-64-1	Acetone	6	BJ
75-15-0	Carbon Disulfide	10	U
75-35-4	1,1-Dichloroethene	10	U
75-34-3	1,1-Dichloroethane	10	U
156-60-5	trans-1,2-Dichloroethene	10	U
156-59-2	cis-1,2-Dichloroethene	10	U
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
108-05-4	Vinyl Acetate	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	10	U
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	10	U
108-10-1	4-Methyl-2-pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	10	U
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-88-3	Toluene	10	U
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U

FORM I VOA 3/90 Rev

3/18/96

3/14/96

000136

100

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

VBLK3683

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: MSA3683

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9657

Level: (low/med) LOW Date Received:

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
1330-20-7	Xylene (total)	10	U

FORM I VOA-2 3/90 Rev

3/14/96

000137

3/14/96 AB

1k

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

VBLK3683

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: MSA3683

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9657

Level: (low/med) LOW Date Received:

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I VOA-TIC 3/90 Rev

3/18/96

3/14/96

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212360

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-11A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9651

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q ASL	C
74-87-3	Chloromethane	10	U	
74-83-9	Bromomethane	10	U	
75-01-4	Vinyl chloride	10	U	
75-00-3	Chloroethane	10	U	
75-09-2	Methylene Chloride	3	BJ	04
67-64-1	Acetone	10	U	
75-15-0	Carbon Disulfide	10	U	
75-35-4	1,1-Dichloroethene	7	J	
75-34-3	1,1-Dichloroethane	2	J	
156-60-5	trans-1,2-Dichloroethene	10	U	
156-59-2	cis-1,2-Dichloroethene	5	J	
67-66-3	Chloroform	10	U	
107-06-2	1,2-Dichloroethane	2	J	
78-93-3	2-Butanone	10	U	
71-55-6	1,1,1-Trichloroethane	7	J	
56-23-5	Carbon Tetrachloride	10	U	
108-05-4	Vinyl Acetate	10	U	
75-27-4	Bromodichloromethane	10	U	
78-87-5	1,2-Dichloropropane	10	U	
10061-01-5	cis-1,3-Dichloropropene	10	U	
79-01-6	Trichloroethene	650	E	J 3/2
124-48-1	Dibromochloromethane	10	U	
79-00-5	1,1,2-Trichloroethane	10	U	
71-43-2	Benzene	10	U	
10061-02-6	trans-1,3-Dichloropropene	10	U	
75-25-2	Bromoform	10	U	
108-[illegible]	4-Methyl-2-pentanone	10	U	
591-[illegible]	2-Hexanone	10	U	
127-[illegible]	Tetrachloroethene	90		
79-[illegible]	1,1,2,2-Tetrachloroethane	10	U	
108-[illegible]	Toluene	10	U	
108-90-7	Chlorobenzene	10	U	
100-41-4	Ethylbenzene	10	U	
100-42-5	Styrene	10	U	

FORM I VOA 3/90 Rev

3/14/96 KM

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
~~Field Duplicate~~
212360

Lab Name: ~~TCT~~-ST. LOUIS Contract: 434286

Lab Code: ~~TCT~~ Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-11A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9651

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
1330-20-7	Xylene (total)	10	U	U

FORM I VOA-2 3/90 Rev

3/18/96

3/14/96

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212360

Lab Name: TCT-ST. LOUIS Contract: 436286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-11A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9651

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 1 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L

ASL C.

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	COLUMN BLEED	21.93	13	J
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

R

FORM I VOA-TIC 3/90 Rev

3/16/96

000141

3/14/96 AA 1S

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212360 DL

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-11A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9659

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 5

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASL C.
74-87-3	Chloromethane	50	U	N
74-83-9	Bromomethane	50	U	
75-01-4	Vinyl chloride	50	U	
75-00-3	Chloroethane	50	U	
75-09-2	Methylene Chloride	50	U	
67-64-1	Acetone	43	BJ	
75-15-0	Carbon Disulfide	50	U	
75-35-4	1,1-Dichloroethene	50	U	
75-34-3	1,1-Dichloroethane	50	U	
156-60-5	trans-1,2-Dichloroethene	50	U	
156-59-2	cis-1,2-Dichloroethene	50	U	
67-66-3	Chloroform	50	U	
107-06-2	1,2-Dichloroethane	50	U	
78-93-3	2-Butanone	50	U	
71-55-6	1,1,1-Trichloroethane	50	U	
56-23-5	Carbon Tetrachloride	50	U	
108-05-4	Vinyl Acetate	50	U	
75-27-4	Bromodichloromethane	50	U	
78-87-5	1,2-Dichloropropane	50	U	
10061-01-5	cis-1,3-Dichloropropene	50	U	N
79-01-6	Trichloroethene	510		N 3/24/96
124-48-1	Dibromochloromethane	50	U	N
79-00-5	1,1,2-Trichloroethane	50	U	N
71-43-2	Benzene	50	U	
10061-02-6	trans-1,3-Dichloropropene	50	U	
75-2[illegible]-2	Bromoform	50	U	
108-[illegible]	4-Methyl-2-pentanone	50	U	
591-[illegible]	2-Hexanone	50	U	
127-[illegible]	Tetrachloroethene	66		
79-3[illegible]	1,1,2,2-Tetrachloroethane	50	U	
108-88-3	Toluene	50	U	
108-90-7	Chlorobenzene	50	U	
100-41-4	Ethylbenzene	50	U	
100-42-5	Styrene	50	U	N

FORM I VOA 3/90 Rev

3/14/96

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
~~Field Duplicate~~
212360 DL

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-11A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9659

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 5

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
1330-20-7	Xylene (total)	50	U

ASLC

FORM I VOA-2 3/90 Rev

3/16/96

000143

3/14/96 AA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212370

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-20A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9654

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
74-87-3	Chloromethane	10	U	U
74-83-9	Bromomethane	10	U	U
75-01-4	Vinyl chloride	10	U	U
75-00-3	Chloroethane	10	U	U
75-09-2	Methylene Chloride	2	BJ	10 U
67-64-1	Acetone	32	B	U
75-15-0	Carbon Disulfide	10	U	U
75-35-4	1,1-Dichloroethene	10	U	U
75-34-3	1,1-Dichloroethane	10	U	U
156-60-5	trans-1,2-Dichloroethene	10	U	U
156-59-2	cis-1,2-Dichloroethene	10	U	U
67-66-3	Chloroform	10	U	U
107-06-2	1,2-Dichloroethane	10	U	U
78-93-3	2-Butanone	10		U
71-55-6	1,1,1-Trichloroethane	1	J	5
56-23-5	Carbon Tetrachloride	10	U	U
108-05-4	Vinyl Acetate	10	U	
75-27-4	Bromodichloromethane	10	U	
78-87-5	1,2-Dichloropropane	10	U	
10061-01-5	cis-1,3-Dichloropropene	10	U	
79-01-6	Trichloroethene	10	U	
124-48-1	Dibromochloromethane	10	U	
79-00-5	1,1,2-Trichloroethane	10	U	
71-43-2	Benzene	10	U	
10061-02-6	trans-1,3-Dichloropropene	10	U	
75-25-2	Bromoform	10	U	
108-10-1	4-Methyl-2-pentanone	10	U	
591-[illegible]	2-Hexanone	10	U	
127-[illegible]	Tetrachloroethene	10	U	
79-[illegible]	1,1,2,2-Tetrachloroethane	10	U	
108-88-3	Toluene	10	U	
108-90-7	Chlorobenzene	10	U	
100-41-4	Ethylbenzene	10	U	
100-42-5	Styrene	10	U	

FORM I VOA 3/90 Rev

3/18/96

3/14/96 KA

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212370

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-20A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9654

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
1330-20-7	Xylene (total)	10	U	U

FORM I VOA-2 3/90 Rev

3/18/96

3/14/96 AA

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Blank
212370

Lab Name: ~~TCT~~-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-20A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9654

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/07/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 0 CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L

ASLC

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I VOA-TIC 3/90 Rev

DGB 3/16/96

000146

3/14/96 AT

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212383

Lab Name: TCI-ST. LOUIS Contract: 434286

Lab Code: TCI Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9681

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/09/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
74-87-3	Chloromethane	10	U	
74-83-9	Bromomethane	10	U	
75-01-4	Vinyl chloride	10	U	
75-00-3	Chloroethane	10	U	
75-09-2	Methylene Chloride	3	J	
67-64-1	Acetone	12		
75-15-0	Carbon Disulfide	10	U	
75-35-4	1,1-Dichloroethene	5	J	
75-34-3	1,1-Dichloroethane	1	J	
156-60-5	trans-1,2-Dichloroethene	10	U	
156-59-2	cis-1,2-Dichloroethene	3	J	
67-66-3	Chloroform	10	U	
107-06-2	1,2-Dichloroethane	2	J	
78-93-3	2-Butanone	10	U	
71-55-6	1,1,1-Trichloroethane	7	J	
56-23-5	Carbon Tetrachloride	10	U	
108-05-4	Vinyl Acetate	10	U	
75-27-4	Bromodichloromethane	10	U	
78-87-5	1,2-Dichloropropane	10	U	
10061-01-5	cis-1,3-Dichloropropene	10	U	
79-01-6	Trichloroethene	550	E	J
124-48-1	Dibromochloromethane	10	U	
79-00-5	1,1,2-Trichloroethane	10	U	
71-43-2	Benzene	10	U	
10061-02-6	trans-1,3-Dichloropropene	10	U	
75-25-2	Bromoform	10	U	
108-[illegible]	4-Methyl-2-pentanone	10	U	
591-[illegible]	2-Hexanone	10	U	
127-[illegible]	Tetrachloroethene	75		
79-[illegible]	1,1,2,2-Tetrachloroethane	2	J	
108-[illegible]	Toluene	10	U	
108-90-7	Chlorobenzene	10	U	
100-41-4	Ethylbenzene	10	U	
100-42-5	Styrene	10	U	

FORM I VOA 3/90 Rev

3/18/96

8/14/96 KA

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212383

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9681

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/09/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
1330-20-7	Xylene (total)	10	U	U

FORM I VOA-2 3/90 Rev

3/18/96

3/14/96

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212383

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9681

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/09/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 1

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

ASLC

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I VOA-TIC 3/90 Rev

000149

3/16/96
3/14/96
KA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212383 DL

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9658

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 5

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASL C
74-87-3	Chloromethane	50	U	N
74-83-9	Bromomethane	50	U	
75-01-4	Vinyl chloride	50	U	
75-00-3	Chloroethane	50	U	
75-09-2	Methylene Chloride	8	BJ	
67-64-1	Acetone	50	U	
75-15-0	Carbon Disulfide	50	U	
75-35-4	1,1-Dichloroethene	5	J	
75-34-3	1,1-Dichloroethane	50	U	
156-60-5	trans-1,2-Dichloroethene	50	U	
156-59-2	cis-1,2-Dichloroethene	50	U	
67-66-3	Chloroform	50	U	
107-06-2	1,2-Dichloroethane	50	U	
78-93-3	2-Butanone	50	U	
71-55-6	1,1,1-Trichloroethane	5	J	
56-23-5	Carbon Tetrachloride	50	U	
108-05-4	Vinyl Acetate	50	U	
75-27-4	Bromodichloromethane	50	U	
78-87-5	1,2-Dichloropropane	50	U	
10061-01-5	cis-1,3-Dichloropropene	50	U	N
79-01-6	Trichloroethene	530		N 2/20/96 A
124-48-1	Dibromochloromethane	50	U	N
79-00-5	1,1,2-Trichloroethane	50	U	
71-43-2	Benzene	50	U	
10061-02-6	trans-1,3-Dichloropropene	50	U	
75-[illegible]	Bromoform	50	U	
106-[illegible]	4-Methyl-2-pentanone	50	U	
591-[illegible]	2-Hexanone	50	U	
127-[illegible]	Tetrachloroethene	72		
79-34-[illegible]	1,1,2,2-Tetrachloroethane	50	U	
108-88-3	Toluene	50	U	
108-90-7	Chlorobenzene	50	U	
100-41-4	Ethylbenzene	50	U	
100-42-5	Styrene	50	U	N

FORM I VOA 3/90 Rev

3/14/96 MR

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212383 DL

Lab Name: ~~TCF~~ ST. LOUIS Contract: 434286

Lab Code: ~~TCF~~ Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9658

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 5

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASL C
1330-20-7	Xylene (total)	50	U	Z

FORM I VOA-2 3/90 Rev

3/15/96

3/14/96
RA

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212383 DL

Lab Name: ~~TCE~~-ST. LOUIS Contract: 434286

Lab Code: ~~TCE~~ Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-01A

Sample wt/vol: 5 (g/ml) ML Lab File ID: >E9658

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: not dec. Date Analyzed: 02/08/96

GC Column: DB624 ID: 0.53 (mm) Dilution Factor: 5

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 2

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

ASL C

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	COLUMN BLEED	16.91	74	J
2.	COLUMN BLEED	21.97	190	J
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I VOA-TIC 3/90 Rev

3/14/96

000152

3/14/96

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212386

Lab Name: TCR-ST. LOUIS Contract: 434286

Lab Code: TCR Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-04A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5370

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/05/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

ASLC

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	
108-95-2	Phenol	20	U	U
111-44-4	bis(2-Chloroethyl)Ether	20	U	
95-57-8	2-Chlorophenol	20	U	
541-73-1	1,3-Dichlorobenzene	20	U	
106-46-7	1,4-Dichlorobenzene	20	U	
95-50-1	1,2-Dichlorobenzene	20	U	
95-48-7	2-Methylphenol	20	U	
108-60-1	bis(2-Chloroisopropyl)ether	20	U	
106-44-5	4-Methylphenol	20	U	
621-64-7	N-Nitroso-di-n-propylamine	20	U	
67-72-1	Hexachloroethane	20	U	
98-95-3	Nitrobenzene	20	U	
78-59-1	Isophorone	20	U	
88-75-5	2-Nitrophenol	20	U	
105-67-9	2,4-Dimethylphenol	20	U	
111-91-1	bis(2-Chloroethoxy)methane	20	U	
120-83-2	2,4-Dichlorophenol	20	U	
120-82-1	1,2,4-Trichlorobenzene	20	U	
91-20-3	Naphthalene	20	U	
106-47-8	4-Chloroaniline	20	U	
87-68-3	Hexachlorobutadiene	20	U	
59-50-7	4-Chloro-3-methylphenol	20	U	
91-57-6	2-Methylnaphthalene	20	U	
77[illegible]	Hexachlorocyclopentadiene	20	U	
[illegible]	2,4,6-Trichlorophenol	20	U	
[illegible]	2,4,5-Trichlorophenol	50	U	
[illegible]	2-Chloronaphthalene	20	U	
[illegible]	2-Nitroaniline	50	U	
131-[illegible]	Dimethylphthalate	20	U	
208-96-8	Acenaphthylene	20	U	
606-20-2	2,6-Dinitrotoluene	20	U	U
99-09-2	3-Nitroaniline	50	U	U J
83-32-9	Acenaphthene	20	U	U

3/27/96

3/21/96

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212386

Lab Name: ~~TCR~~-ST. LOUIS Contract: 434286

Lab Code: TCR Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-04A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5370

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/05/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

ASL C

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	
51-28-5	2,4-Dinitrophenol	50	U	U
100-02-7	4-Nitrophenol	50	U	
132-64-9	Dibenzofuran	20	U	
121-14-2	2,4-Dinitrotoluene	20	U	
84-66-2	Diethylphthalate	20	U	
7005-72-3	4-Chlorophenyl-phenyl ether	20	U	
86-73-7	Fluorene	20	U	
100-01-6	4-Nitroaniline	50	U	
126-73-8	Tributylphosphate	20	U	
534-52-1	4,6-Dinitro-2-methylphenol	50	U	
86-30-6	N-Nitrosodiphenylamine	20	U	
101-55-3	4-Bromophenyl-phenylether	20	U	
118-74-1	Hexachlorobenzene	20	U	
87-86-5	Pentachlorophenol	50	U	
85-01-8	Phenanthrene	20	U	
120-12-7	Anthracene	20	U	U
86-74-8	Carbazole	20	U	UJ
84-74-2	Di-n-butylphthalate	20	U	U
206-44-0	Fluoranthene	20	U	
129-00-0	Pyrene	20	U	
85-68-7	Butylbenzylphthalate	20	U	U
91-94-1	3,3'-Dichlorobenzidine	20	U	U
56-[illegible]	Benzo(a)anthracene	20	U	U
21[illegible]	Chrysene	20	U	U
1[illegible]	bis(2-Ethylhexyl)phthalate	5	J	20U
1[illegible]	Di-n-octylphthalate	20	U	U
2[illegible]	Benzo(b)fluoranthene	20	U	
20[illegible]	Benzo(k)fluoranthene	20	U	
50-[illegible]	Benzo(a)pyrene	20	U	
193-39-5	Indeno(1,2,3-cd)pyrene	20	U	
53-70-3	Dibenzo(a,h)anthracene	20	U	
191-24-2	Benzo(g,h,i)perylene	20	U	U

FORM I SV-2 3/90 Rev

3/27/96

3/21/96

387 212373
212363

6B

SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: TCT-ST.LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Instrument ID: 59701D Calibration Date(s): 02/29/96 03/01/96

Calibration Times: 22:36 02:24

LAB FILE ID: RRF020= >D5304 RRF050= >D5303
RRF080= >D5305 RRF120= >D5306 RRF160= >D5307

COMPOUND		RRF020	RRF050	RRF080	RRF120	RRF160	$\overline{RRF}$	RSD
Phenol	*	1.422	1.305	1.313	1.245	1.158	1.288	7.5*
bis(2-Chloroethyl)Ether	*	1.380	1.197	1.222	1.171	1.104	1.215	8.4*
2-Chlorophenol	*	1.352	1.254	1.210	1.141	1.004	1.192	10.9*
1,3-Dichlorobenzene	*	1.621	1.471	1.393	1.286	1.152	1.385	12.9*
1,4-Dichlorobenzene	*	1.651	1.493	1.421	1.292	1.136	1.399	14.0*
1,2-Dichlorobenzene	*	1.545	1.386	1.291	1.148	1.018	1.278	16.0*
2-Methylphenol	*	1.081	.975	.979	.923	.868	.965	8.2*
bis(2-Chloroisopropyl)ether		1.398	1.277	1.430	1.433	1.431	1.394	4.8
4-Methylphenol	*	1.116	1.013	.990	.939	.811	.974	11.5*
N-Nitroso-di-n-propylamine	*	.988	.920	.904	.891	.866	.914	5.0*
Hexachloroethane	*	.694	.653	.603	.564	.507	.604	12.1*
Nitrobenzene	*	.437	.410	.404	.374	.349	.395	8.6*
Isophorone	*	.817	.777	.758	.737	.724	.763	4.8*
2-Nitrophenol	*	.276	.234	.233	.222	.211	.235	10.5*
2,4-Dimethylphenol	*	.397	.375	.361	.337	.321	.358	8.4*
bis(2-Chloroethoxy)methane	*	.519	.470	.472	.447	.417	.465	8.0*
2,4-Dichlorophenol	*	.385	.377	.360	.343	.313	.356	8.1*
1,2,4-Trichlorobenzene	*	.465	.440	.413	.373	.339	.406	12.5*
Naphthalene	*	1.179	1.060	1.001	.895	.814	.990	14.3*
4-Chloroaniline		.241	.300	.368	.376	.364	.330	17.6
Hexachlorobutadiene		.266	.262	.237	.215	.199	.236	12.4
4-Chloro-3-methylphenol	*	.376	.363	.351	.316	.302	.342	9.3*
2-Methylnaphthalene	*	.767	.688	.655	.580	.533	.645	14.2*
Hexachlorocyclopentadiene		.187	.288	.300	.307	.286	.274	17.9
2,4,6-Trichlorophenol	*	.410	.452	.433	.424	.412	.426	4.0*
2,4,5-Trichlorophenol	*	.415	.484	.449	.443	.400	.438	7.4*
2-Chloronaphthalene	*	1.291	1.224	1.136	1.055	.978	1.137	11.1*
2-Nitroaniline		.398	.392	.389	.412	.406	.400	2.3
Dimethylphthalate		1.630	1.553	1.471	1.371	1.236	1.453	10.6
Acenaphthylene	*	2.047	1.837	1.686	1.515	1.422	1.701	14.7*
2,6-Dinitrotoluene	*	.387	.387	.383	.372	.343	.374	5.0*
3-Nitroaniline		.452	.440	.460	.470	.457	.456	2.4
Acenaphthene	*	1.245	1.146	1.065	.940	.863	1.052	14.6*
2,4-Dinitrophenol		.022	.085	.116	.139	.157	.104	51.1
4-Nitrophenol		.058	.115	.112	.132	.134	.110	28.0
Dibenzofuran	*	1.830	1.721	1.628	1.469	1.349	1.599	12.0*

* Compounds with required minimum RRF and maximum %RSD values.
All other compounds must meet a minimum RRF of 0.010.

FORM VI SV-1

3/27/96

000155

3/27/96

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212386

Lab Name: TCT-ST.LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 02005-04A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5370

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 Date Analyzed: 03/05/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

Number TICs found: 22

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

ASLC

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	75854	2-Butanol, 2-methyl-	4.74	17	JBN
2.	563804	3-Methyl-2-butanone	5.12	15	JBN
3.	1569502	3-Pentan-2-ol	5.70	17	J N
4.	79016	Ethene, trichloro-	6.13	85	J N
5.	127184	Ethene, tetrachloro-	8.78	35	J N
6.	25013165	Phenol, (1,1-dimethylethyl)-	20.80	45	J N
7.		Unknown	21.06	12	J
8.		Unknown	22.18	11	J
9.		Isomer of tetrachlorophenol	22.52	12	J
10.		Unknown	23.96	9	J
11.		Unknown	24.52	59	J
12.		Unknown	24.93	18	J
13.		Unknown	25.04	130	J
14.		Unknown	25.21	570	J
15.		Unknown	25.47	38	J
16.		Unknown	25.56	75	J
17.		Unknown	25.75	1200	J
18.		Unknown	26.02	47	J
19.		Unknown	26.12	15	J
20.		Unknown	26.24	680	J
21.		Unknown	26.54	19	J
22.		Phosphine oxide, triphenyl-	33.53	9	JBN
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

RR 3/11/96

DF

AW 3-11-96

3/27/96

3/27/96

387

212373
212363

7C

SEMIVOLATILE CONTINUING CALIBRATION CHECK

Lab Name: TCT-ST.LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Instrument ID: 59701D Calibration Date: 03/01/96 Time: 10:38

Lab File ID: >D5312 Init. Calib. Date(s): 02/29/96 03/01/96

Init. Calib. Times: 22:36 02:24

COMPOUND	RRF	RRF050	MIN RRF	%D	MAX %D
Diethylphthalate	1.433	1.522		6.2	
4-Chlorophenyl-phenyl ether	.631	.697	.400	10.5	25.0
Fluorene	1.160	1.292	.900	11.4	25.0
4-Nitroaniline	.156	.132		15.4	
Tributylphosphate	4.160	4.441		6.8	
4,6-Dinitro-2-methylphenol	.111	.116		4.5	
N-Nitrosodiphenylamine	.479	.475		.9	
4-Bromophenyl-phenylether	.234	.236	.100	1.1	25.0
Hexachlorobenzene	.280	.276	.100	1.5	25.0
* Pentachlorophenol	.102	.075	.050	26.0	25.0
Phenanthrene	1.028	1.030	.700	.2	25.0
Anthracene	.957	.990	.700	3.5	25.0
Carbazole	.537	.555		3.3	
Di-n-butylphthalate	1.434	1.452		1.3	
Fluoranthene	1.083	1.076	.600	.7	25.0
Pyrene	1.954	1.922	.600	1.6	25.0
Butylbenzylphthalate	1.130	1.124		.6	
3,3'-Dichlorobenzidine	.138	.143		3.4	
Benzo(a)anthracene	1.357	1.352	.800	.4	25.0
Chrysene	1.209	1.395	.700	15.3	25.0
bis(2-Ethylhexyl)phthalate	1.393	1.382		.8	
Di-n-octylphthalate	3.034	2.362		22.2	
* Benzo(b)fluoranthene	1.664	1.199	.700	28.0	25.0
Benzo(k)fluoranthene	1.226	1.146	.700	6.6	25.0
Benzo(a)pyrene	1.167	1.123	.700	3.7	25.0
Indeno(1,2,3-cd)pyrene	.844	.746	.500	11.6	25.0
Dibenzo(a,h)anthracene	.610	.656	.400	7.5	25.0
Benzo(g,h,i)perylene	.766	.606	.500	20.9	25.0
Nitrobenzene-d5	.409	.375	.200	8.3	25.0
2-Fluorobiphenyl	1.242	1.348	.700	8.5	25.0
Terphenyl-d14	1.168	1.046	.500	10.4	25.0
Phenol-d5	1.323	1.403	.800	6.0	25.0
2-Fluorophenol	1.102	1.166	.600	5.8	25.0
2,4,6-Tribromophenol	.188	.198		5.0	
2-Chlorophenol-d4	1.263	1.356	.800	7.3	25.0
1,2-Dichlorobenzene-d4	.890	.962	.400	8.1	25.0

All other compounds must meet a minimum RRF of 0.010.

FORM VII SV-2 3/90

DJB 3/27/96

000157

3/27/96 AM

387

212356

6B

SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: TCT-ST.LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Instrument ID: 59701D Calibration Date(s): 03/04/96

Calibration Times: 14:09 20:17

LAB FILE ID: RRF020= >D5354 RRF050= >D5349
RRF080= >D5351 RRF120= >D5352 RRF160= >D5353

COMPOUND		RRF020	RRF050	RRF080	RRF120	RRF160	$\overline{RRF}$	RSD
Phenol	*	1.717	1.633	1.730	1.764	1.756	1.720	3.0*
bis(2-Chloroethyl)Ether	*	1.537	1.357	1.421	1.417	1.314	1.409	6.0*
2-Chlorophenol	*	1.334	1.358	1.414	1.400	1.387	1.379	2.4*
1,3-Dichlorobenzene	*	1.529	1.587	1.590	1.527	1.487	1.544	2.8*
1,4-Dichlorobenzene	*	1.581	1.647	1.633	1.600	1.565	1.605	2.1*
1,2-Dichlorobenzene	*	1.485	1.524	1.505	1.436	1.347	1.460	4.9*
2-Methylphenol	*	1.189	1.193	1.197	1.157	1.110	1.169	3.1*
bis(2-Chloroisopropyl)ether		1.962	1.891	1.943	1.896	2.231	1.985	7.1
4-Methylphenol	*	1.190	1.237	1.287	1.286	1.269	1.254	3.3*
N-Nitroso-di-n-propylamine	*	1.079	1.042	1.083	1.087	1.067	1.072	1.7*
Hexachloroethane	*	.669	.675	.673	.673	.652	.668	1.4*
Nitrobenzene	*	.468	.440	.467	.463	.450	.457	2.7*
Isophorone	*	.849	.844	.853	.850	.839	.847	.7*
2-Nitrophenol	*	.279	.244	.241	.251	.245	.252	6.2*
2,4-Dimethylphenol	*	.385	.389	.384	.399	.388	.389	1.5*
bis(2-Chloroethoxy)methane	*	.533	.526	.538	.547	.558	.540	2.3*
2,4-Dichlorophenol	*	.355	.374	.367	.373	.376	.369	2.3*
1,2,4-Trichlorobenzene	*	.428	.452	.440	.440	.436	.439	2.0*
Naphthalene	*	1.197	1.173	1.214	1.221	1.188	1.199	1.6*
4-Chloroaniline		.443	.514	.564	.590	.590	.540	11.6
Hexachlorobutadiene		.294	.310	.304	.302	.291	.300	2.5
4-Chloro-3-methylphenol	*	.347	.361	.367	.371	.358	.361	2.5*
2-Methylnaphthalene	*	.729	.765	.762	.758	.750	.753	1.9*
Hexachlorocyclopentadiene		.463	.486	.523	.530	.494	.499	5.5
2,4,6-Trichlorophenol	*	.466	.497	.515	.549	.558	.517	7.3*
2,4,5-Trichlorophenol	*	.505	.517	.531	.482	.480	.503	4.4*
2-Chloronaphthalene	*	1.268	1.248	1.268	1.276	1.256	1.263	.9*
2-Nitroaniline		.415	.388	.440	.446	.439	.426	5.7
Dimethylphthalate		1.546	1.509	1.584	1.552	1.543	1.547	1.7
Acenaphthylene	*	1.900	1.818	1.729	1.829	1.869	1.829	3.5*
2,6-Dinitrotoluene	*	.348	.364	.383	.354	.349	.360	4.0*
3-Nitroaniline		.100	.151	.225	.324	.354	.231	47.1
Acenaphthene	*	1.212	1.230	1.229	1.209	1.150	1.206	2.7*
2,4-Dinitrophenol		.150	.204	.226	.248	.257	.217	19.6
4-Nitrophenol		.153	.173	.175	.183	.180	.173	6.7
Dibenzofuran	*	1.800	1.789	1.828	1.819	1.791	1.805	1.0*

* Compounds with required minimum RRF and maximum %RSD values.
All other compounds must meet a minimum RRF of 0.010.

FORM VI SV-1 3/90

3/27/96

3/27/96

000158

387 212386

7C

SEMIVOLATILE CONTINUING CALIBRATION CHECK

Lab Name: TCF-ST.LOUIS Contract: 434286

Lab Code: TCF Case No.: 10033 SAS No.: SDG No.: 212383

Instrument ID: 59701D Calibration Date: 03/05/96 Time: 10:55

Lab File ID: >D5367 Init. Calib. Date(s): 03/04/96

Init. Calib. Times: 14:09 20:17

COMPOUND	RRF	RRF050	MIN RRF	%D	MAX %D
Diethylphthalate	1.584	1.570		.9	
4-Chlorophenyl-phenyl ether	.763	.793	.400	3.9	25.0
Fluorene	1.280	1.364	.900	6.5	25.0
4-Nitroaniline	.202	.210		4.0	
Tributylphosphate	5.540	6.161		11.2	
4,6-Dinitro-2-methylphenol	.168	.174		3.3	
N-Nitrosodiphenylamine	.498	.469		5.8	
4-Bromophenyl-phenylether	.273	.278	.100	1.7	25.0
Hexachlorobenzene	.342	.336	.100	1.6	25.0
Pentachlorophenol	.218	.198	.050	9.0	25.0
Phenanthrene	1.154	1.140	.700	1.3	25.0
Anthracene	1.069	1.087	.700	1.7	25.0
* Carbazole	.504	.681		35.2	
Di-n-butylphthalate	1.524	1.487		2.4	
Fluoranthene	1.229	1.113	.600	9.4	25.0
Pyrene	1.594	1.680	.600	5.4	25.0
Butylbenzylphthalate	.805	.837		4.0	
* 3,3'-Dichlorobenzidine	.221	.105		52.8	R
Benzo(a)anthracene	1.258	1.262	.800	.3	25.0
Chrysene	1.264	1.221	.700	3.4	25.0
bis(2-Ethylhexyl)phthalate	1.046	1.066		2.0	
Di-n-octylphthalate	1.837	1.789		2.6	
Benzo(b)fluoranthene	1.210	1.168	.700	3.5	25.0
Benzo(k)fluoranthene	1.247	1.206	.700	3.3	25.0
Benzo(a)pyrene	1.054	1.032	.700	2.0	25.0
Indeno(1,2,3-cd)pyrene	.986	1.015	.500	3.0	25.0
Dibenzo(a,h)anthracene	.787	.791	.400	.5	25.0
Benzo(g,h,i)perylene	.835	.844	.500	1.1	25.0
Ni[illegible]zene-d5	.502	.494	.200	1.5	25.0
2-[illegible]biphenyl	1.434	1.467	.700	2.3	25.0
Te[illegible]-d14	1.193	1.240	.500	3.9	25.0
Ph[illegible]	1.657	1.645	.800	.7	25.0
2-Fluorophenol	1.317	1.291	.600	2.0	25.0
2,4,6-Tribromophenol	.300	.288		4.0	
2-Chlorophenol-d4	1.383	1.410	.800	1.9	25.0
1,2-Dichlorobenzene-d4	.986	1.011	.400	2.5	25.0

All other compounds must meet a minimum RRF of 0.010.

FORM VII SV-2 3/90

3/27/96

000159

3/21/96

8C
SEMIVOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: TCT-ST.LOUIS Contract: 434286

Lab code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Lab File ID (Standard): >D5312 Date Analyzed: 03/01/96

Instrument ID: 59701D Time Analyzed: 10:38

		IS4(PHN) AREA #	RT #	IS5(CHR) AREA #	RT #	IS6(PER) AREA #	RT #
	12 HOUR STD	184166	23.63	103526	30.73	80704	34.96
	UPPER LIMIT	368332	24.13	207052	31.23	161408	35.46
	LOWER LIMIT	92083	23.13	51763	30.23	40352	34.46
	EPA SAMPLE NO.						
1	212373	138943	23.63	74160	30.74	45449	34.96
2	212363	111970	23.64	47791 *	30.75	20157 *	34.99
3	212363 MS	150821	23.64	60609	30.75	29705 *	34.97
4	212363 MSD	172940	23.65	70750	30.76	35567 *	34.98
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

IS4 ([illegible]) = D10 PHENANTHRENE
IS5 ([illegible]) = D12 CHRYSENE
IS6 ([illegible]) = D12 PERYLENE

AREA UPPER LIMIT = +100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = +.50 minutes of internal standard RT
RT LOWER LIMIT = -.50 minutes of internal standard RT

Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.

page __ of __.

FORM VIII SV-2

3/90 Rev

3/27/96

3/27/96 AK

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

212363 MS

Lab Name: TCP-ST. LOUIS Contract: 434286

Lab Code: TCP Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-14A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5315

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
108-95-2	Phenol	49	
111-44-4	bis(2-Chloroethyl)Ether	20	U
95-57-8	2-Chlorophenol	53	
541-73-1	1,3-Dichlorobenzene	20	U
106-46-7	1,4-Dichlorobenzene	37	
95-50-1	1,2-Dichlorobenzene	20	U
95-48-7	2-Methylphenol	20	U
108-60-1	bis(2-Chloroisopropyl)ether	20	U
106-44-5	4-Methylphenol	20	U
621-64-7	N-Nitroso-di-n-propylamine	43	
67-72-1	Hexachloroethane	20	U
98-95-3	Nitrobenzene	20	U
78-59-1	Isophorone	20	U
88-75-5	2-Nitrophenol	20	U
105-67-9	2,4-Dimethylphenol	20	U
111-91-1	bis(2-Chloroethoxy)methane	20	U
120-83-2	2,4-Dichlorophenol	20	U
120-82-1	1,2,4-Trichlorobenzene	39	
91-20-3	Naphthalene	20	U
106-47-8	4-Chloroaniline	20	U
87-68-3	Hexachlorobutadiene	20	U
59-50-7	4-Chloro-3-methylphenol	44	
91-57-6	2-Methylnaphthalene	20	U
77-47-4	Hexachlorocyclopentadiene	20	U
[illegible]	2,4,6-Trichlorophenol	20	U
[illegible]	2,4,5-Trichlorophenol	50	U
[illegible]	2-Chloronaphthalene	20	U
[illegible]	2-Nitroaniline	50	U
131-[illegible]	Dimethylphthalate	20	U
208-96-8	Acenaphthylene	20	U
606-20-2	2,6-Dinitrotoluene	20	U
99-09-2	3-Nitroaniline	50	U
83-32-9	Acenaphthene	42	

3/27/96

3/21/96

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

212363 MS

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-14A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5315

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	61	
132-64-9	Dibenzofuran	20	U
121-14-2	2,4-Dinitrotoluene	38	
84-66-2	Diethylphthalate	20	U
7005-72-3	4-Chlorophenyl-phenyl ether	20	U
86-73-7	Fluorene	20	U
100-01-6	4-Nitroaniline	50	U
126-73-8	Tributylphosphate	5	J
534-52-1	4,6-Dinitro-2-methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine	20	U
101-55-3	4-Bromophenyl-phenylether	20	U
118-74-1	Hexachlorobenzene	20	U
87-86-5	Pentachlorophenol	130	
85-01-8	Phenanthrene	20	U
120-12-7	Anthracene	20	U
86-74-8	Carbazole	20	U
84-74-2	Di-n-butylphthalate	20	U
206-44-0	Fluoranthene	20	U
129-00-0	Pyrene	53	
85-68-7	Butylbenzylphthalate	20	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)anthracene	20	U
218[illegible]	Chrysene	20	U
1[illegible]7	bis(2-Ethylhexyl)phthalate	4	J
1[illegible]	Di-n-octylphthalate	20	U
20[illegible]	Benzo(b)fluoranthene	20	U
207[illegible]	Benzo(k)fluoranthene	20	U
50-32-8	Benzo(a)pyrene	20	U
193-39-5	Indeno(1,2,3-cd)pyrene	20	U
53-70-3	Dibenzo(a,h)anthracene	20	U
191-24-2	Benzo(g,h,i)perylene	20	U

3/27/96

3/21/96

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

212363 MSD

Lab Name: TCE-ST. LOUIS Contract: 434286

Lab Code: TCE Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-14A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5316

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
108-95-2	Phenol	55	
111-44-4	bis(2-Chloroethyl)Ether	20	U
95-57-8	2-Chlorophenol	57	
541-73-1	1,3-Dichlorobenzene	20	U
106-46-7	1,4-Dichlorobenzene	37	
95-50-1	1,2-Dichlorobenzene	20	U
95-48-7	2-Methylphenol	20	U
108-60-1	bis(2-Chloroisopropyl)ether	20	U
106-44-5	4-Methylphenol	20	U
621-64-7	N-Nitroso-di-n-propylamine	46	
67-72-1	Hexachloroethane	20	U
98-95-3	Nitrobenzene	20	U
78-59-1	Isophorone	20	U
88-75-5	2-Nitrophenol	20	U
105-67-9	2,4-Dimethylphenol	20	U
111-91-1	bis(2-Chloroethoxy)methane	20	U
120-83-2	2,4-Dichlorophenol	20	U
120-82-1	1,2,4-Trichlorobenzene	40	
91-20-3	Naphthalene	20	U
106-47-8	4-Chloroaniline	20	U
87-68-3	Hexachlorobutadiene	20	U
59-50-7	4-Chloro-3-methylphenol	51	
91-57-6	2-Methylnaphthalene	20	U
77-47-4	Hexachlorocyclopentadiene	20	U
[illegible]	2,4,6-Trichlorophenol	20	U
[illegible]	2,4,5-Trichlorophenol	50	U
[illegible]	2-Chloronaphthalene	20	U
[illegible]	2-Nitroaniline	50	U
[illegible]	Dimethylphthalate	20	U
[illegible]	Acenaphthylene	20	U
606-20-2	2,6-Dinitrotoluene	20	U
99-09-2	3-Nitroaniline	50	U
83-32-9	Acenaphthene	40	

3/22/96

000163

3/21/96

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

212363 MSD

Lab Name: TGI-ST. LOUIS Contract: 434286

Lab Code: TGI Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-14A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5316

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	59	
132-64-9	Dibenzofuran	20	U
121-14-2	2,4-Dinitrotoluene	36	
84-66-2	Diethylphthalate	20	U
7005-72-3	4-Chlorophenyl-phenyl ether	20	U
86-73-7	Fluorene	20	U
100-01-6	4-Nitroaniline	50	U
126-73-8	Tributylphosphate	5	J
534-52-1	4,6-Dinitro-2-methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine	20	U
101-55-3	4-Bromophenyl-phenylether	20	U
118-74-1	Hexachlorobenzene	20	U
87-86-5	Pentachlorophenol	110	
85-01-8	Phenanthrene	20	U
120-12-7	Anthracene	20	U
86-74-8	Carbazole	20	U
84-74-2	Di-n-butylphthalate	20	U
206-44-0	Fluoranthene	20	U
129-00-0	Pyrene	55	
85-68-7	Butylbenzylphthalate	20	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)anthracene	20	U
218-[illegible]	Chrysene	20	U
11[illegible]	bis(2-Ethylhexyl)phthalate	5	J
1[illegible]	Di-n-octylphthalate	20	U
2[illegible]	Benzo(b)fluoranthene	20	U
2[illegible]	Benzo(k)fluoranthene	20	U
50-[illegible]	Benzo(a)pyrene	20	U
193-39-5	Indeno(1,2,3-cd)pyrene	20	U
53-70-3	Dibenzo(a,h)anthracene	20	U
191-24-2	Benzo(g,h,i)perylene	20	U

3/27/96

000164 3/21/96

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212363

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-14A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5314

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q ASLC
108-95-2	Phenol	20	U
111-44-4	bis(2-Chloroethyl)Ether	20	U
95-57-8	2-Chlorophenol	20	U
541-73-1	1,3-Dichlorobenzene	20	U
106-46-7	1,4-Dichlorobenzene	20	U
95-50-1	1,2-Dichlorobenzene	20	U
95-48-7	2-Methylphenol	20	U
108-60-1	bis(2-Chloroisopropyl)ether	20	U
106-44-5	4-Methylphenol	20	U
621-64-7	N-Nitroso-di-n-propylamine	20	U
67-72-1	Hexachloroethane	20	U
98-95-3	Nitrobenzene	20	U
78-59-1	Isophorone	20	U
88-75-5	2-Nitrophenol	20	U
105-67-9	2,4-Dimethylphenol	20	U
111-91-1	bis(2-Chloroethoxy)methane	20	U
120-83-2	2,4-Dichlorophenol	20	U
120-82-1	1,2,4-Trichlorobenzene	20	U
91-20-3	Naphthalene	20	U
106-47-8	4-Chloroaniline	20	U
87-68-3	Hexachlorobutadiene	20	U
59-50-7	4-Chloro-3-methylphenol	20	U
91-57-6	2-Methylnaphthalene	20	U
77-47-4	Hexachlorocyclopentadiene	20	U
88-06-2	2,4,6-Trichlorophenol	20	U
95-95-4	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	20	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethylphthalate	20	U
208-96-8	Acenaphthylene	20	U
606-20-2	2,6-Dinitrotoluene	20	U
99-09-2	3-Nitroaniline	50	U
83-32-9	Acenaphthene	20	U

3/27/96

3/27/96

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212363

Lab Name: ST. LOUIS Contract: 434286

Lab Code: TCF Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-14A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5314

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
51-28-5	2,4-Dinitrophenol	50	U	R
100-02-7	4-Nitrophenol	50	U	U
132-64-9	Dibenzofuran	20	U	
121-14-2	2,4-Dinitrotoluene	20	U	
84-66-2	Diethylphthalate	20	U	
7005-72-3	4-Chlorophenyl-phenyl ether	20	U	
86-73-7	Fluorene	20	U	
100-01-6	4-Nitroaniline	50	U	
126-73-8	Tributylphosphate	6	J	UJ
534-52-1	4,6-Dinitro-2-methylphenol	50	U	U
86-30-6	N-Nitrosodiphenylamine	20	U	
101-55-3	4-Bromophenyl-phenylether	20	U	
118-74-1	Hexachlorobenzene	20	U	
87-86-5	Pentachlorophenol	50	U	UJ
85-01-8	Phenanthrene	20	U	U
120-12-7	Anthracene	20	U	
86-74-8	Carbazole	20	U	
84-74-2	Di-n-butylphthalate	20	U	
206-44-0	Fluoranthene	20	U	U
129-00-0	Pyrene	20	U	UJ
[illegible]	Butylbenzylphthalate	20	U	
[illegible]	3,3'-Dichlorobenzidine	20	U	
[illegible]	Benzo(a)anthracene	20	U	
[illegible]	Chrysene	20	U	UJ
[illegible]	bis(2-Ethylhexyl)phthalate	5	J	20UJ
[illegible]	Di-n-octylphthalate	20	U	UJ
205-99-2	Benzo(b)fluoranthene	20	U	
207-08-9	Benzo(k)fluoranthene	20	U	
50-32-8	Benzo(a)pyrene	20	U	
193-39-5	Indeno(1,2,3-cd)pyrene	20	U	
53-70-3	Dibenzo(a,h)anthracene	20	U	
191-24-2	Benzo(g,h,i)perylene	20	U	UJ

FORM I SV-2 [illegible]/90 Rev

000166 3/27/96

3/21/96 KT

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212363

Lab Name: TCT-ST.LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-14A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5314

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

Number TICs found: 19

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

ASLC

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	79016	Ethene, trichloro-	4.58	98	J N
2.	127184	Ethene, tetrachloro-	7.13	39	J N
3.		Unknown	8.74	18	J
4.		Unknown	19.16	19	J
5.		Unknown	19.72	37	J
6.		Unknown	20.26	26	J
7.		Unknown	21.94	34	J
8.		Unknown	22.55	250	J
9.		Unknown	22.61	27	J
10.		Unknown	22.96	53	J
11.		Unknown	23.07	510	J
12.		Unknown	23.22	970	J
13.		Unknown	23.49	180	J
14.		Unknown	23.56	280	J
15.		Unknown	23.73	1200	J
16.		Unknown	24.04	210	J
17.		Unknown	24.24	870	J
18.		Unknown	24.55	83	J
19.	[illegible]	Acetic acid, (triphenylphosp	30.97	15	J N
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

MW 3.11.96

FORM I SV-TIC

3/27/96 3190 Rev

000167

3/21/96

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212373

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCT Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-23A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5313

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

ASLC

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
108-95-2	Phenol	20	U
111-44-4	bis(2-Chloroethyl)Ether	20	U
95-57-8	2-Chlorophenol	20	U
541-73-1	1,3-Dichlorobenzene	20	U
106-46-7	1,4-Dichlorobenzene	20	U
95-50-1	1,2-Dichlorobenzene	20	U
95-48-7	2-Methylphenol	20	U
108-60-1	bis(2-Chloroisopropyl)ether	20	U
106-44-5	4-Methylphenol	20	U
621-64-7	N-Nitroso-di-n-propylamine	20	U
67-72-1	Hexachloroethane	20	U
98-95-3	Nitrobenzene	20	U
78-59-1	Isophorone	20	U
88-75-5	2-Nitrophenol	20	U
105-67-9	2,4-Dimethylphenol	20	U
111-91-1	bis(2-Chloroethoxy)methane	20	U
120-83-2	2,4-Dichlorophenol	20	U
120-82-1	1,2,4-Trichlorobenzene	20	U
91-20-3	Naphthalene	20	U
106-47-8	4-Chloroaniline	20	U
87-68-3	Hexachlorobutadiene	20	U
59-50-7	4-Chloro-3-methylphenol	20	U
91-57-6	2-Methylnaphthalene	20	U
77-47-4	Hexachlorocyclopentadiene	20	U
88-06-2	2,4,6-Trichlorophenol	20	U
95-95-4	2,4,5-Trichlorophenol	50	U
91-58-7	2-Chloronaphthalene	20	U
88-74-4	2-Nitroaniline	50	U
131-11-3	Dimethylphthalate	20	U
208-96-8	Acenaphthylene	20	U
606-20-2	2,6-Dinitrotoluene	20	U
99-09-2	3-Nitroaniline	50	U
83-32-9	Acenaphthene	20	U

3/27/96

3/27/96

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank 1C
212373

Lab Name: [redacted]ST. LOUIS Contract: 434286

Lab Code: TGW Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-23A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5313

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 (uL) Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

ASL C

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	
51-28-5	2,4-Dinitrophenol	50	U	R
100-02-7	4-Nitrophenol	50	U	U
132-64-9	Dibenzofuran	20	U	
121-14-2	2,4-Dinitrotoluene	20	U	
84-66-2	Diethylphthalate	20	U	
7005-72-3	4-Chlorophenyl-phenyl ether	20	U	
86-73-7	Fluorene	20	U	
100-01-6	4-Nitroaniline	50	U	
126-73-8	Tributylphosphate	20	U	
534-52-1	4,6-Dinitro-2-methylphenol	50	U	
86-30-6	N-Nitrosodiphenylamine	20	U	
101-55-3	4-Bromophenyl-phenylether	20	U	
118-74-1	Hexachlorobenzene	20	U	U
87-86-5	Pentachlorophenol	50	U	UJ
85-01-8	Phenanthrene	20	U	U
120-12-7	Anthracene	20	U	
86-74-8	Carbazole	20	U	
84-74-2	Di-n-butylphthalate	20	U	
206-44-0	Fluoranthene	20	U	
129-00-0	Pyrene	20	U	
85-68-7	Butylbenzylphthalate	20	U	
[redacted]	3,3'-Dichlorobenzidine	20	U	
[redacted]	Benzo(a)anthracene	20	U	
[redacted]	Chrysene	20	U	U
[redacted]	Bis(2-Ethylhexyl)phthalate	5	J	UJ
[redacted]	Di-n-octylphthalate	20	U	U
[redacted]	Benzo(b)fluoranthene	20	U	UJ
207-08-9	Benzo(k)fluoranthene	20	U	U
50-32-8	Benzo(a)pyrene	20	U	
193-39-5	Indeno(1,2,3-cd)pyrene	20	U	
53-70-3	Dibenzo(a,h)anthracene	20	U	
191-24-2	Benzo(g,h,i)perylene	20	U	U

3/21/96

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Blank
212373

Lab Name: ~~TCF~~ ST.LOUIS Contract: 434286

Lab Code: TCF Case No.: 10033 SAS No.: SDG No.: 212383

Matrix: (soil/water) WATER Lab Sample ID: 2005-23A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5313

Level: (low/med) LOW Date Received: 02/01/96

% Moisture: decanted: (Y/N) N Date Extracted: 02/06/96

Concentrated Extract Volume: 2000 Date Analyzed: 03/01/96

Injection Volume: 1.0 (uL) Dilution Factor: 1

GPC Cleanup: (Y/N) N pH: 7

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

ASL C

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

FORM I SV-TIC 3/90 Rev

3/27/96
3/27/96
RM

APPENDIX B

APPENDIX B

GEOMEMBRANE/LEACHATE USEPA METHOD 9090 COMPATIBILITY TEST RESULTS

draft

APPENDIX B

GEOMEMBRANE/LEACHATE USEPA 9090 COMPATIBILITY TEST RESULTS

1. USEPA METHOD 9090 TEST RESULTS

1.1 Overview

The results of the USEPA Method 9090 testing program for the FEMP leachate/liner compatibility program are presented in this appendix. The rationale, results and discussion, and conclusions for each of the USEPA Method 9090 tests are presented followed by the graphical and numerical results of each test.

draft

1.2 Organization

Two general categories of tests included under USEPA Method 9090 are discussed in this appendix: (i) physical properties; and (ii) mechanical properties. The individual tests included are listed below:

Physical Properties

- mass;
- thickness;
- dimensions;
- specific gravity;
- volatiles loss; and
- extractables content.

Mechanical Properties

- stress and strain at yield;
- stress and strain at break;
- modulus of elasticity;
- initial tearing resistance;
- hardness;
- puncture resistance; and
- Mullen burst strength.

draft

2. TEST RESULTS

A discussion of the rationale, results and discussion, and conclusion for each of the above physical and mechanical tests on the five geomembrane samples is provided in a separate section below. Copies of the laboratory testing results are included in each section. For ease of reference, the sections are tabbed separately.

Testing was performed on five samples of geomembrane. These include:

- GSE-SLT;
- NSC;
- GSE-Gundle;
- Polyflex; and
- Serrot.

2.1 Mass

Rationale for Test

In chemical compatibility test programs, mass of geomembranes and other geosynthetic materials is monitored to evaluate whether: (i) the material has gained weight, due to absorption of some constituents of the leachate; or (ii) the material has lost weight, due to the extraction of some constituent by the leachate.

Results and Discussion

The mass of both the 23°C (73°F) and 50°C (122°F) geomembrane samples were constant (within the limits of measurement of the test methodology and the inherent variability in HDPE resin properties) during the 120 days of exposure to the test leachate, indicating that the leachate did not extract constituents from the geomembranes and that leachate constituents were not absorbed by the geomembranes. All post-exposure mean values were within one standard deviation of the control value means.

Conclusion

The test leachate did not measurably impact the mass of the geomembranes during the 120 day exposure period.

draft

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

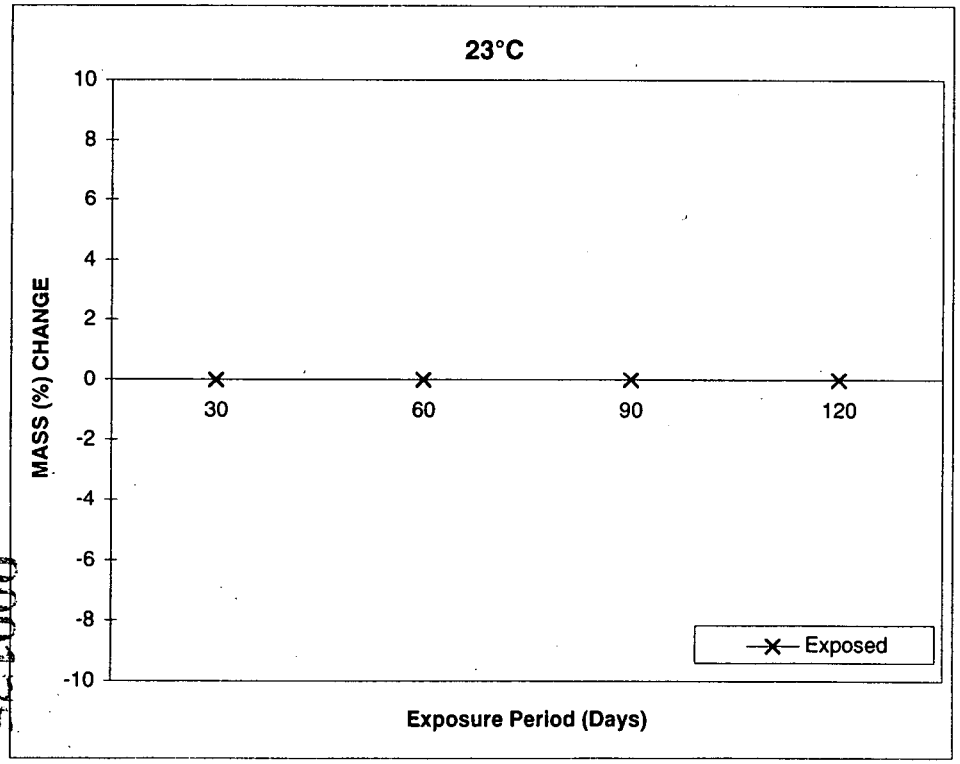
CHEMICAL COMPATIBILITY TEST RESULTS

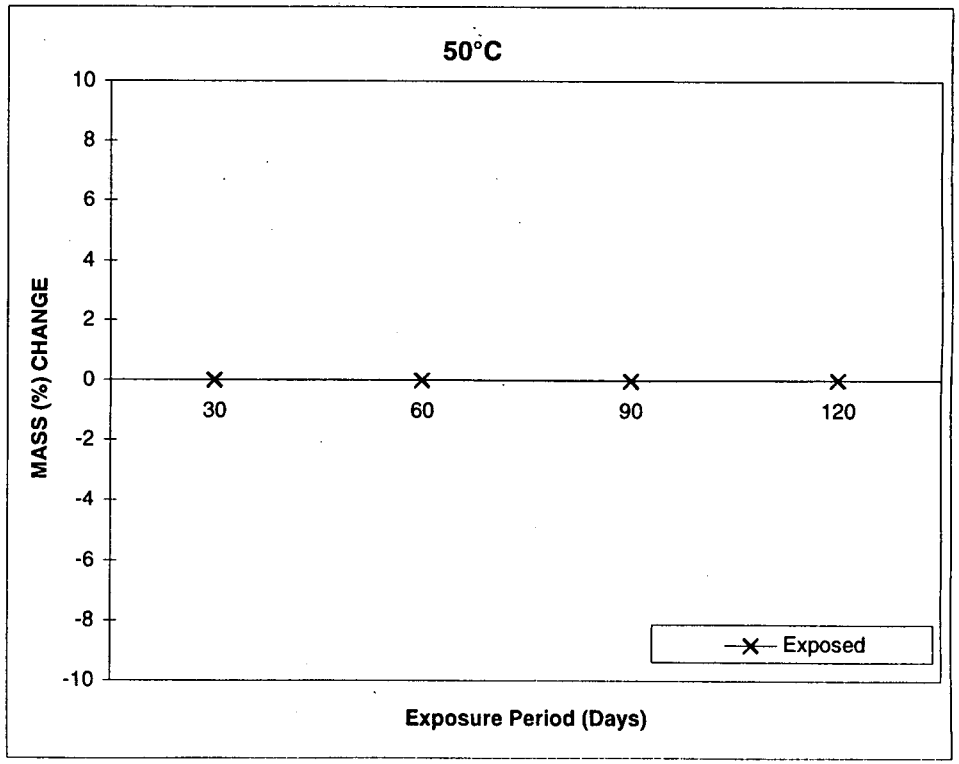
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MASS (g)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	75.9470	72.6470	73.5610	69.0240		72.7948	2.9	0.000	73.8310	68.1020	75.8780	74.0030		72.9535	3.4	0.000	CR
30	75.9310	72.6310	73.5720	69.0180		72.7880	2.9	-0.009	73.8280	68.0810	75.9090	74.0080		72.9565	3.4	0.004	CR
Control	72.4610	70.4890	74.0230	74.5870		72.8900	1.8	0.000	69.0710	70.1860	74.7870	74.8150		72.2148	3.0	0.000	CR
60	72.4600	70.4900	74.0210	74.5840		72.8888	1.8	-0.002	69.0690	70.1810	74.7800	74.8110		72.2103	3.0	-0.006	CR
Control	69.5660	69.5100	75.5120	75.4820		72.5175	3.4	0.000	77.9050	73.8960	73.6770	72.2680		74.4365	2.4	0.000	CR
90	69.5700	69.4800	75.5140	75.4970		72.5153	3.5	-0.003	77.8960	73.8560	73.6730	72.2620		74.4218	2.4	-0.020	CR
Control	69.2730	74.4300	70.0470	76.1140		72.4660	3.3	0.000	72.2180	73.8490	75.3050	73.5520		73.7310	1.3	0.000	CR
120	69.2700	74.4210	70.0390	76.1130		72.4608	3.3	-0.007	72.2110	73.8460	75.3040	73.5480		73.7273	1.3	-0.005	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

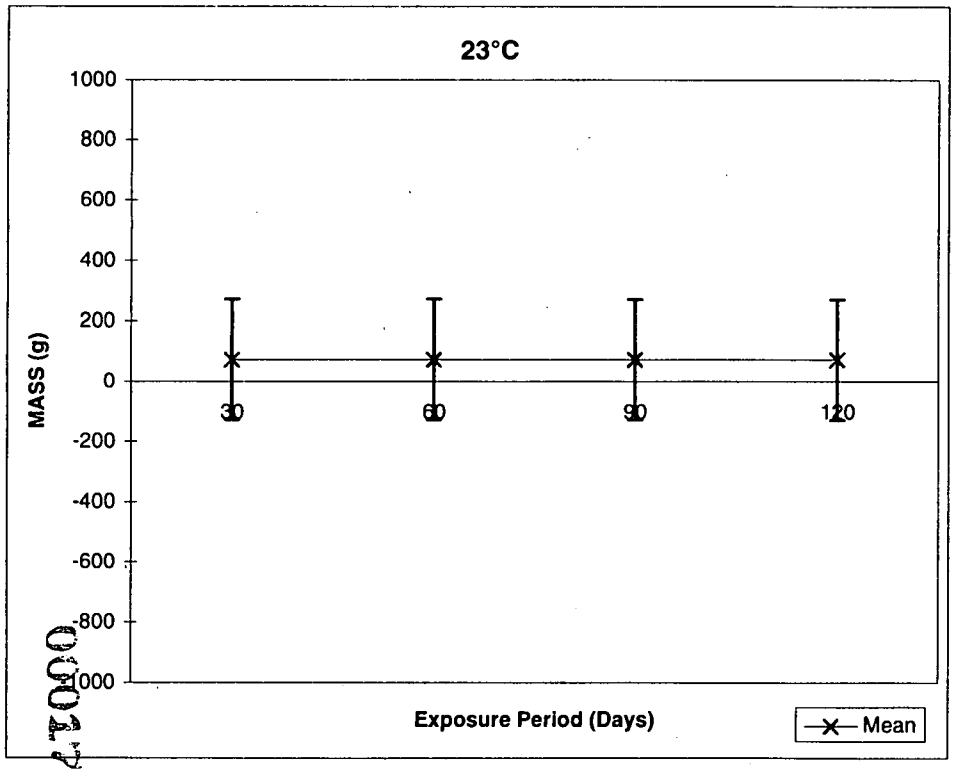
CHEMICAL COMPATIBILITY TEST RESULTS

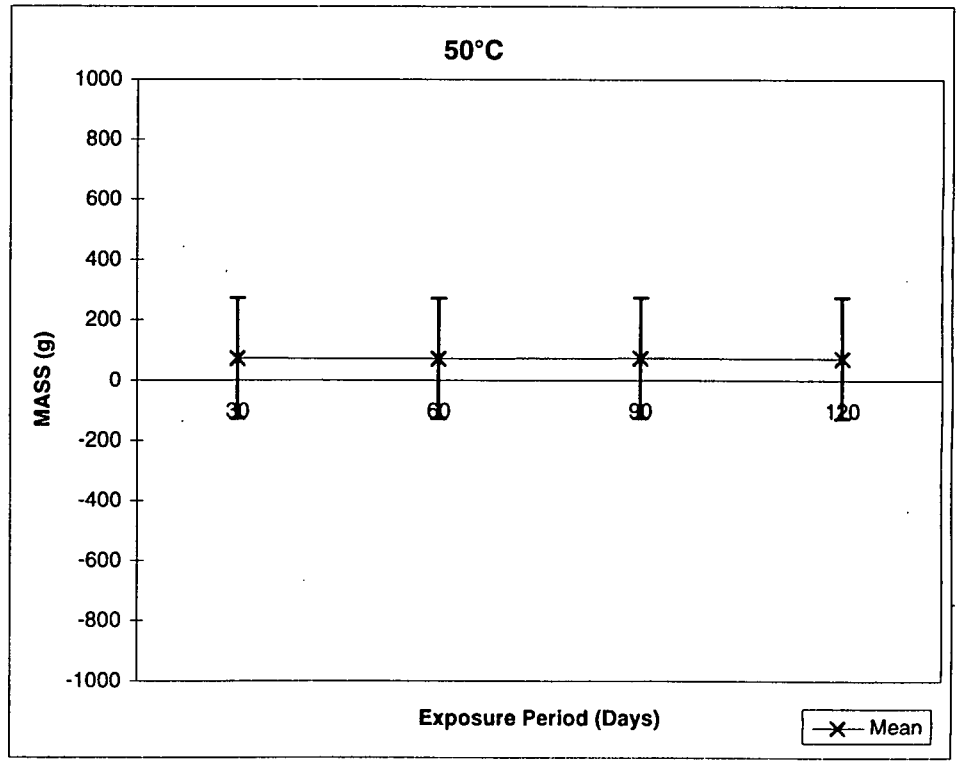
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MASS (g)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	75.9470	72.6470	73.5610	69.0240		72.7948	2.9	0.0	73.8310	68.1020	75.8780	74.0030		72.9535	3.4	0.0	CR
30	75.9310	72.6310	73.5720	69.0180		72.7880	2.9	0.0	73.8280	68.0810	75.9090	74.0080		72.9565	3.4	0.0	CR
60	72.4600	70.4900	74.0210	74.5840		72.8888	1.8	0.1	69.0690	70.1810	74.7800	74.8110		72.2103	3.0	-1.0	CR
90	69.5700	69.4800	75.5140	75.4970		72.5153	3.5	-0.4	77.8960	73.8560	73.6730	72.2620		74.4218	2.4	2.0	CR
120	69.2700	74.4210	70.0390	76.1130		72.4608	3.3	-0.5	72.2110	73.8460	75.3040	73.5480		73.7273	1.3	1.1	CR





© 1996 GEOSYNTEC CONSULTANTS

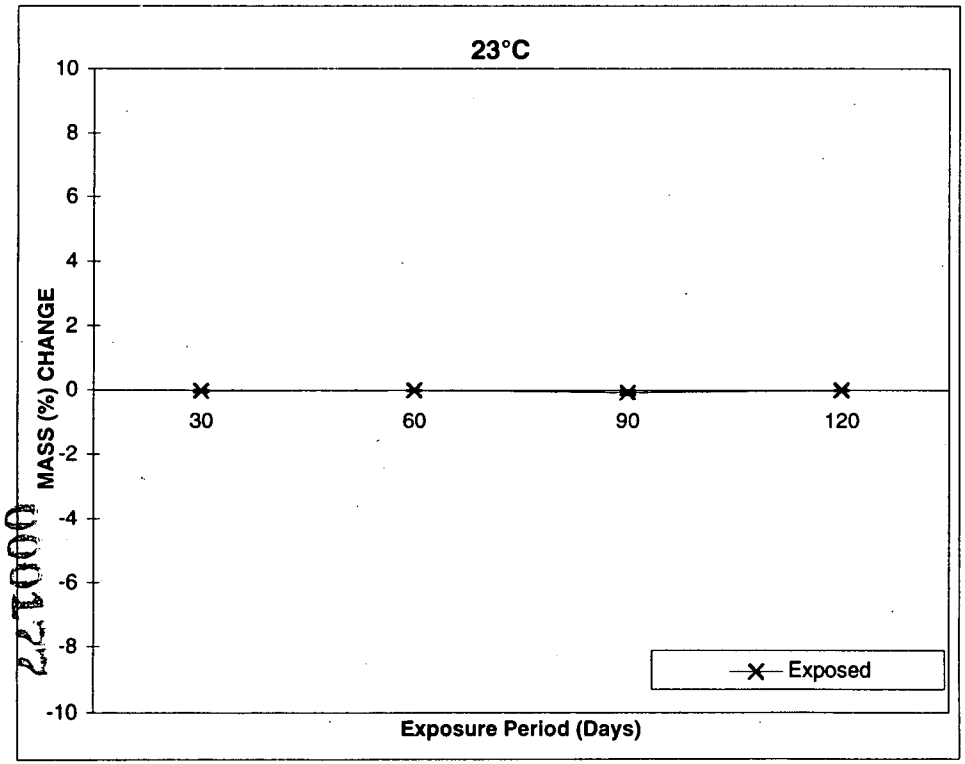
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

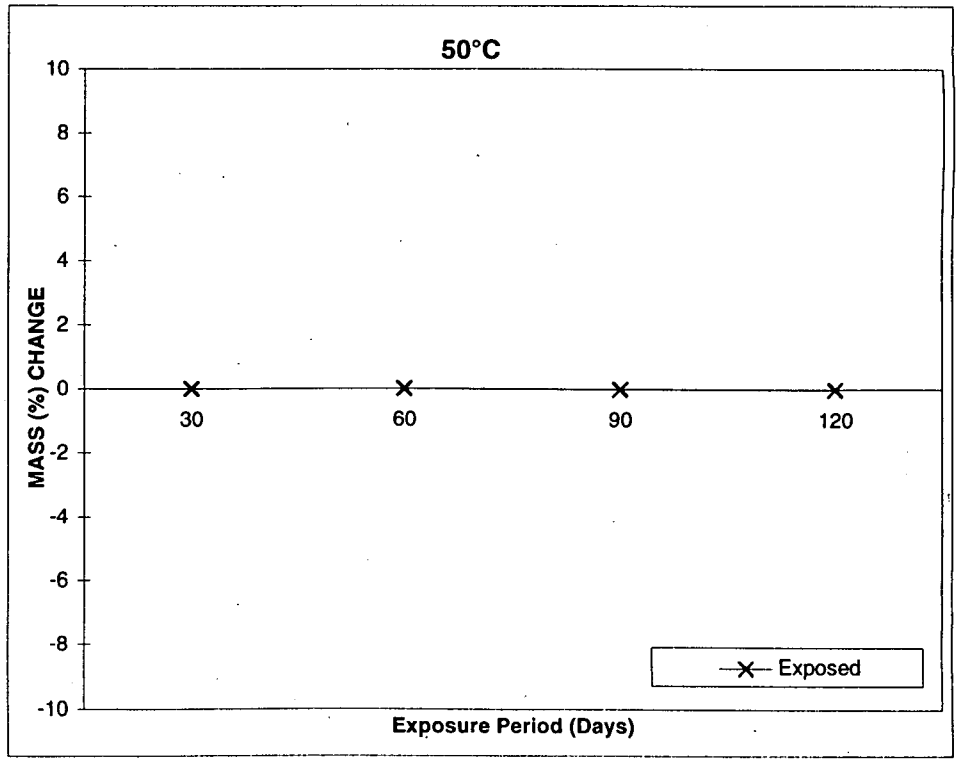
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*EPA 9090*	*MATERIAL TYPE:*	*NSC*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): MASS (g)
DIRECTION: N/A

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	72.0480	72.0810	72.3190	75.8150		73.0658	1.8	0.000	72.4130	73.4170	71.5300	71.5420		72.2255	0.9	0.000	CR
30	72.0440	72.0200	72.3030	75.8130		73.0450	1.8	-0.028	72.4060	73.4250	71.5340	71.5340		72.2248	0.9	-0.001	CR
Control	71.8640	70.4550	69.7970	68.9800		70.2740	1.2	0.000	75.3500	68.1940	67.9020	74.4010		71.4618	4.0	0.000	CR
60	71.8610	70.4530	69.7930	68.9770		70.2710	1.2	-0.004	75.3510	68.1870	67.9080	74.4110		71.4643	4.0	0.003	CR
Control	69.5790	70.5950	65.7100	67.2180		68.2755	2.2	0.000	70.7510	69.9720	70.6100	68.9160		70.0623	0.8	0.000	CR
90	69.5040	70.5160	65.7120	67.1660		68.2245	2.2	-0.075	70.7230	69.9760	70.6040	68.9170		70.0550	0.8	-0.010	CR
Control	68.4760	70.1930	73.1130	72.7320		71.1285	2.2	0.000	71.0770	71.0920	70.4050	72.3000		71.2185	0.8	0.000	CR
120	68.4750	70.1890	73.1110	72.7280		71.1258	2.2	-0.004	71.0690	71.0830	70.4010	72.3060		71.2148	0.8	-0.005	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

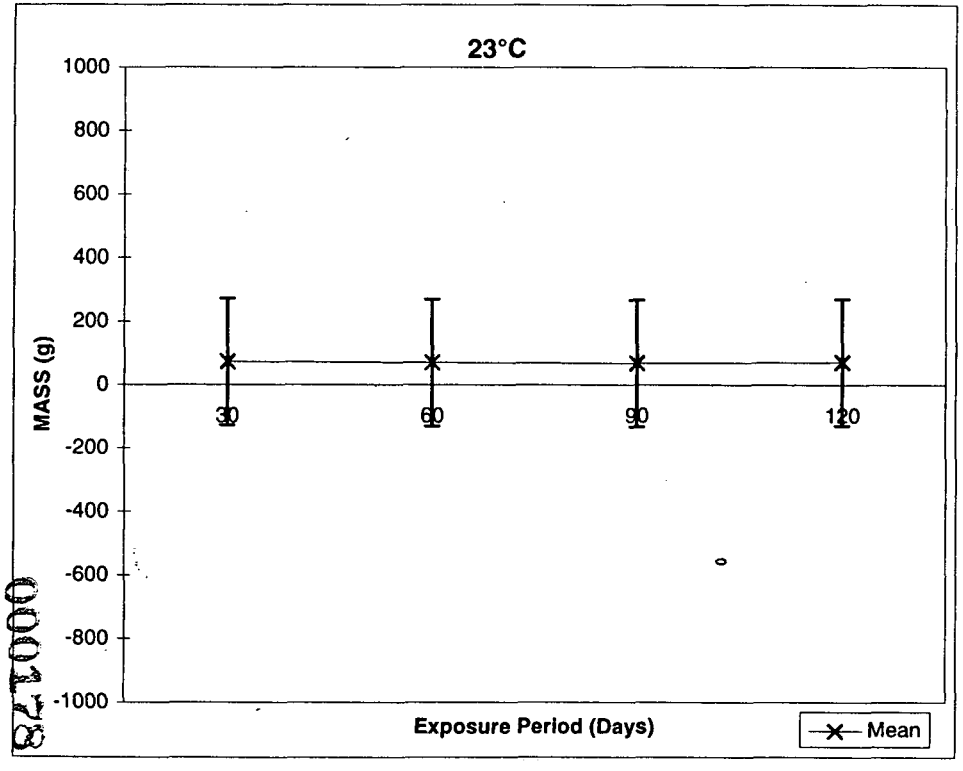
CHEMICAL COMPATIBILITY TEST RESULTS

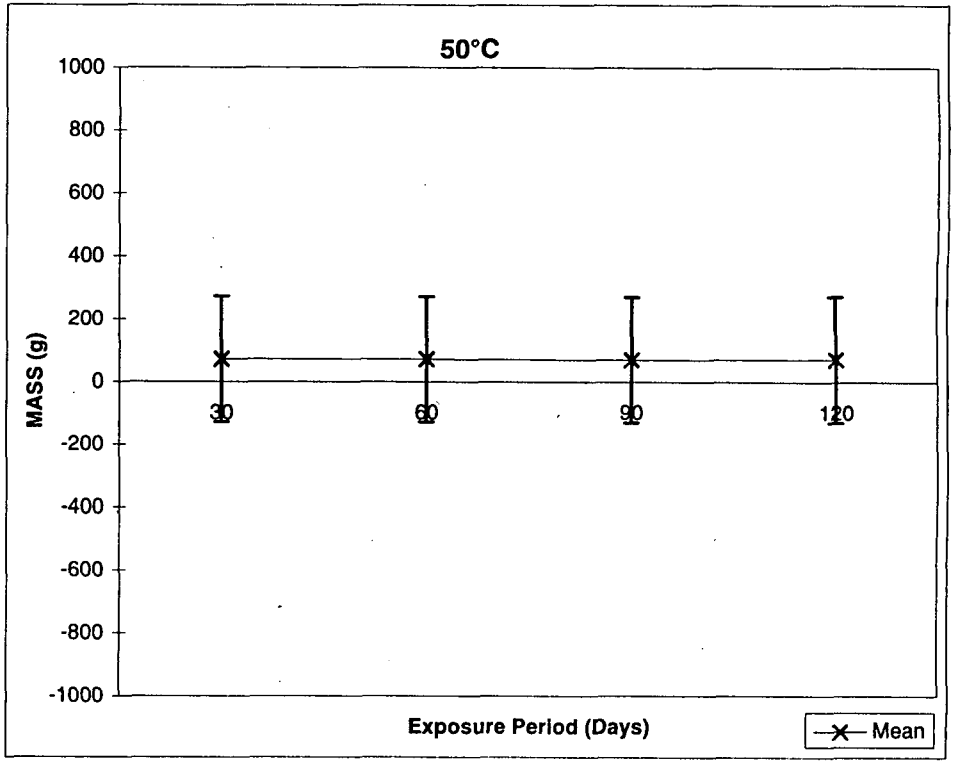
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MASS (g)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	72.0480	72.0810	72.3190	75.8150		73.0658	1.8	0.0	72.4130	73.4170	71.5300	71.5420		72.2255	0.9	0.0	CR
30	72.0440	72.0200	72.3030	75.8130		73.0450	1.8	0.0	72.4060	73.4250	71.5340	71.5340		72.2248	0.9	0.0	CR
60	71.8610	70.4530	67.7930	68.9770		69.7710	1.8	-4.5	75.3510	68.1870	67.9080	74.4110		71.4643	4.0	-1.1	CR
90	69.5040	70.5160	65.7120	67.1660		68.2245	2.2	-6.6	70.7230	69.9760	70.6040	68.9170		70.0550	0.8	-3.0	CR
120	68.4750	70.1890	73.1110	72.7280		71.1258	2.2	-2.7	71.0690	71.0830	70.4010	72.3060		71.2148	0.8	-1.4	CR





© 1996 GEOSYNTEC CONSULTANTS

000178

382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

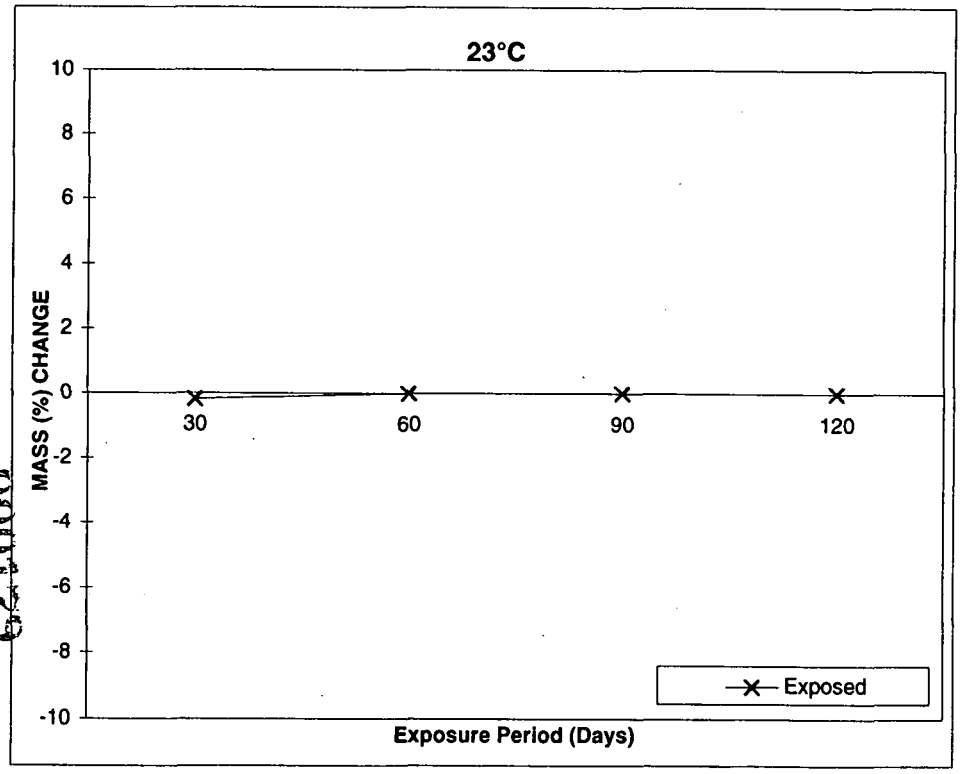
CHEMICAL COMPATIBILITY TEST RESULTS

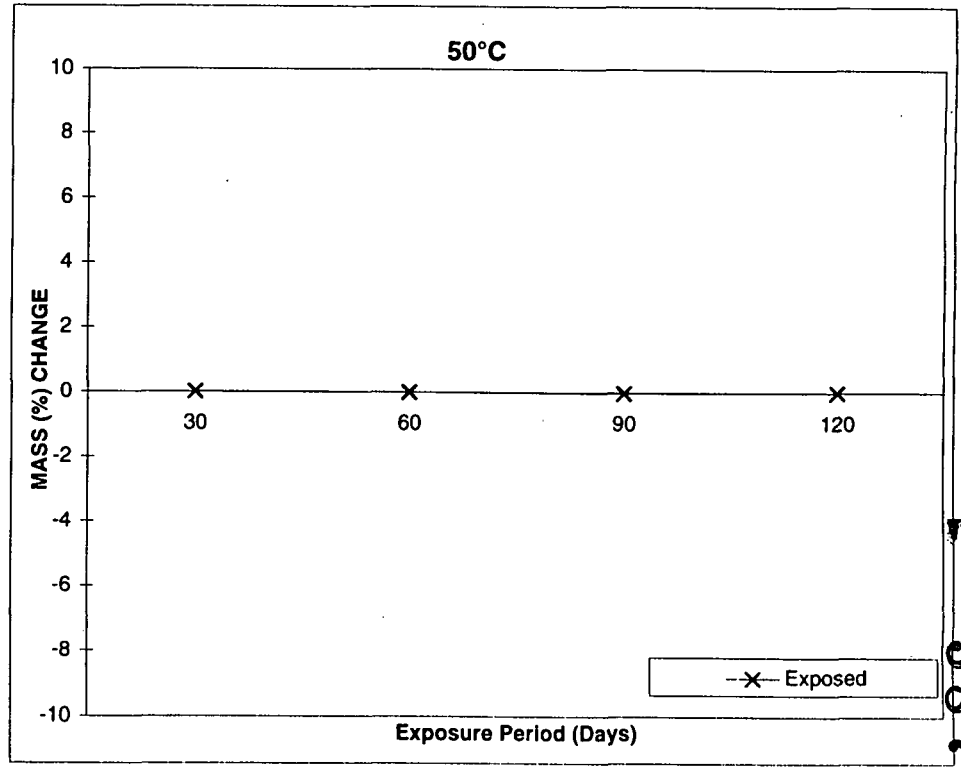
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MASS (g)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	72.9280	74.0680	74.6910	72.5560		73.5608	1.0	0.000	70.1170	62.5720	67.4620	68.6820		67.2083	3.3	0.000	CR
30	72.8130	73.8830	74.4950	72.5360		73.4318	0.9	-0.175	70.1330	62.5830	67.4720	68.6910		67.2198	3.3	0.017	CR
Control	73.9590	72.1210	75.3130	69.8390		72.8080	2.4	0.000	66.9090	67.5120	67.4380	66.7440		67.1508	0.4	0.000	CR
60	73.9630	72.1280	75.3170	69.8340		72.8105	2.4	0.003	66.9110	67.5150	67.4410	66.7480		67.1538	0.4	0.004	CR
Control	70.3170	73.1710	73.1650	73.1460		72.4498	1.4	0.000	67.2880	68.5990	69.4780	68.2170		68.3955	0.9	0.000	CR
90	70.3090	73.1560	72.8960	73.4560		72.4543	1.4	0.006	67.2860	68.5890	69.4360	68.2090		68.3800	0.9	-0.023	CR
Control	71.8790	72.6130	73.1260	72.1620		72.4450	0.5	0.000	68.1900	68.2880	68.5350	68.7380		68.4378	0.2	0.000	CR
120	71.8810	72.6210	73.1280	72.1630		72.4483	0.5	0.004	68.1930	68.2880	68.5340	68.7410		68.4390	0.2	0.002	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

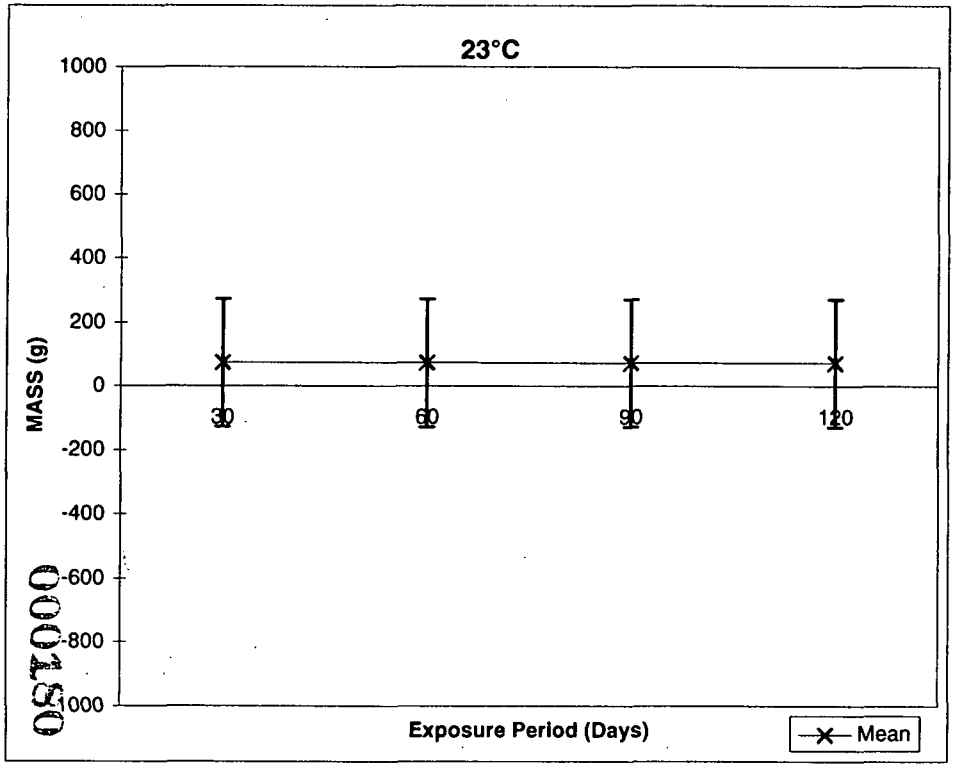
CHEMICAL COMPATIBILITY TEST RESULTS

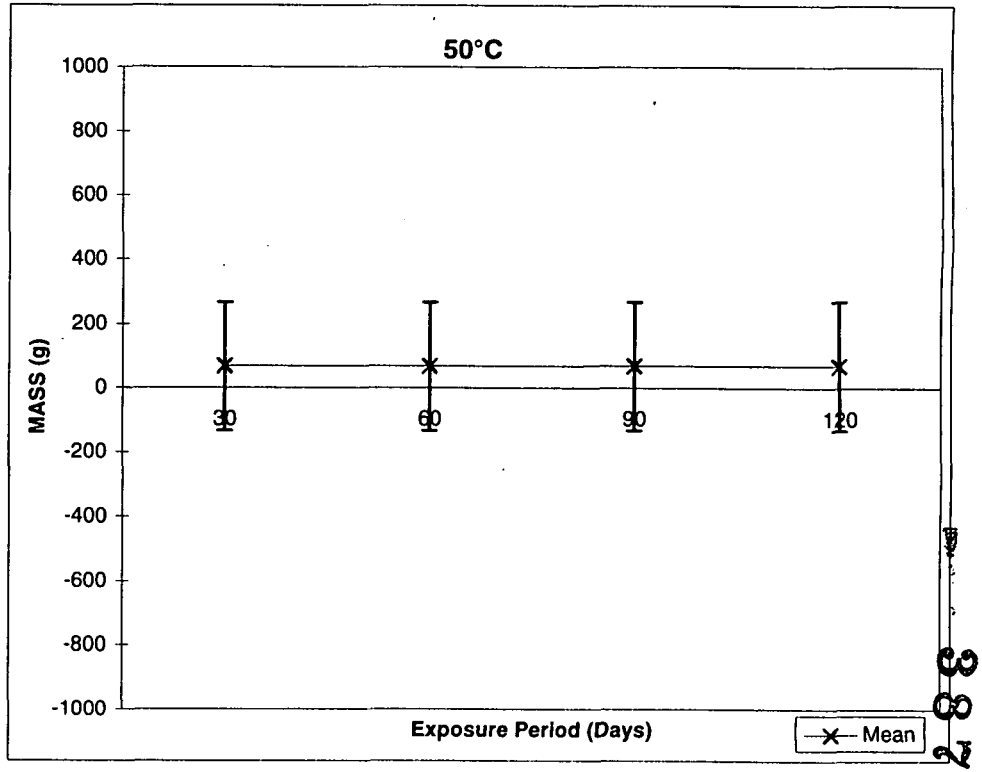
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MASS (g)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	72.9280	74.0680	74.6910	72.5560		73.5608	1.0	0.0	70.1170	62.5720	67.4620	68.6820		67.2083	3.3	0.0	CR
30	72.8130	73.8830	74.4950	72.5360		73.4318	0.9	-0.2	70.1330	62.5830	67.4720	68.6910		67.2198	3.3	0.0	CR
60	73.9630	72.1280	75.3170	69.8340		72.8105	2.4	-1.0	66.9110	67.5150	67.4410	66.7480		67.1538	0.4	-0.1	CR
90	70.3090	73.1560	72.8960	73.4560		72.4543	1.4	-1.5	67.2860	68.5890	69.4360	68.2090		68.3800	0.9	1.7	CR
120	71.8810	72.6210	73.1280	72.1630		72.4483	0.5	-1.5	68.1930	68.2880	68.5340	68.7410		68.4390	0.2	1.8	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

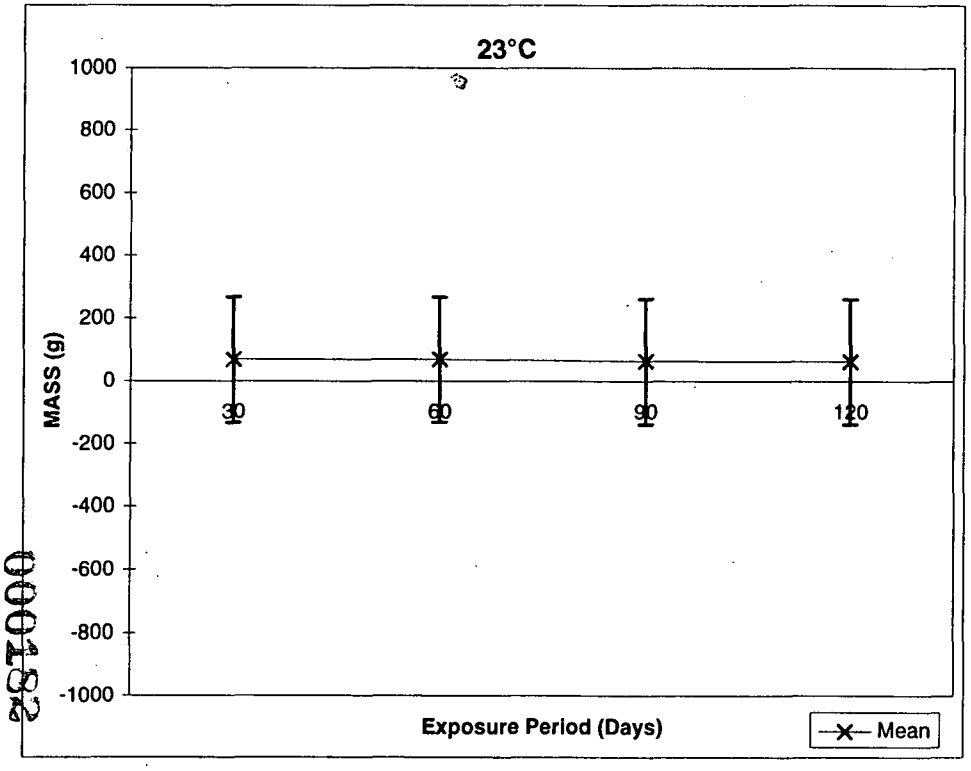
CHEMICAL COMPATIBILITY TEST RESULTS

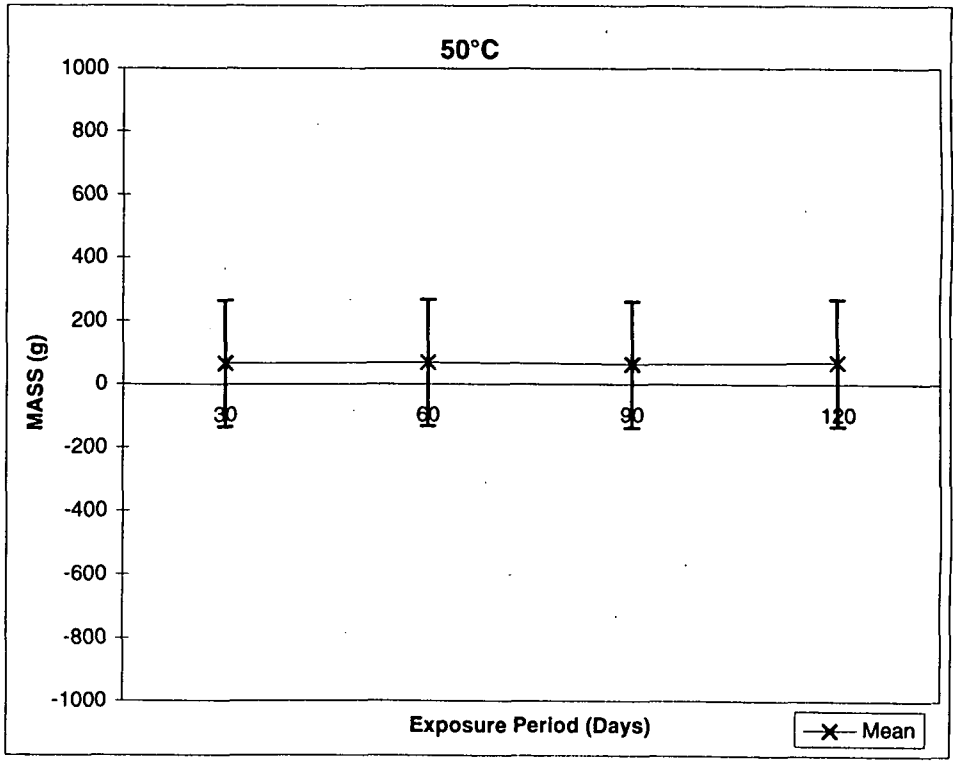
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MASS (g)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	67.9070	67.9810	71.1730	65.8620		68.2308	2.2	0.0	65.1760	64.8920	63.0740	66.5480		64.9225	1.4	0.0	CR
30	67.9430	67.9690	71.1510	65.8390		68.2255	2.2	0.0	65.1880	64.8740	63.0650	66.5120		64.9098	1.4	0.0	CR
60	71.3100	69.8710	63.6390	70.3090		68.7823	3.5	0.8	70.0910	66.5900	68.3090	65.0910		67.5203	2.2	4.0	CR
90	65.3060	61.1400	62.8240	63.0510		63.0803	1.7	-7.5	61.7710	62.9540	62.4790	61.4520		62.1640	0.7	-4.2	CR
120	62.1680	63.4460	64.4870	60.3810		62.6205	1.8	-8.2	65.9890	67.8470	67.8250	69.3700		67.7578	1.4	4.4	CR





© 1996 GEOSYNTEC CONSULTANTS

000182

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

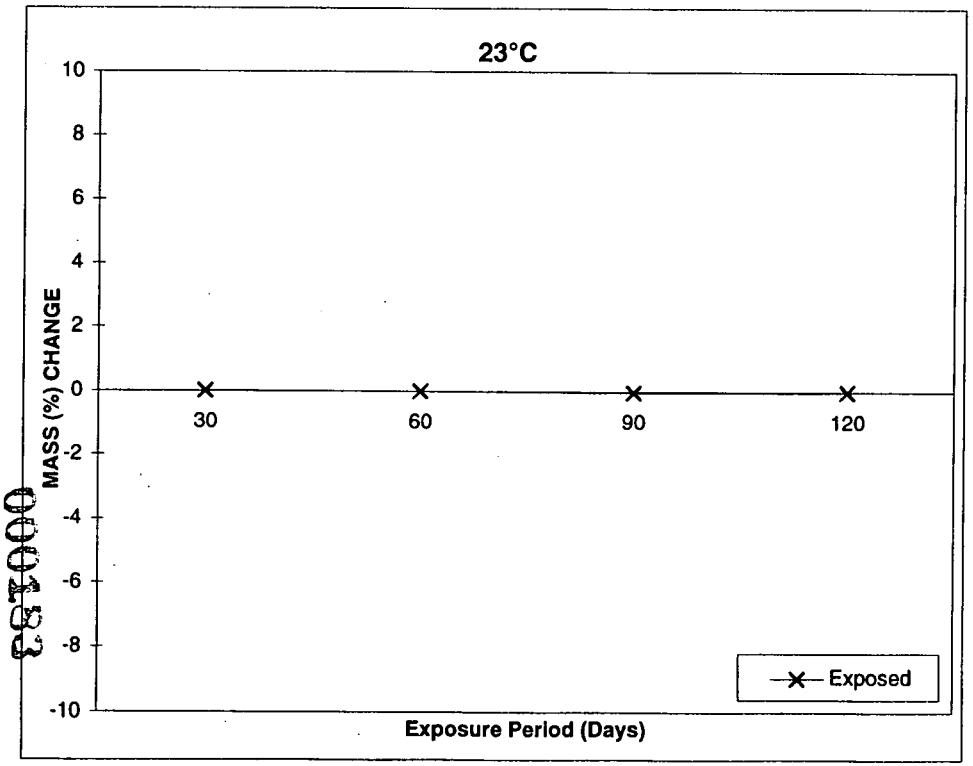
CHEMICAL COMPATIBILITY TEST RESULTS

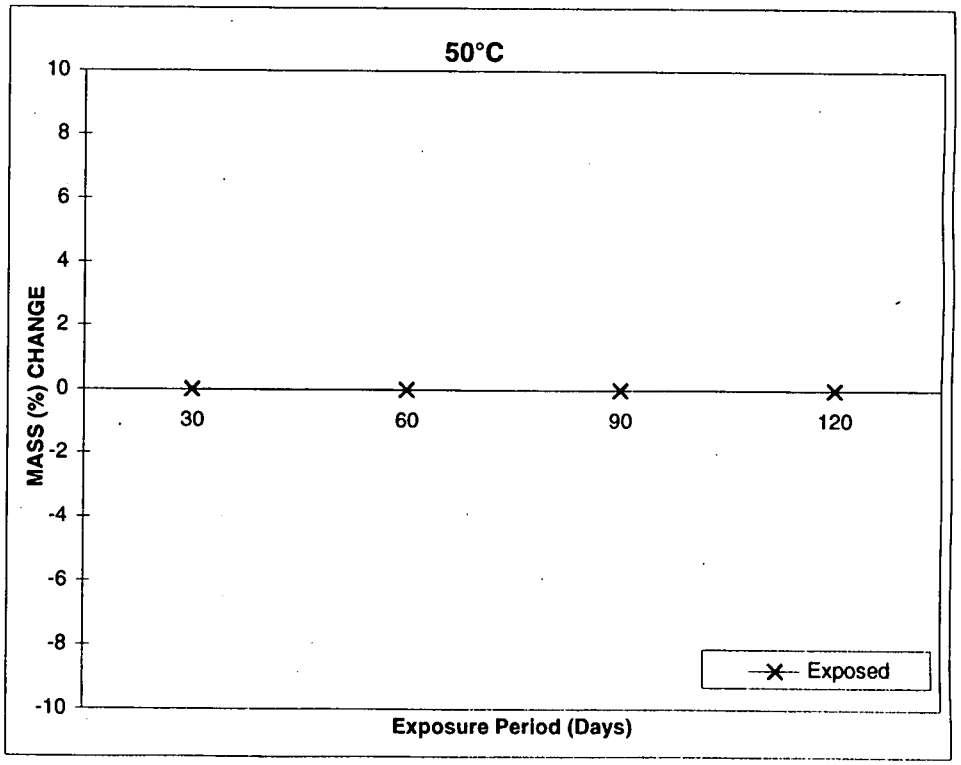
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MASS (g)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	70.2850	69.3090	69.5430	71.4670		70.1510	1.0	0.000	68.6020	70.0040	70.5560	68.9810		69.5358	0.9	0.000	CR
30	70.3020	69.3130	69.5430	71.4680		70.1565	1.0	0.008	68.6200	70.0120	70.5650	68.9740		69.5428	0.9	0.010	CR
Control	68.7390	69.7470	69.9980	72.1730		70.1643	1.4	0.000	69.5390	69.3670	68.9700	69.4560		69.3330	0.3	0.000	CR
60	68.7410	69.7410	69.9980	72.1690		70.1623	1.4	-0.003	69.5410	69.3690	68.9750	69.4600		69.3363	0.3	0.005	CR
Control	69.3610	70.0040	70.2670	68.9290		69.6403	0.6	0.000	68.6080	68.9490	69.4850	67.7310		68.6933	0.7	0.000	CR
90	69.3480	70.2450	69.9600	68.9310		69.6210	0.6	-0.028	68.6080	68.9370	69.4810	67.7360		68.6905	0.7	-0.004	CR
Control	67.5960	69.0350	69.8920	67.8410		68.5910	1.1	0.000	67.4280	66.2430	67.3460	66.4460		66.8658	0.6	0.000	CR
120	67.5900	69.0280	69.8890	67.8320		68.5848	1.1	-0.009	67.4210	66.2400	67.3470	66.4480		66.8640	0.6	-0.003	CR





© 1996 GEOSYNTEC CONSULTANTS

000183

- 387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

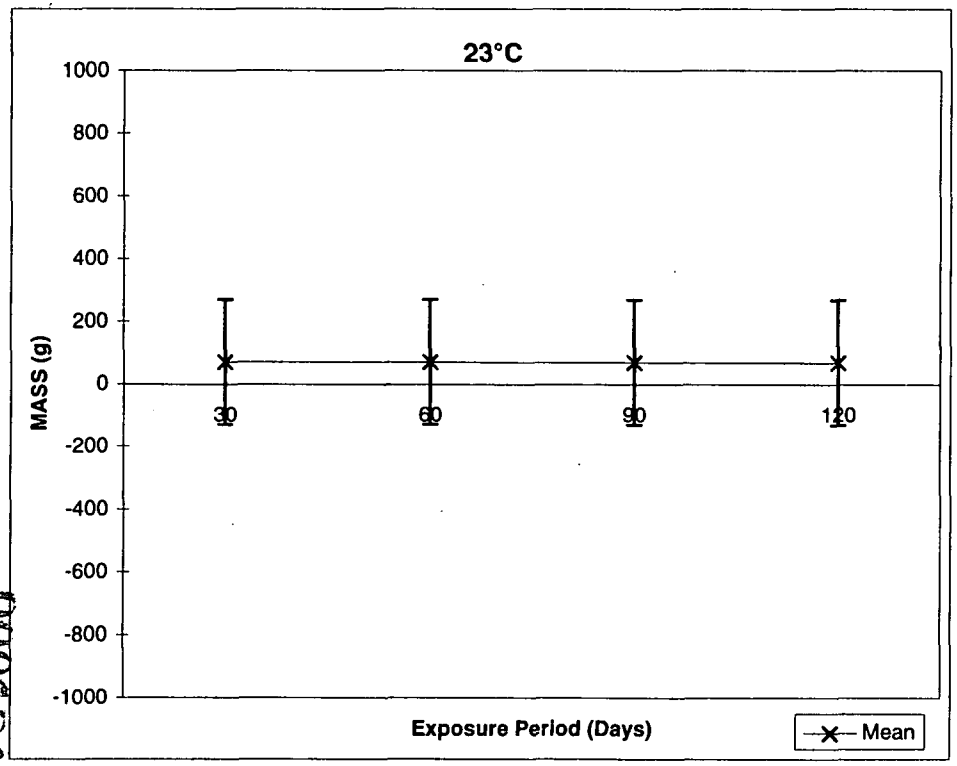
CHEMICAL COMPATIBILITY TEST RESULTS

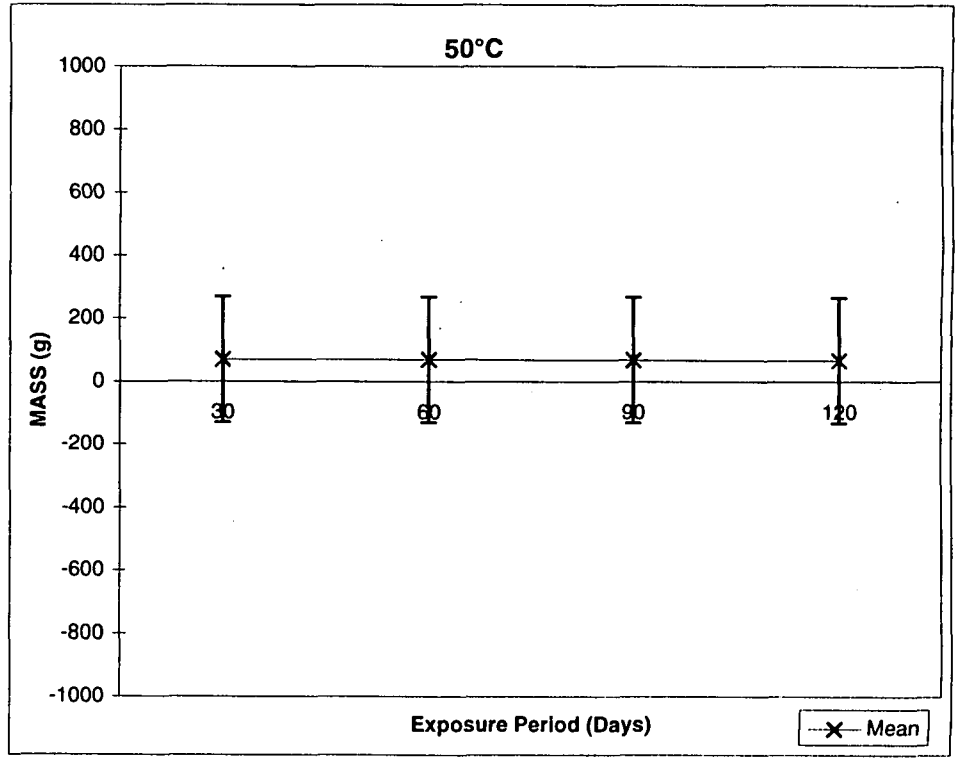
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MASS (g)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	70.2850	69.3090	69.5430	71.4670		70.1510	1.0	0.0	68.6020	70.0040	70.5560	68.9810		69.5358	0.9	0.0	CR
30	70.3020	69.3130	69.5430	71.4680		70.1565	1.0	0.0	68.6200	70.0120	70.5650	68.9740		69.5428	0.9	0.0	CR
60	68.7410	69.7410	69.9980	72.1690		70.1623	1.4	0.0	69.5410	69.3690	68.9750	69.4600		69.3363	0.3	-0.3	CR
90	69.3480	70.2450	69.9600	68.9310		69.6210	0.6	-0.8	68.6080	68.9370	69.4810	67.7360		68.6905	0.7	-1.2	CR
120	67.5900	69.0280	69.8890	67.8320		68.5848	1.1	-2.2	67.4210	66.2400	67.3470	66.4480		66.8640	0.6	-3.8	CR





© 1996 GEOSYNTEC CONSULTANTS

000184

382

2.2 Thickness

Rationale for Test

Similarly to the mass measurements above, thickness increases when a material has absorbed some constituents of the leachate. Likewise, thickness decreases when leachate has extracted constituents from a material. Therefore, mass and thickness undergo parallel changes when a leachate acts on a material. Thickness (as with mass) values can provide an indication of how much a material has either swelled or contracted as the result of interaction with leachate.

Results and Discussion

As with mass, the thickness of each geomembrane was also constant (within the limits of measurement of the test methodology and the inherent variability in HDPE geomembrane sheet thickness) during the 120 days of exposure to the test leachate. In addition, all of the mean values for the exposed samples were within one standard deviation of the control value means.

Conclusion

The test leachate did not measurably impact the thickness of the geomembranes during the 120 day exposure period.

draft

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

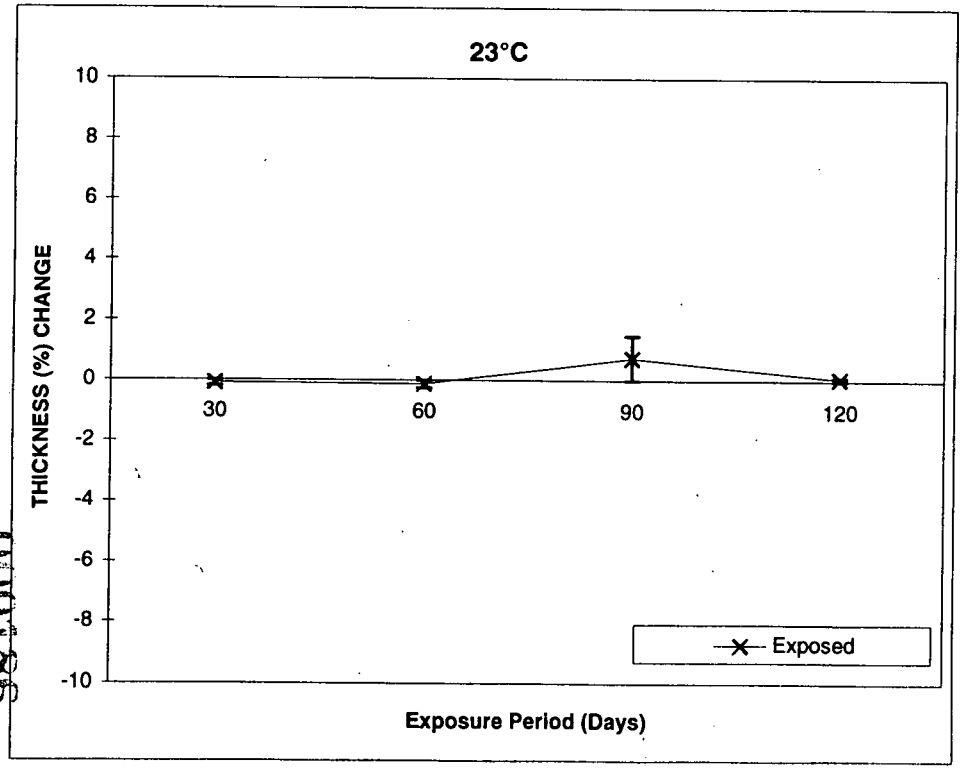
CHEMICAL COMPATIBILITY TEST RESULTS

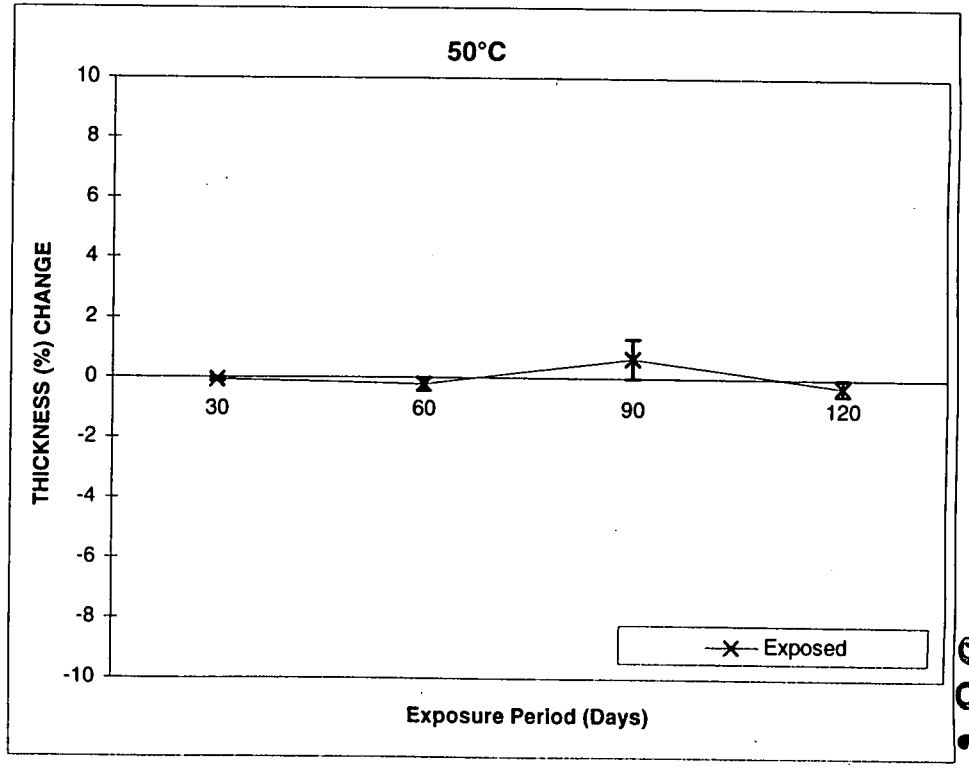
CLIENT: FERMCO
METHOD: ASTM D374C
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): THICKNESS (mil)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	86.9	86.4	84.1	77.9		83.8250	4.1	0.000	83.0	78.4	85.2	82.3		82.2250	2.8	0.000	CR
30	86.7	86.3	84.2	77.8		83.7500	4.1	-0.089	83.1	78.5	85.1	82.0		82.1750	2.8	-0.061	CR
Control	82.8	79.9	82.5	84.8		82.5000	2.0	0.000	77.5	77.7	84.4	83.9		80.8750	3.8	0.000	CR
60	82.9	79.8	82.4	84.5		82.4000	2.0	-0.121	77.4	77.5	84.1	83.8		80.7000	3.8	-0.216	CR
Control	78.1	79.0	83.9	83.5		81.1250	3.0	0.000	87.2	83.0	82.7	80.7		83.4000	2.7	0.000	CR
90	80.6	82.0	83.9	80.4		81.7250	1.6	0.740	88.4	83.6	83.2	80.6		83.9500	3.3	0.659	CR
Control	79.4	83.9	80.2	86.0		82.3750	3.1	0.000	81.7	84.1	83.4	83.6		83.2000	1.0	0.000	CR
120	79.5	83.9	80.0	86.3		82.4250	3.2	0.061	81.6	84.3	83.0	83.0		82.9750	1.1	-0.270	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

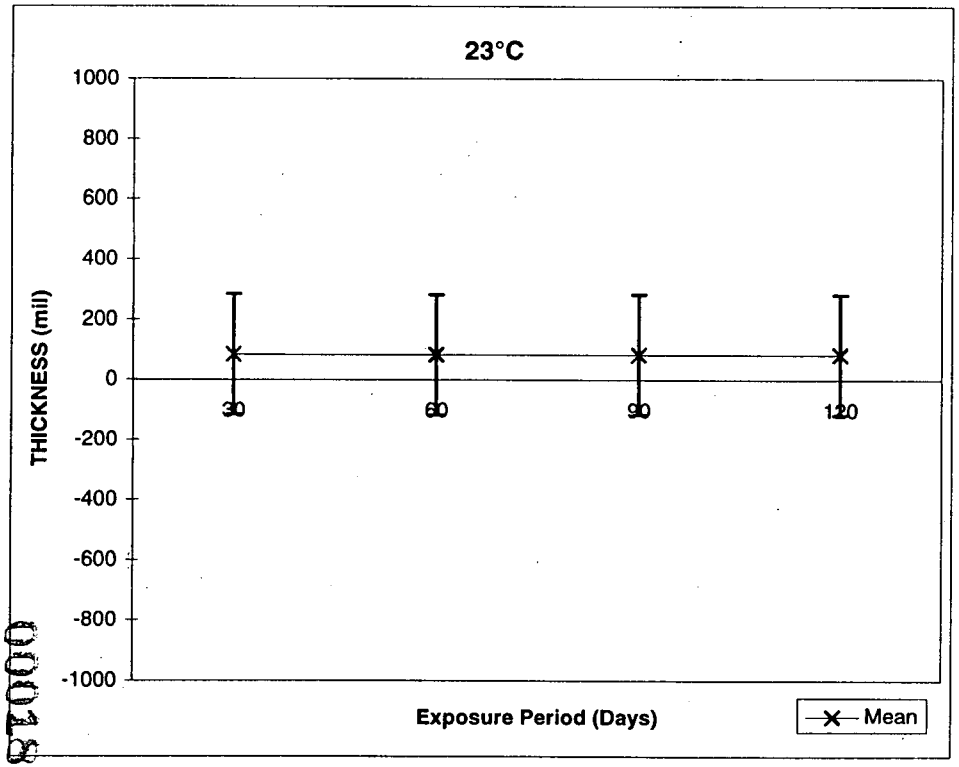
CHEMICAL COMPATIBILITY TEST RESULTS

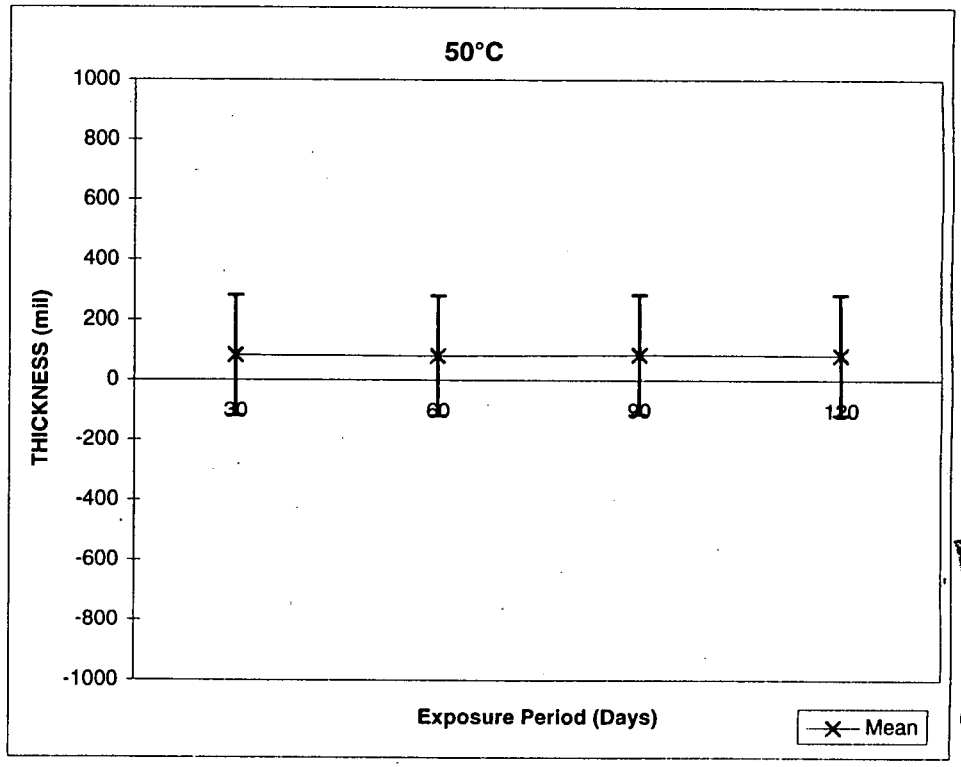
CLIENT: FERMCO
METHOD: ASTM D374C
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): THICKNESS (mil)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	86.9	86.4	84.1	77.9		83.8250	4.1	0.0	83.0	78.4	85.2	82.3		82.2250	2.8	0.0	CR
30	86.7	86.3	84.2	77.8		83.7500	4.1	-0.1	83.1	78.5	85.1	82.0		82.1750	2.8	-0.1	CR
60	82.9	79.8	82.4	84.5		82.4000	2.0	-1.7	77.4	77.5	84.1	83.8		80.7000	3.8	-1.9	CR
90	80.6	87.0	83.9	80.4		82.9750	3.1	-1.0	88.4	83.6	83.2	83.6		84.7000	2.5	3.0	CR
120	79.5	83.9	80.0	86.3		82.4250	3.2	-1.7	81.6	84.3	83.0	83.0		82.9750	1.1	0.9	CR





© 1996 GEOSYNTEC CONSULTANTS

000287

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

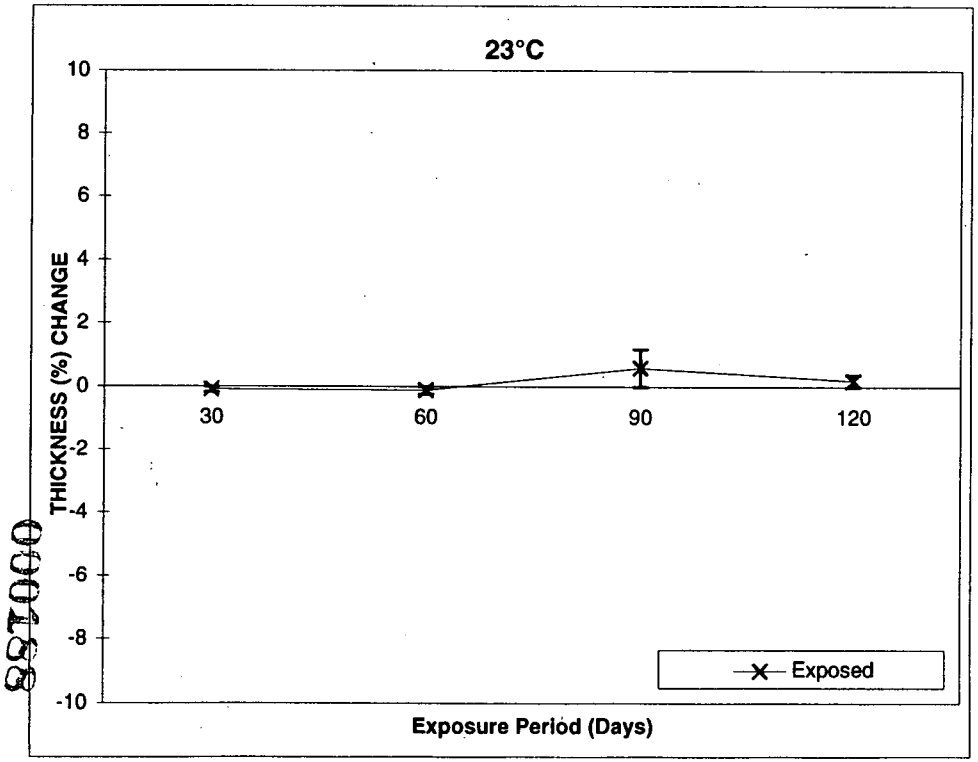
CHEMICAL COMPATIBILITY TEST RESULTS

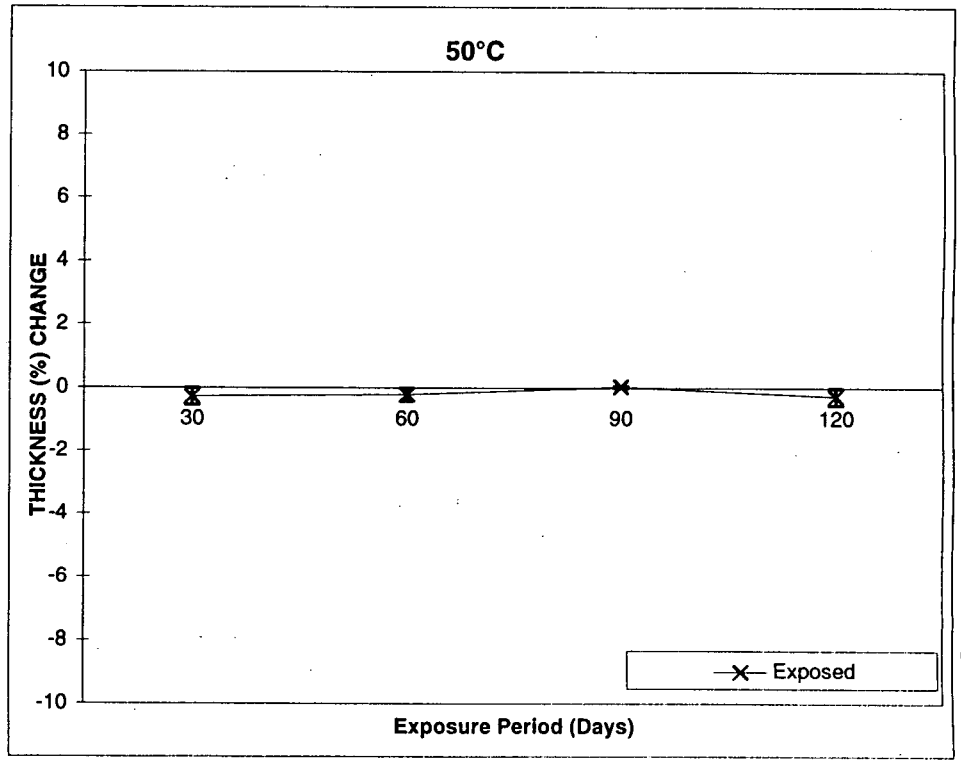
CLIENT: FERMCO
METHOD: ASTM D374C
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): THICKNESS (mil)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	80.7	80.6	80.4	80.0		80.4250	0.3	0.000	79.9	81.6	79.8	80.9		80.5500	0.9	0.000	CR
30	80.6	80.5	80.3	80.0		80.3525	0.3	-0.090	79.8	81.5	79.6	80.4		80.3250	0.9	-0.279	CR
Control	82.8	79.9	82.5	84.8		82.5000	2.0	0.000	79.4	81.0	80.8	80.6		80.4500	0.7	0.000	CR
60	82.9	79.8	82.4	84.5		82.4000	2.0	-0.121	79.1	81.2	80.3	80.5		80.2750	0.9	-0.218	CR
Control	80.8	81.0	79.6	80.4		80.4500	0.6	0.000	81.5	80.2	80.8	80.7		80.8000	0.5	0.000	CR
90	81.0	81.2	80.2	81.3		80.9250	0.5	0.590	81.9	80.6	80.0	80.8		80.8250	0.8	0.031	CR
Control	80.8	79.6	79.5	80.5		80.1000	0.6	0.000	80.5	80.2	80.4	81.3		80.6000	0.5	0.000	CR
120	80.5	79.5	80.0	81.0		80.2500	0.6	0.187	80.0	80.0	80.5	81.0		80.3750	0.5	-0.279	CR





000188

387

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

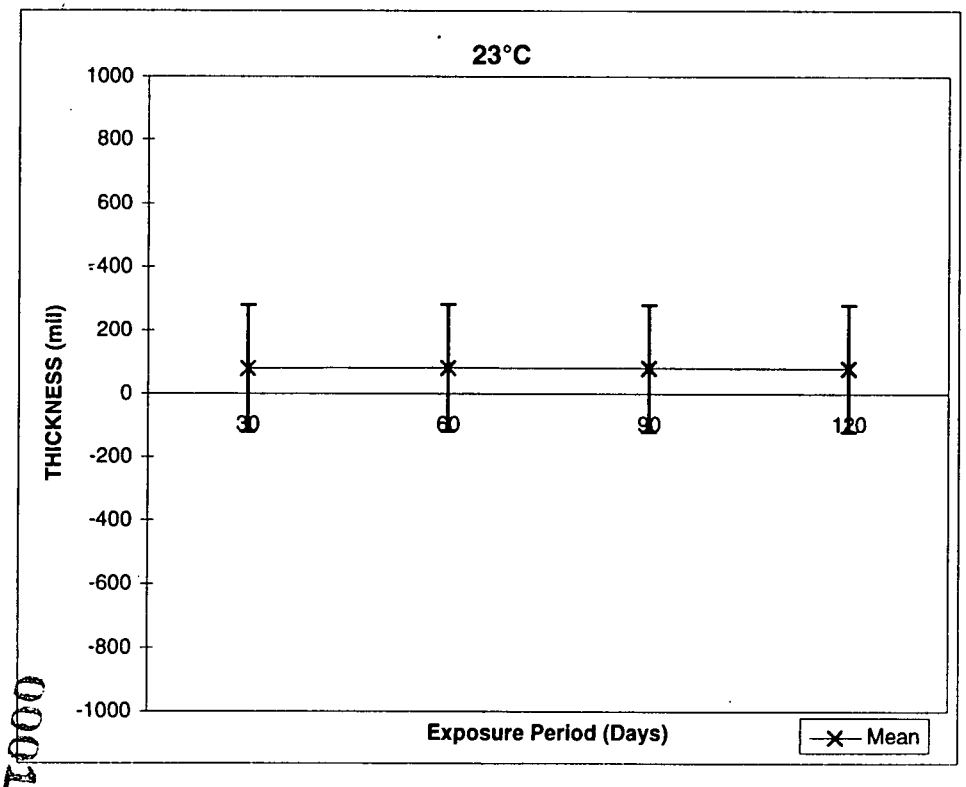
CHEMICAL COMPATIBILITY TEST RESULTS

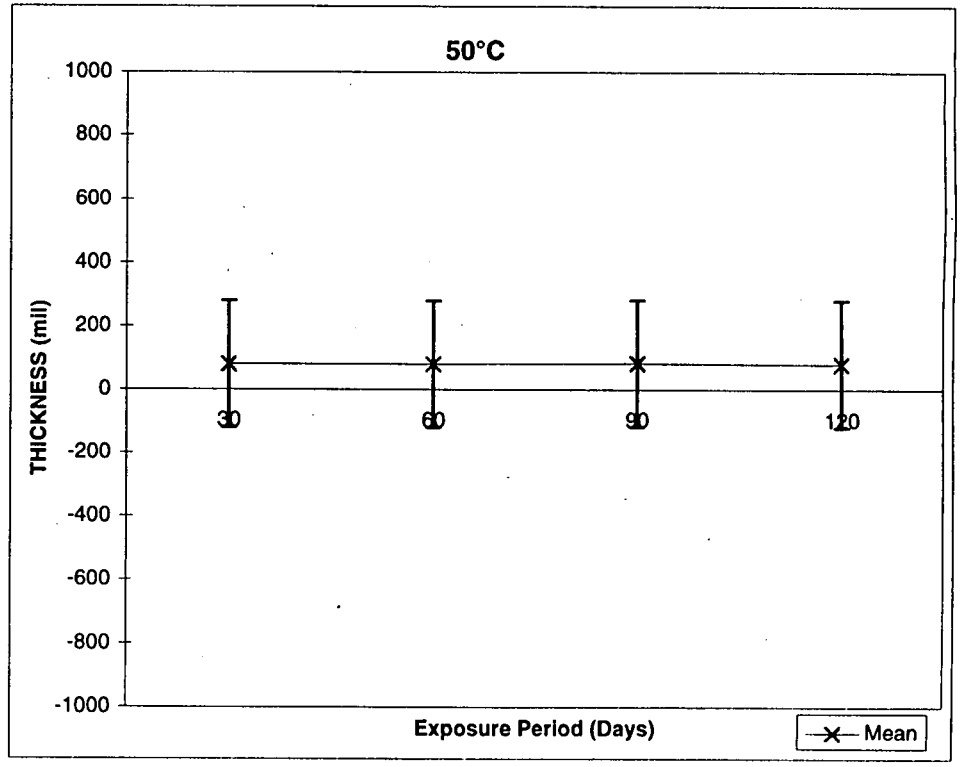
CLIENT: *FERMCO*
METHOD: *ASTM D374C*
DATE TESTED: *06/14/96*

GEOSYNTEC JOB NO.: *GE 3900*
MATERIAL TYPE: *NSC*
CHARACTERISTICS: *80 mil HDPE Geomembrane*
IMMERSION MEDIUM: *Perched Ground Water*

PROPERTY (UNIT): THICKNESS (mil)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	80.7	80.6	80.4	80.0		80.4250	0.3	0.0	79.9	81.6	79.8	80.9		80.5500	0.9	0.0	CR
30	80.6	80.5	80.3	80.0		80.3525	0.3	-0.1	79.8	81.5	79.6	80.4		80.3250	0.9	-0.3	CR
60	82.9	79.8	82.4	84.5		82.4000	2.0	2.5	79.1	81.2	80.3	80.5		80.2750	0.9	-0.3	CR
90	81.0	81.2	80.2	81.3		80.9250	0.5	0.6	81.9	80.6	86.0	81.8		82.5750	2.4	2.5	CR
120	80.5	79.5	80.0	81.0		80.2500	0.6	-0.2	80.0	80.0	80.5	81.0		80.3750	0.5	-0.2	CR





© 1996 GEOSYNTEC CONSULTANTS

000189

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

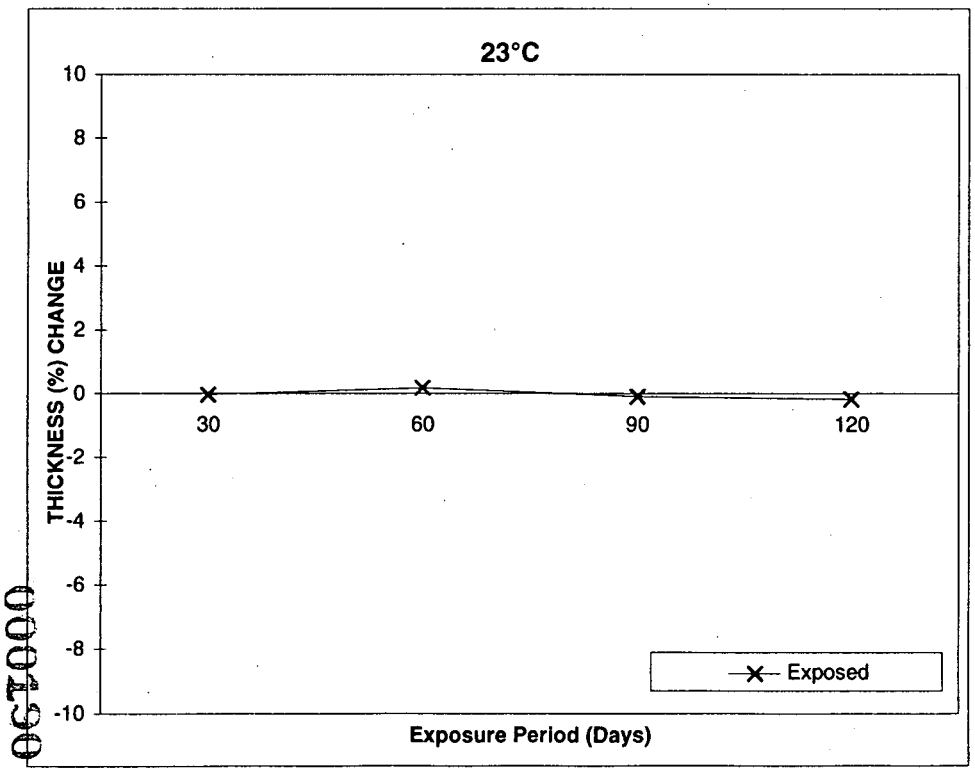
CHEMICAL COMPATIBILITY TEST RESULTS

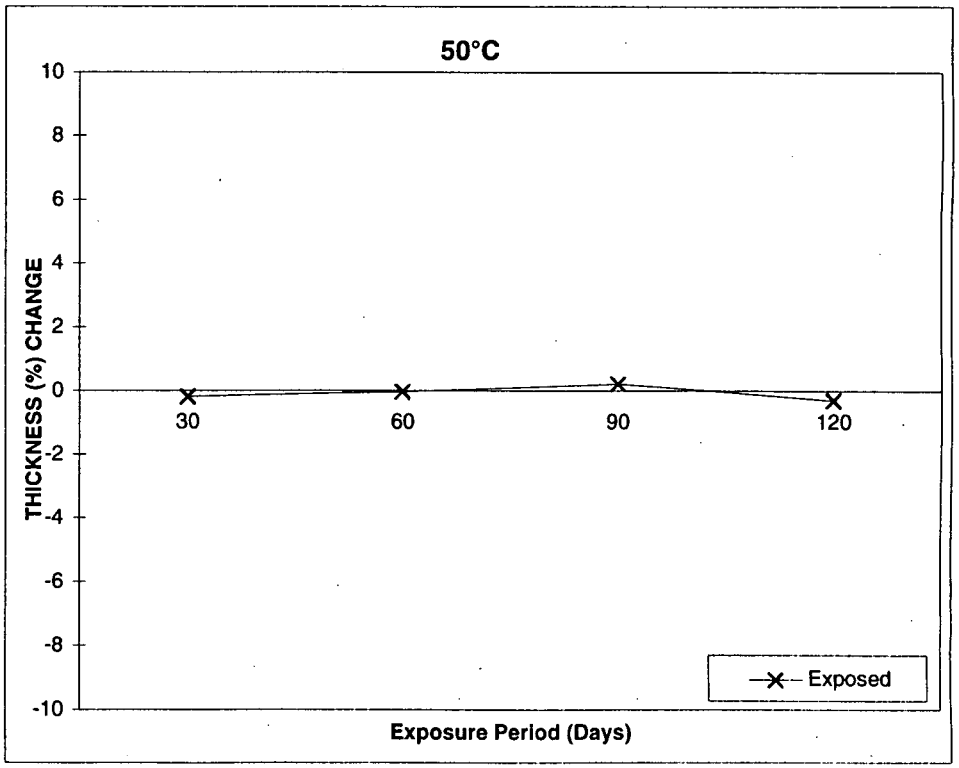
CLIENT: *FERMCO*
METHOD: *ASTM D374C*
DATE TESTED: *06/14/96*

GEOSYNTEC JOB NO.: *GE 3900*
MATERIAL TYPE: *GSE Gundle*
CHARACTERISTICS: *80 mil HDPE Geomembrane*
IMMERSION MEDIUM: *Perched Ground Water*

PROPERTY (UNIT): THICKNESS (mil)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	80.5	80.9	80.6	81.9		80.9750	0.6	0.000	80.9	80.1	79.4	78.9		79.8250	0.9	0.000	CR
30	80.6	80.9	80.6	81.7		80.9500	0.5	-0.031	80.4	80.2	79.3	78.8		79.6750	0.8	-0.188	CR
Control	86.8	80.4	85.3	83.6		84.0250	2.7	0.000	79.9	80.9	77.4	80.4		79.6500	1.6	0.000	CR
60	86.9	80.5	85.6	83.7		84.1750	2.8	0.179	79.9	80.5	77.5	80.6		79.6250	1.5	-0.031	CR
Control	78.5	81.7	83.2	82.4		81.4500	2.1	0.000	79.8	81.7	83.5	82.3		81.8250	1.5	0.000	CR
90	79.7	82.2	81.1	82.5		81.3750	1.3	-0.092	80.6	81.3	83.9	82.2		82.0000	1.4	0.214	CR
Control	82.4	82.5	84.6	83.1		83.1500	1.0	0.000	82.1	82.9	83.1	83.7		82.9500	0.7	0.000	CR
120	82.5	82.0	84.5	83.0		83.0000	1.1	-0.180	82.0	82.5	83.0	83.3		82.7000	0.6	-0.301	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

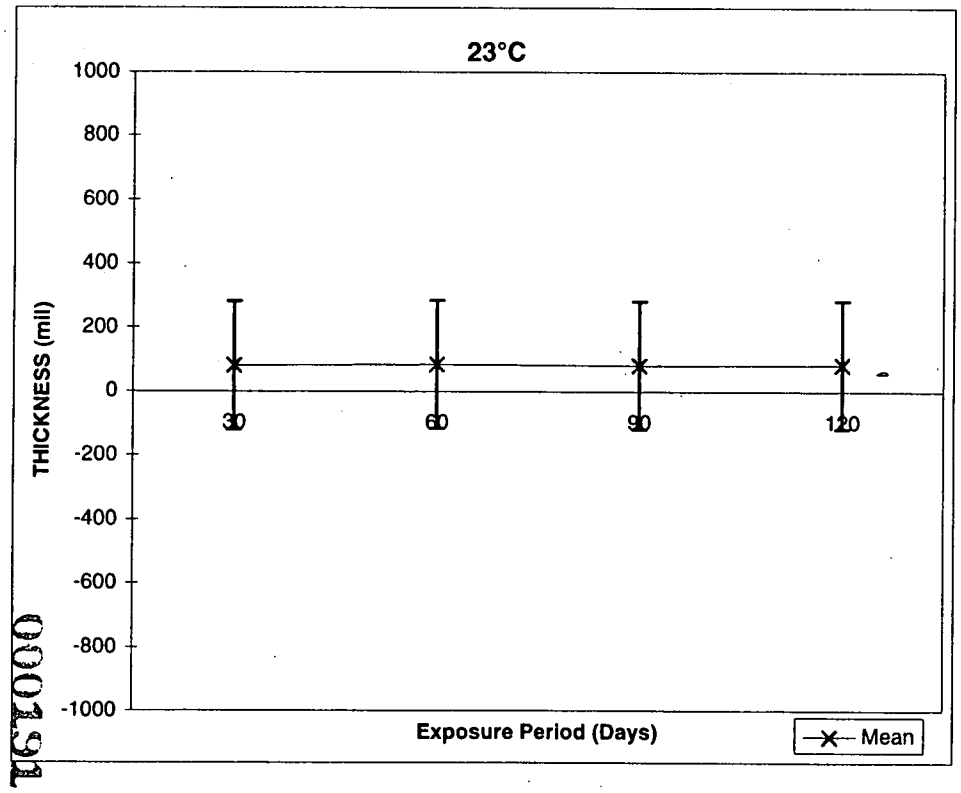
CHEMICAL COMPATIBILITY TEST RESULTS

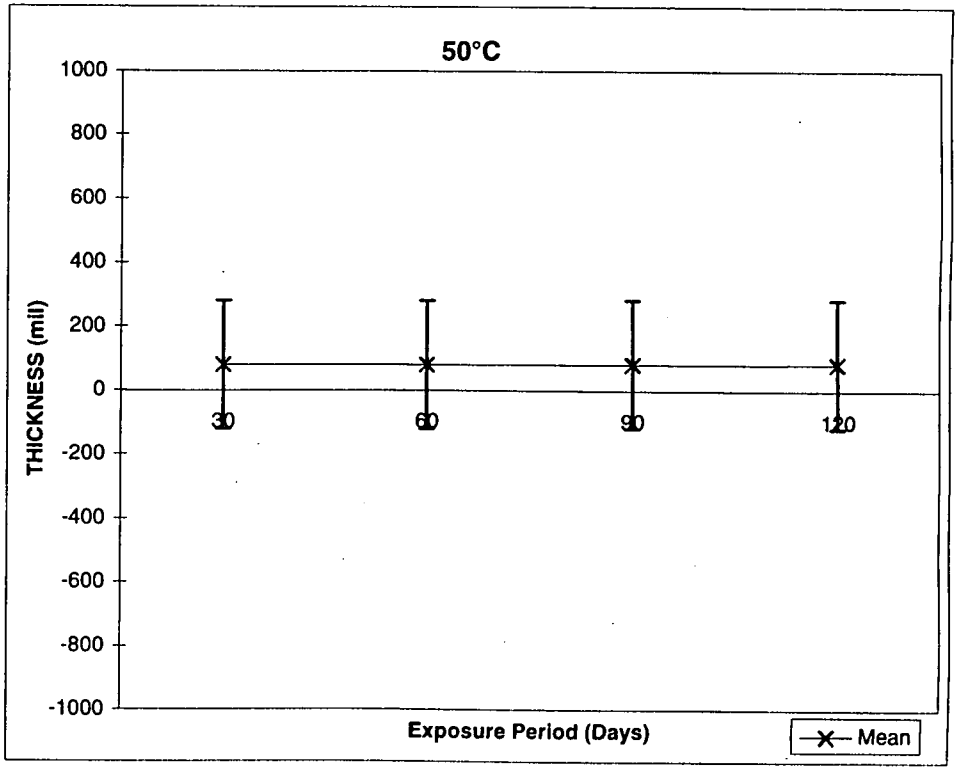
CLIENT: FERMCO
METHOD: ASTM D374C
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): THICKNESS (mil)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	80.5	80.9	80.6	81.9		80.9750	0.6	0.0	80.9	80.1	79.4	78.9		79.8250	0.9	0.0	CR
30	80.6	80.9	80.6	81.7		80.9500	0.5	0.0	80.4	80.2	79.3	78.8		79.6750	0.8	-0.2	CR
60	86.9	80.5	85.6	83.7		84.1750	2.8	4.0	79.9	80.5	77.5	80.6		79.6250	1.5	-0.3	CR
90	79.7	82.2	81.1	82.5		81.3750	1.3	0.5	80.6	81.3	83.9	82.2		82.0000	1.4	2.7	CR
120	82.5	82.0	84.5	83.0		83.0000	1.1	2.5	82.0	82.5	83.0	83.3		82.7000	0.6	3.6	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

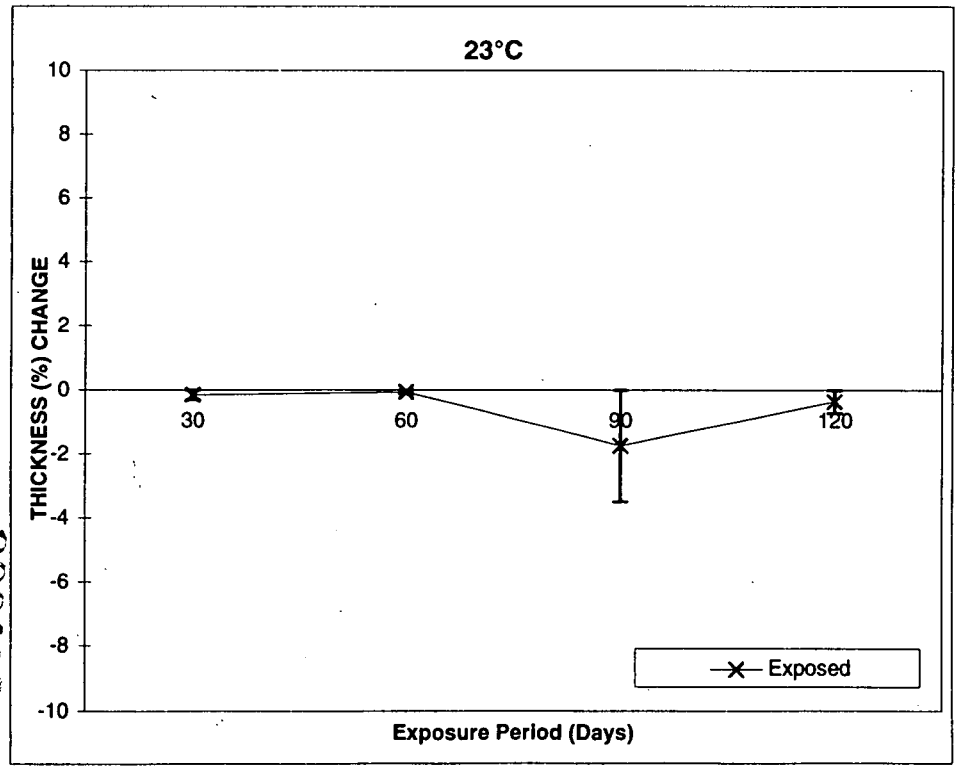
CHEMICAL COMPATIBILITY TEST RESULTS

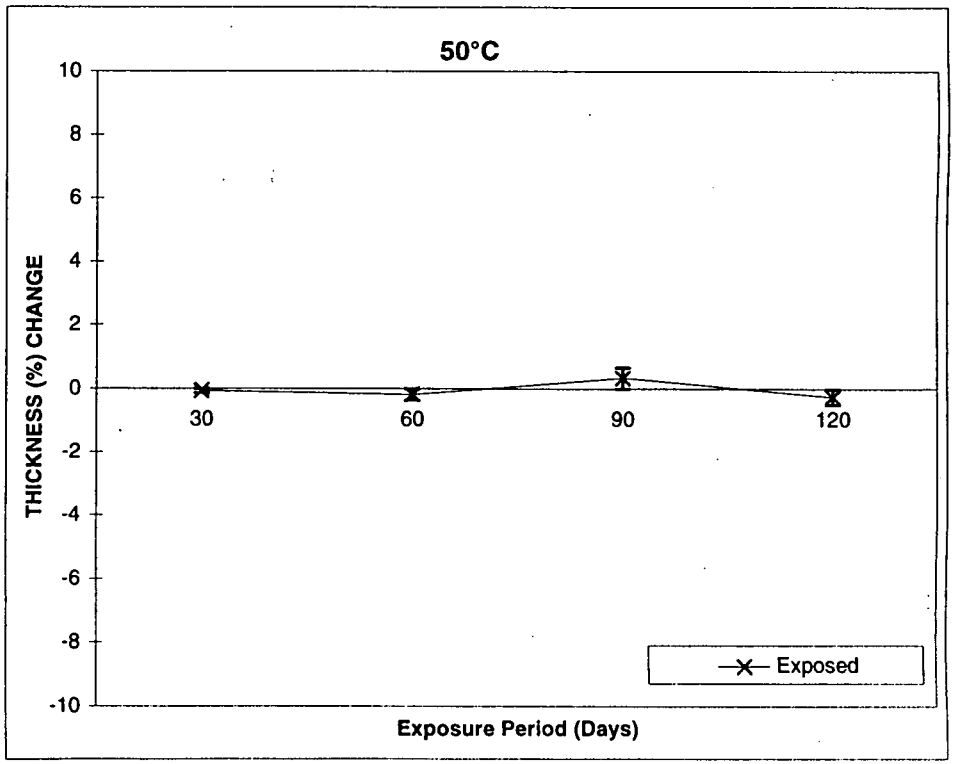
CLIENT: FERMCO
METHOD: ASTM D374C
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): THICKNESS (mil)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	76.4	81.5	83.4	83.3		81.1500	3.3	0.000	75.3	72.7	73.7	81.1		75.7000	3.8	0.000	CR
30	76.5	81.3	83.1	83.2		81.0250	3.1	-0.154	75.2	72.6	73.8	81.0		75.6500	3.7	-0.066	CR
Control	80.1	80.4	73.2	86.3		80.0000	5.4	0.000	86.7	77.8	78.3	80.9		80.9250	4.1	0.000	CR
60	80.0	80.2	73.4	86.2		79.9500	5.2	-0.062	86.5	77.6	78.2	80.8		80.7750	4.1	-0.185	CR
Control	80.2	71.7	70.1	71.4		73.3500	4.6	0.000	70.9	75.2	75.9	75.0		74.2500	2.3	0.000	CR
90	76.0	70.2	70.8	71.3		72.0750	2.7	-1.738	73.4	77.4	75.0	72.2		74.5000	2.2	0.337	CR
Control	75.0	76.3	76.6	75.3		75.8000	0.8	0.000	75.6	77.8	75.9	81.2		77.6250	2.6	0.000	CR
120	75.0	76.1	76.0	75.0		75.5250	0.6	-0.363	75.0	77.5	75.6	81.6		77.4250	3.0	-0.258	CR





000192

387

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

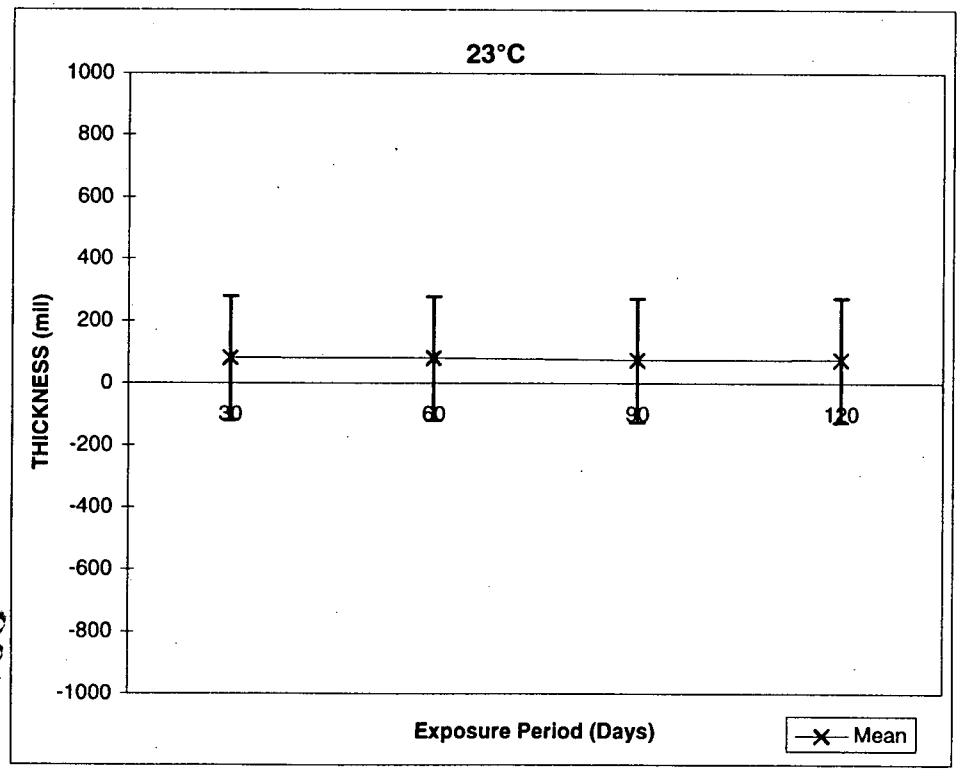
CHEMICAL COMPATIBILITY TEST RESULTS

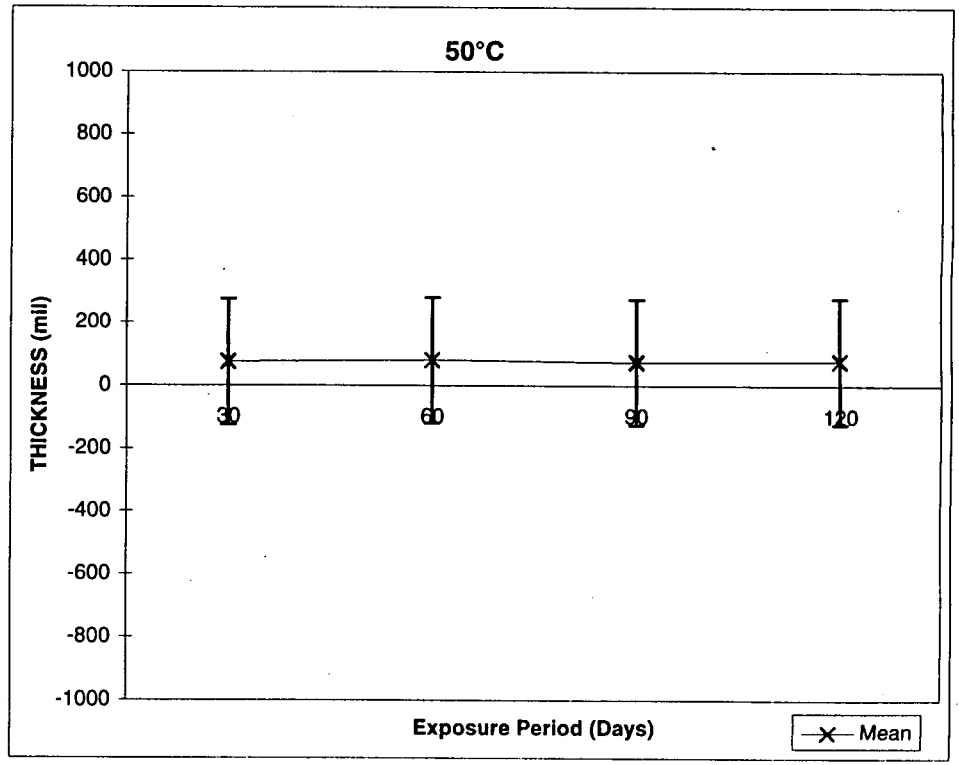
CLIENT: FERMCO
METHOD: ASTM D374C
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): THICKNESS (mil)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	76.4	81.5	83.4	83.3		81.1500	3.3	0.0	75.3	72.7	73.7	81.1		75.7000	3.8	0.0	CR
30	76.5	81.3	83.1	83.2		81.0250	3.1	-0.2	75.2	72.6	73.8	81.0		75.6500	3.7	-0.1	CR
60	80.0	80.2	73.4	86.2		79.9500	5.2	-1.5	86.5	77.6	78.2	80.8		80.7750	4.1	6.7	CR
90	76.0	70.2	76.8	74.3		74.3250	2.9	-8.4	75.4	77.4	75.0	72.2		75.0000	2.1	-0.9	CR
120	75.0	76.1	76.0	75.0		75.5250	0.6	-6.9	75.0	77.5	75.6	81.6		77.4250	3.0	2.3	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

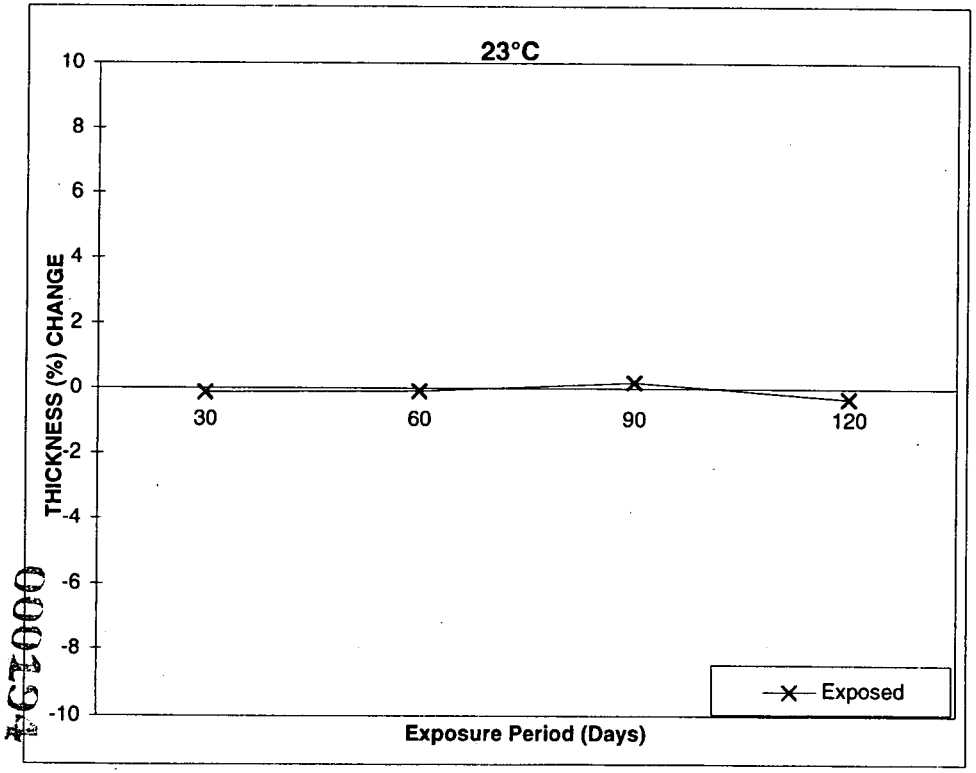
CHEMICAL COMPATIBILITY TEST RESULTS

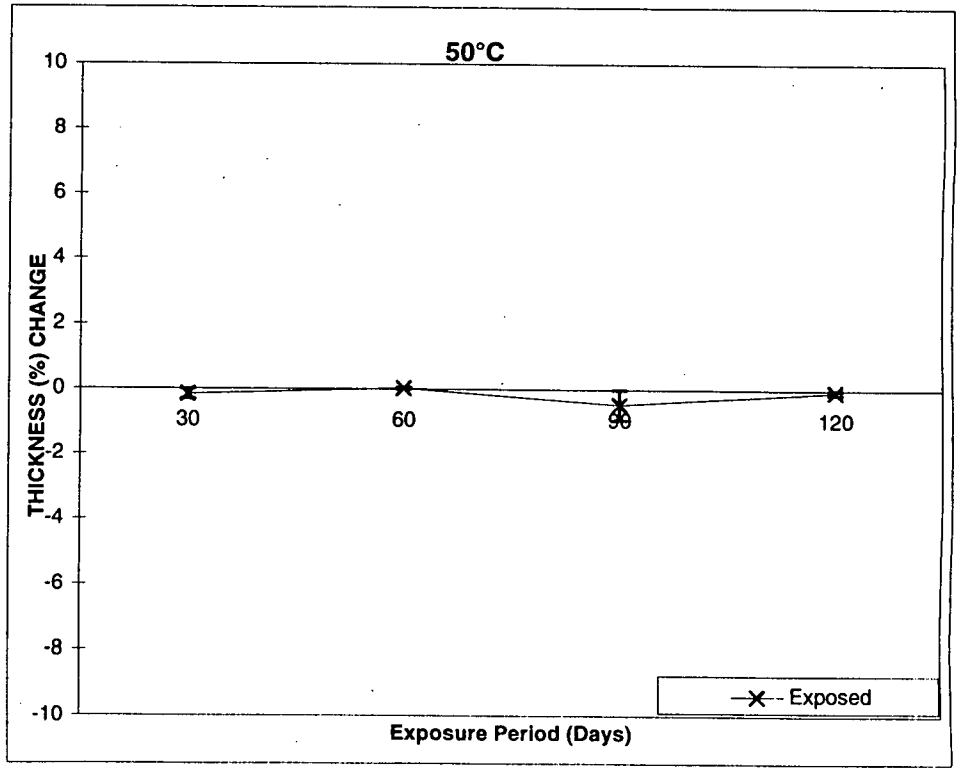
CLIENT: FERMCO
METHOD: ASTM D374C
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): THICKNESS (mil)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	79.7	79.5	80.2	81.6		80.2500	0.9	0.000	79.9	80.6	82.2	82.0		81.1750	1.1	0.000	CR
30	79.8	79.4	80.0	81.4		80.1500	0.9	-0.125	79.8	80.4	82.0	82.0		81.0500	1.1	-0.154	CR
Control	81.1	82.3	81.5	83.3		82.0500	1.0	0.000	81.1	81.1	81.3	82.3		81.4500	0.6	0.000	CR
60	81.1	82.3	81.4	83.1		81.9750	0.9	-0.091	81.1	81.0	81.4	82.4		81.4750	0.6	0.031	CR
Control	80.9	82.2	82.4	80.7		81.5500	0.9	0.000	81.3	82.1	82.0	78.7		81.0250	1.6	0.000	CR
90	81.5	80.9	82.0	82.4		81.7000	0.6	0.184	80.3	78.8	82.0	81.5		80.6500	1.4	-0.463	CR
Control	80.9	81.1	82.4	79.9		81.0750	1.0	0.000	78.0	77.8	78.0	78.8		78.1500	0.4	0.000	CR
120	80.5	81.0	82.3	79.5		80.8250	1.2	-0.308	78.0	77.6	78.3	78.5		78.1000	0.4	-0.064	CR





© 1996 GEOSYNTEC CONSULTANTS

000294

383 2

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

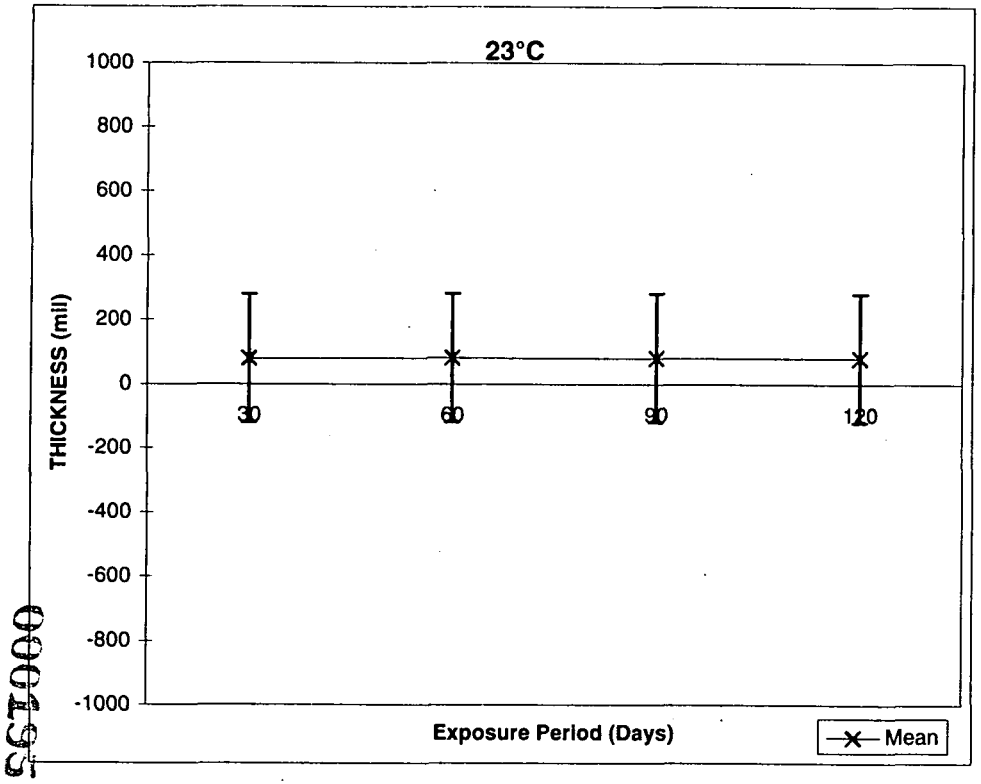
CHEMICAL COMPATIBILITY TEST RESULTS

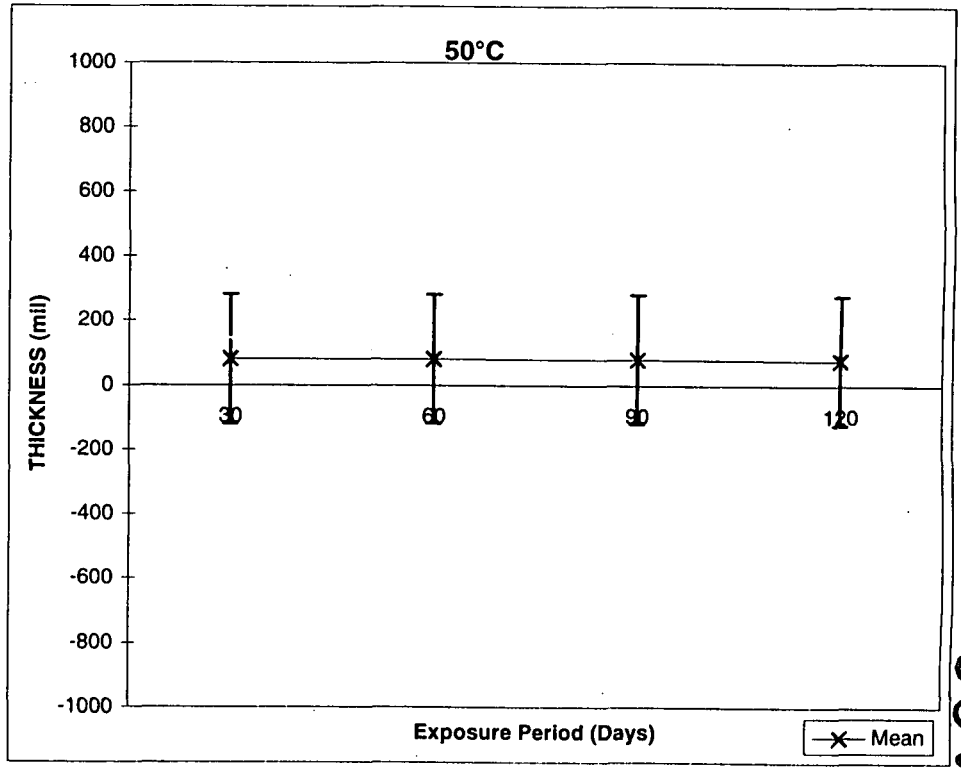
CLIENT: *FERMCO*
METHOD: *ASTM D374C*
DATE TESTED: *06/14/96*

GEOSYNTEC JOB NO.: *GE 3900*
MATERIAL TYPE: *SERROT*
CHARACTERISTICS: *80 mil HDPE Geomembrane*
IMMERSION MEDIUM: *Perched Ground Water*

PROPERTY (UNIT): THICKNESS (mil)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	79.7	79.5	80.2	81.6		80.2500	0.9	0.0	79.9	80.6	82.2	82.0		81.1750	1.1	0.0	CR
30	79.8	79.4	80.0	81.4		80.1500	0.9	-0.1	79.8	80.4	82.0	82.0		81.0500	1.1	-0.2	CR
60	81.1	82.3	81.4	83.1		81.9750	0.9	2.1	81.1	81.0	81.4	82.4		81.4750	0.6	0.4	CR
90	81.5	80.9	82.0	82.4		81.7000	0.6	1.8	80.3	78.8	82.0	81.5		80.6500	1.4	-0.6	CR
120	80.5	81.0	82.3	79.5		80.8250	1.2	0.7	78.0	77.6	78.3	78.5		78.1000	0.4	-3.8	CR





© 1996 GEOSYNTEC CONSULTANTS

2.3 Dimensions

Rationale for Test

Displaying behavior parallel to mass and thickness, dimensions (i.e., length in the machine and cross-machine directions) increase if a material has absorbed some constituents of leachate, and likewise, decrease if leachate has extracted constituents from a material. Accordingly, as with thickness, dimensions indicate whether a sample has swelled or contracted as the result of interaction with leachate.

Results and Discussion

Dimensions of the geomembranes were constant (within the limits of measurement of the test methodology and the inherent variability in HDPE sheet dimensions) during the 120 days of exposure to the test leachate. These results correlate well with mass and thickness. All of the exposed geomembrane mean dimensional values were within one standard deviation of the control value means.

Conclusion

The test leachate did not measurably impact the dimensions of the geomembranes during the 120 day exposure period.

draft

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

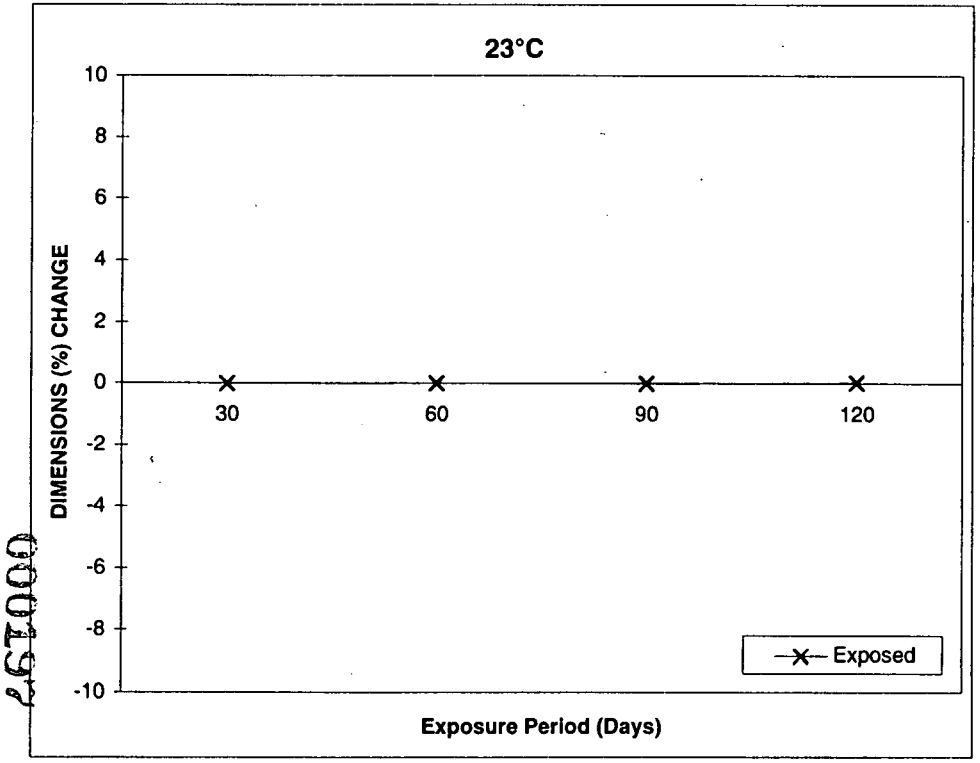
CHEMICAL COMPATIBILITY TEST RESULTS

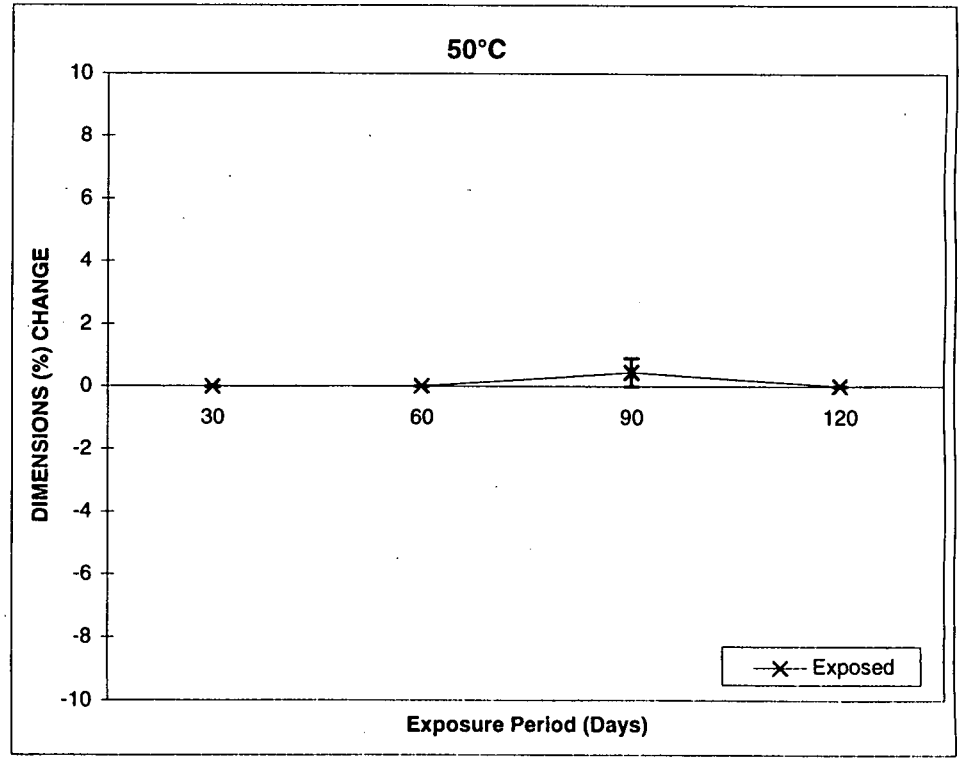
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: LENGTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	268.40	268.78	267.35	269.69		268.56	1.0	0.000	269.66	270.96	273.65	272.16		271.61	1.7	0.000	CR
30	268.38	268.72	267.30	269.64		268.51	1.0	-0.017	269.62	270.91	273.61	272.13		271.57	1.7	-0.015	CR
Control	267.35	272.04	272.75	271.37		270.88	2.4	0.000	270.12	269.00	269.06	270.66		269.71	0.8	0.000	CR
60	267.31	272.09	272.71	271.35		270.87	2.4	-0.005	270.15	269.04	269.12	270.61		269.73	0.8	0.007	CR
Control	271.64	271.20	272.46	270.90		271.55	0.7	0.000	272.30	273.19	274.30	269.49		272.32	2.1	0.000	CR
90	271.60	271.19	272.32	270.88		271.50	0.6	-0.019	272.30	273.29	279.18	269.46		273.56	4.1	0.454	CR
Control	268.71	271.04	269.65	271.47		270.22	1.3	0.000	272.59	272.34	275.53	271.04		272.88	1.9	0.000	CR
120	268.68	271.21	269.72	271.39		270.25	1.3	0.012	272.58	272.38	275.51	271.10		272.89	1.9	0.006	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000397

382

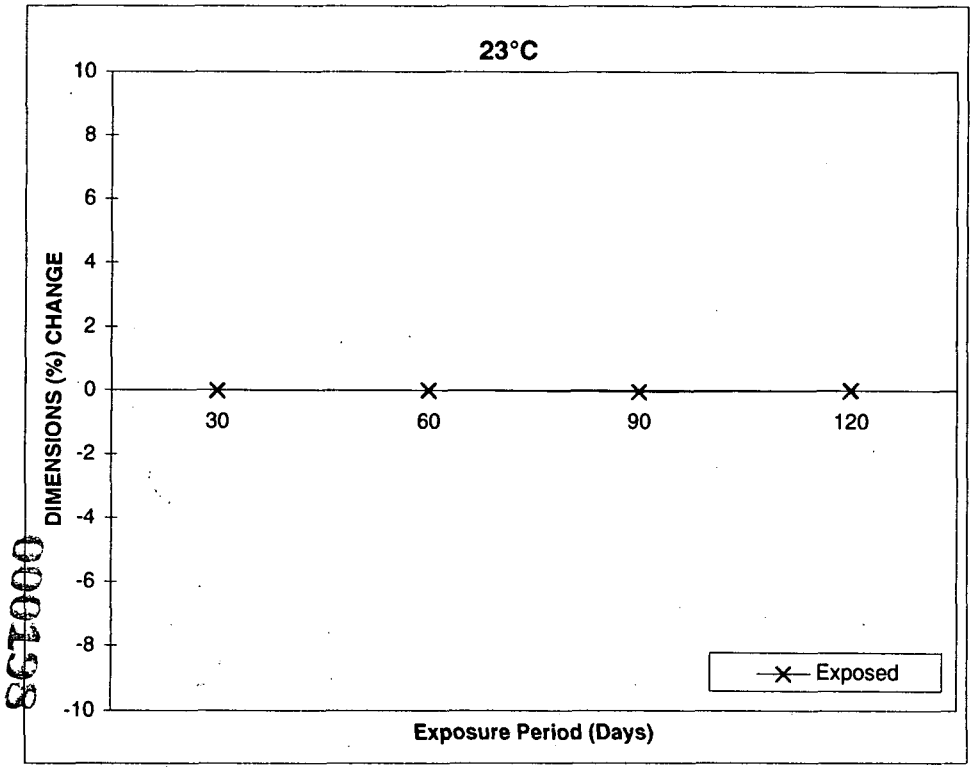
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

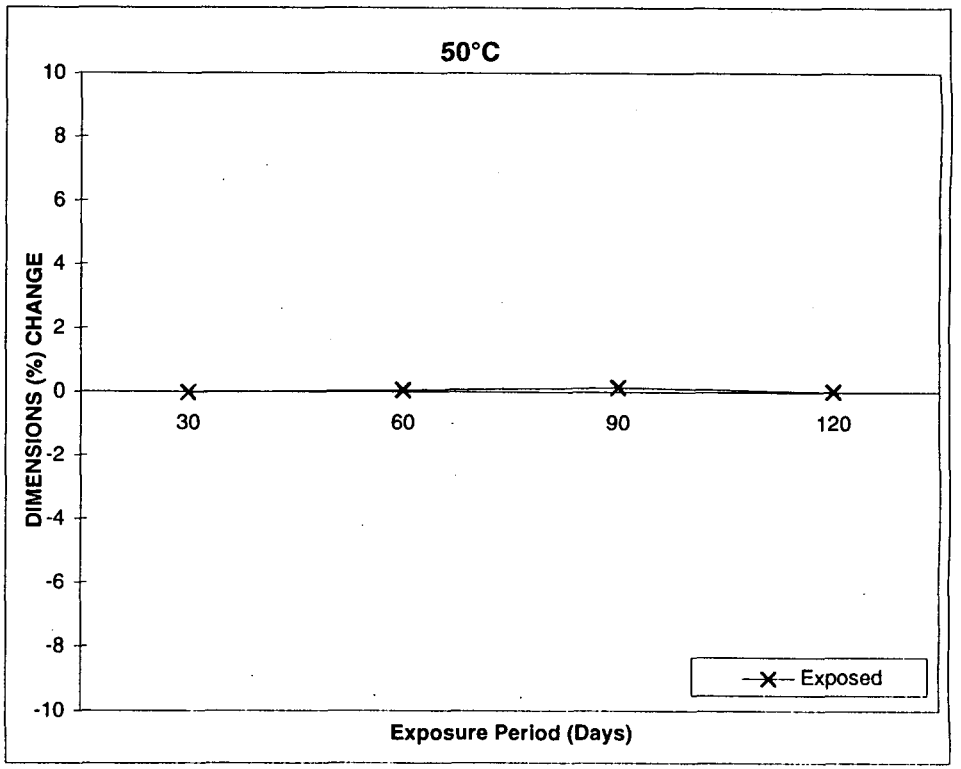
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*EPA 9090*	*MATERIAL TYPE:*	*GSE - SLT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: WIDTH

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	139.42	133.41	139.26	138.22		137.58	2.8	0.000	137.81	136.51	139.49	138.75		138.14	1.3	0.000	CR
30	139.38	133.40	139.21	138.21		137.55	2.8	-0.020	137.80	136.52	139.40	138.71		138.11	1.2	-0.024	CR
Control	139.26	132.95	138.26	138.23		137.18	2.9	0.000	138.71	140.54	137.22	138.85		138.83	1.4	0.000	CR
60	139.20	132.98	138.31	138.19		137.17	2.8	-0.004	138.75	140.61	137.28	138.91		138.89	1.4	0.041	CR
Control	139.35	138.94	141.39	138.84		139.63	1.2	0.000	139.15	137.67	139.29	139.00		138.78	0.7	0.000	CR
90	139.54	138.84	141.44	138.46		139.57	1.3	-0.043	139.41	137.55	139.72	139.20		138.97	1.0	0.139	CR
Control	140.34	135.86	137.62	138.73		138.14	1.9	0.000	138.46	137.90	138.67	139.89		138.73	0.8	0.000	CR
120	140.31	135.82	137.68	138.71		138.13	1.9	-0.005	138.49	137.92	138.68	139.91		138.75	0.8	0.014	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000398

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

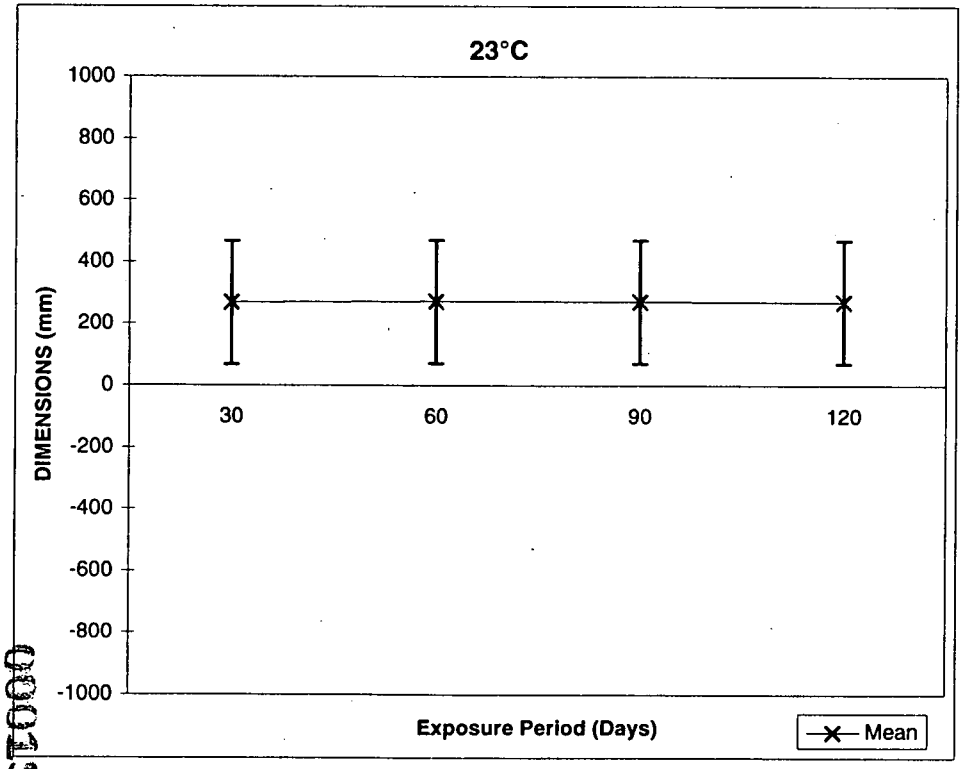
CHEMICAL COMPATIBILITY TEST RESULTS

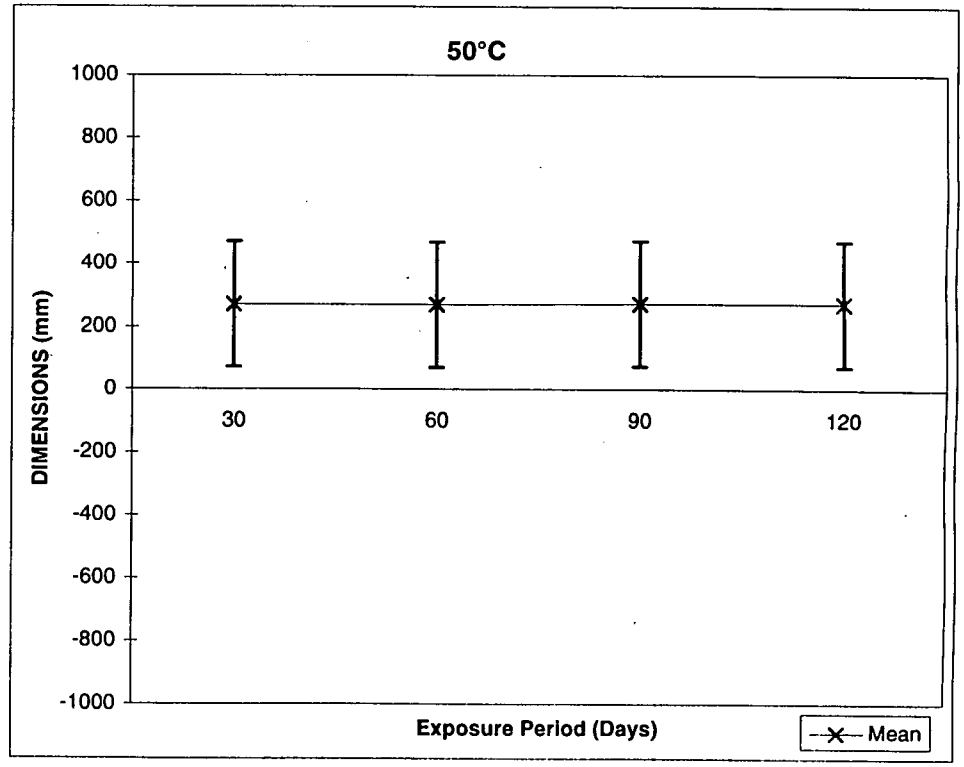
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: LENGTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	268.40	268.78	267.35	269.69		268.56	1.0	0.0	269.66	270.96	273.65	272.16		271.61	1.7	0.0	CR
30	268.38	268.72	267.30	269.64		268.51	1.0	0.0	269.62	270.91	273.61	272.13		271.57	1.7	0.0	CR
60	267.31	272.09	272.71	271.35		270.87	2.4	0.9	270.15	269.04	269.12	270.61		269.73	0.8	-0.7	CR
90	271.60	271.19	272.32	270.88		271.50	0.6	1.1	272.30	273.29	279.18	269.46		273.56	4.1	0.7	CR
120	268.68	271.21	269.72	271.39		270.25	1.3	0.6	272.58	272.38	275.51	271.10		272.89	1.9	0.5	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

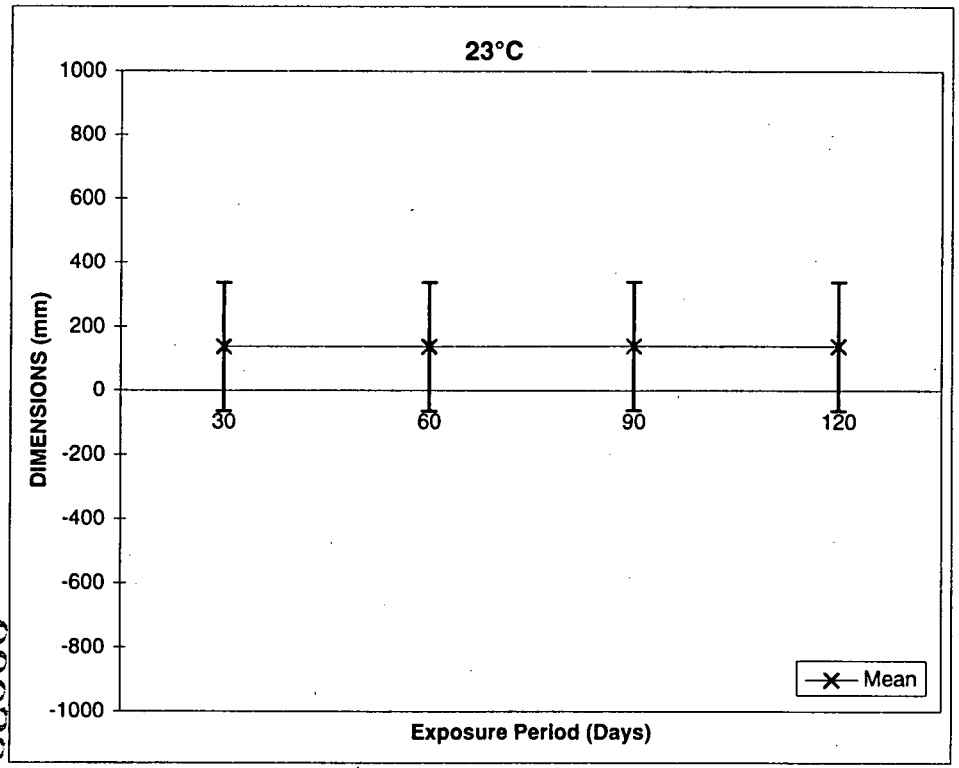
CHEMICAL COMPATIBILITY TEST RESULTS

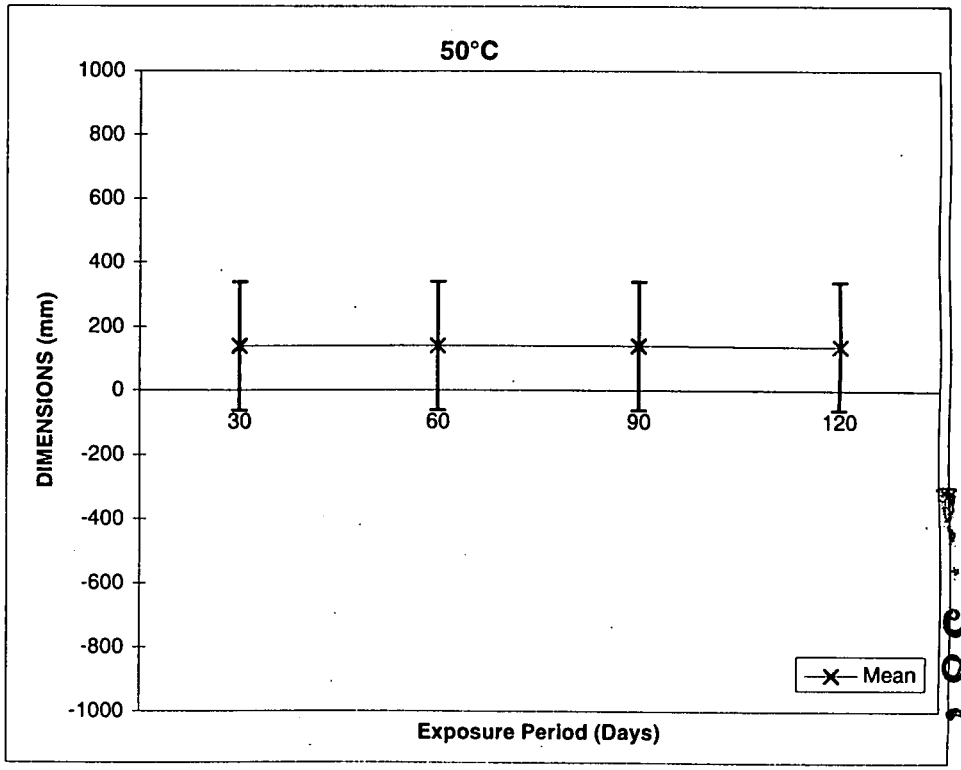
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: WIDTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	139.42	133.41	139.26	138.22		137.58	2.8	0.0	137.81	136.51	139.49	138.75		138.14	1.3	0.0	CR
30	139.38	133.40	139.21	138.21		137.55	2.8	0.0	137.80	136.52	139.40	138.71		138.11	1.2	0.0	CR
60	139.20	132.98	138.31	138.19		137.17	2.8	-0.3	138.75	140.61	137.28	138.91		138.89	1.4	0.5	CR
90	139.54	138.84	141.44	138.46		139.57	1.3	1.4	139.41	137.55	139.72	139.20		138.97	1.0	0.6	CR
120	140.31	135.82	137.68	138.71		138.13	1.9	0.4	138.49	137.92	138.68	139.91		138.75	0.8	0.4	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

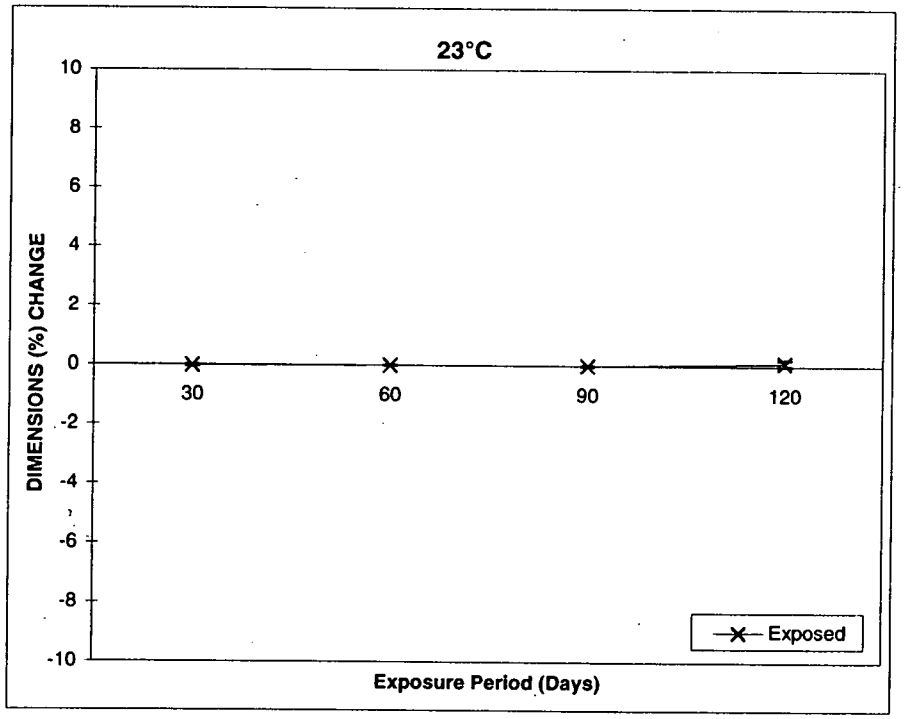
CHEMICAL COMPATIBILITY TEST RESULTS

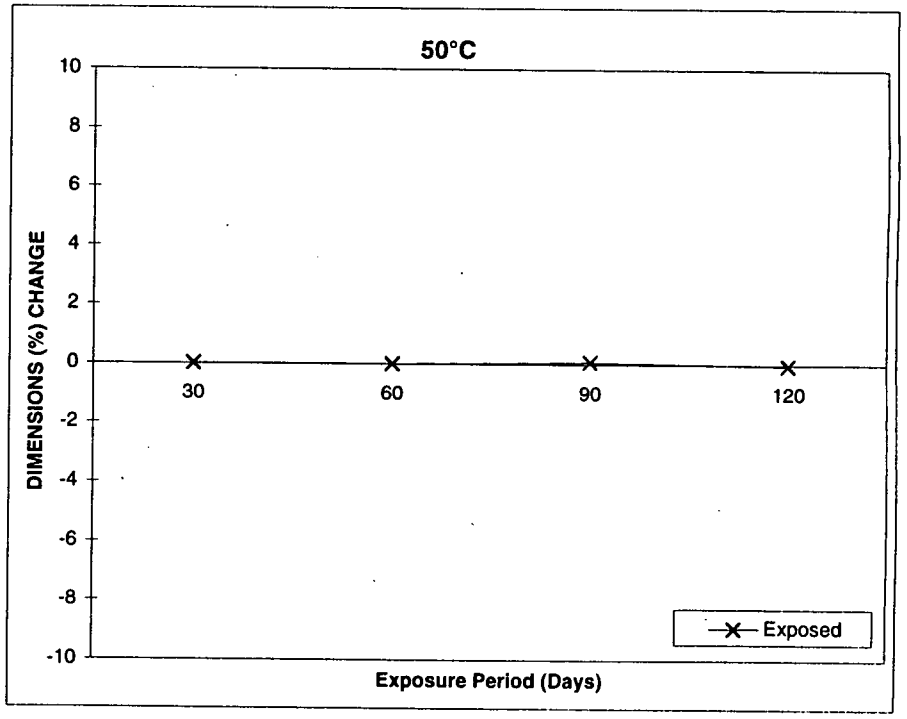
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: LENGTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	267.52	267.07	267.07	267.29		267.24	0.2	0.000	274.74	267.32	263.94	269.07		268.77	4.5	0.000	CR
30	267.48	267.01	267.03	267.21		267.18	0.2	-0.021	274.78	267.35	263.91	269.10		268.79	4.5	0.007	CR
Control	264.02	273.16	266.12	273.84		269.29	4.9	0.000	280.77	268.70	272.03	270.05		272.89	5.4	0.000	CR
60	264.01	273.18	266.09	273.86		269.29	5.0	0.000	280.79	268.74	272.05	270.06		272.91	5.4	0.008	CR
Control	270.90	276.98	269.67	273.33		272.72	3.2	0.000	276.27	272.06	271.97	269.41		272.43	2.8	0.000	CR
90	270.49	276.86	270.13	273.36		272.71	3.1	-0.004	276.66	272.56	271.95	269.38		272.64	3.0	0.077	CR
Control	270.35	276.44	276.51	271.22		273.63	3.3	0.000	269.84	273.87	272.87	275.32		272.98	2.3	0.000	CR
120	270.38	276.41	276.53	272.32		273.91	3.1	0.102	269.58	273.91	272.73	275.28		272.88	2.4	-0.037	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000201

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

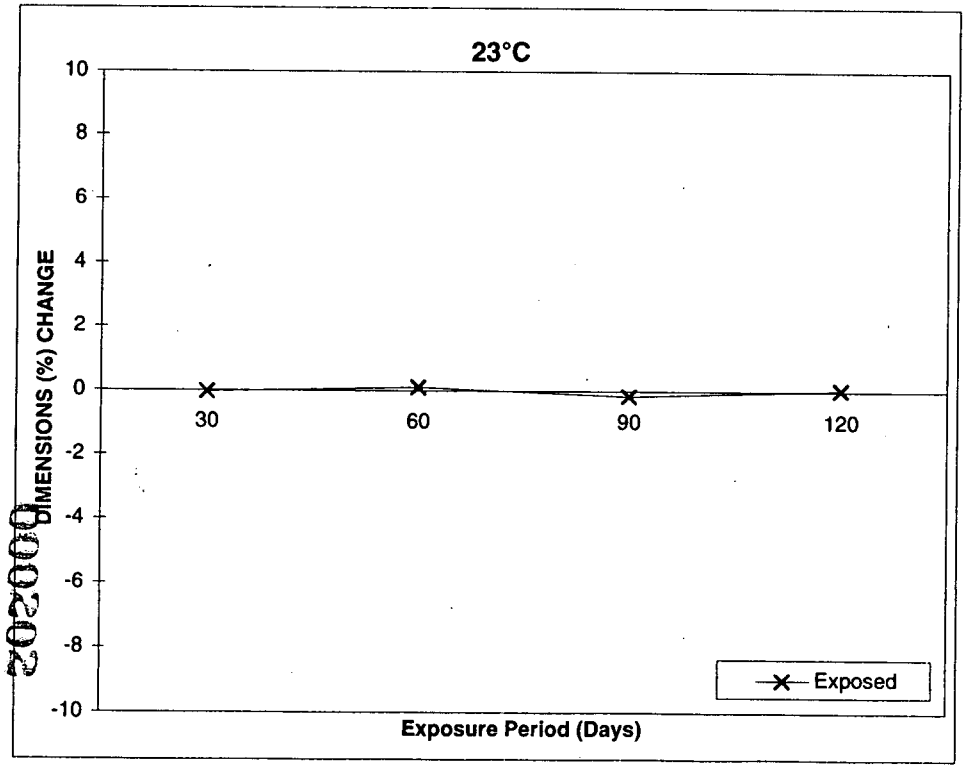
CHEMICAL COMPATIBILITY TEST RESULTS

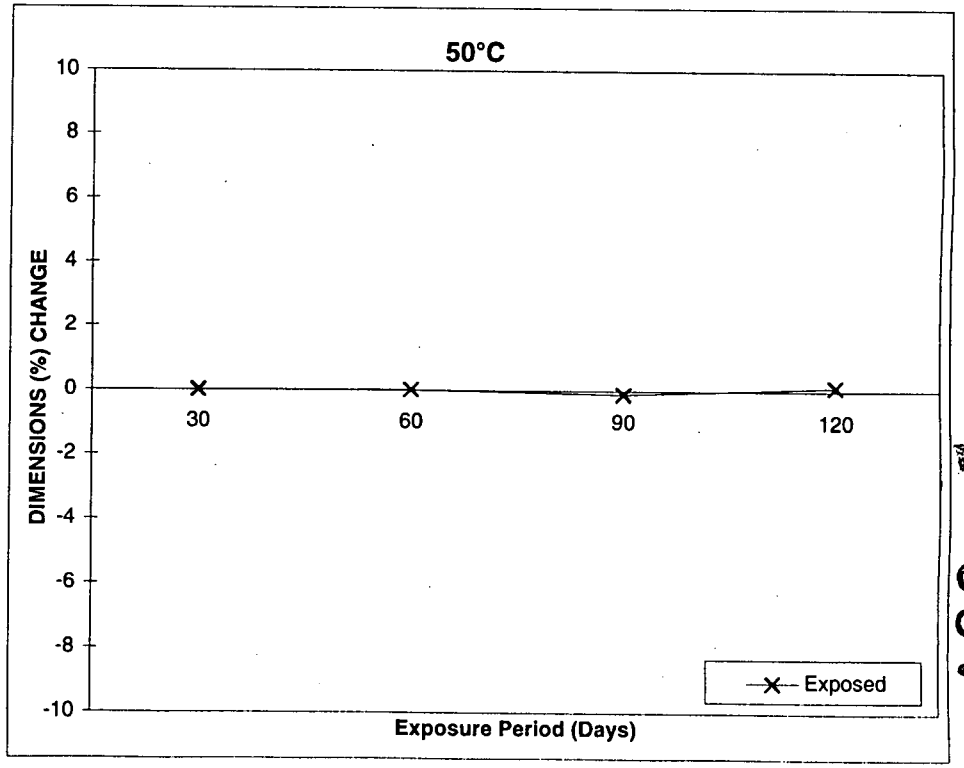
CLIENT: *FERMCO*
METHOD: *EPA 9090*
DATE TESTED: *06/14/96*

GEOSYNTEC JOB NO.: *GE 3900*
MATERIAL TYPE: *NSC*
CHARACTERISTICS: *80 mil HDPE Geomembrane*
IMMERSION MEDIUM: *Perched Ground Water*

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: WIDTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	141.15	141.56	144.26	140.05		141.76	1.8	0.000	141.92	143.70	139.01	133.90		139.63	4.3	0.000	CR
30	141.11	141.52	144.20	140.01		141.71	1.8	-0.032	141.90	143.68	139.06	133.93		139.64	4.3	0.007	CR
Control	141.10	131.17	136.06	132.70		135.26	4.4	0.000	140.00	132.00	131.20	144.04		136.81	6.2	0.000	CR
60	141.08	131.69	136.09	132.75		135.40	4.2	0.107	140.09	132.01	131.23	144.03		136.84	6.2	0.022	CR
Control	135.28	131.84	127.94	128.34		130.85	3.4	0.000	133.29	134.57	133.70	134.00		133.89	0.5	0.000	CR
90	135.30	131.68	127.42	128.12		130.63	3.6	-0.168	133.08	134.08	133.65	134.18		133.75	0.5	-0.106	CR
Control	132.80	145.27	141.65	138.50		139.56	5.3	0.000	140.01	135.48	133.30	136.00		136.20	2.8	0.000	CR
120	132.86	145.60	141.68	138.29		139.61	5.4	0.038	140.21	135.49	133.61	136.21		136.38	2.8	0.134	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

0002002

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

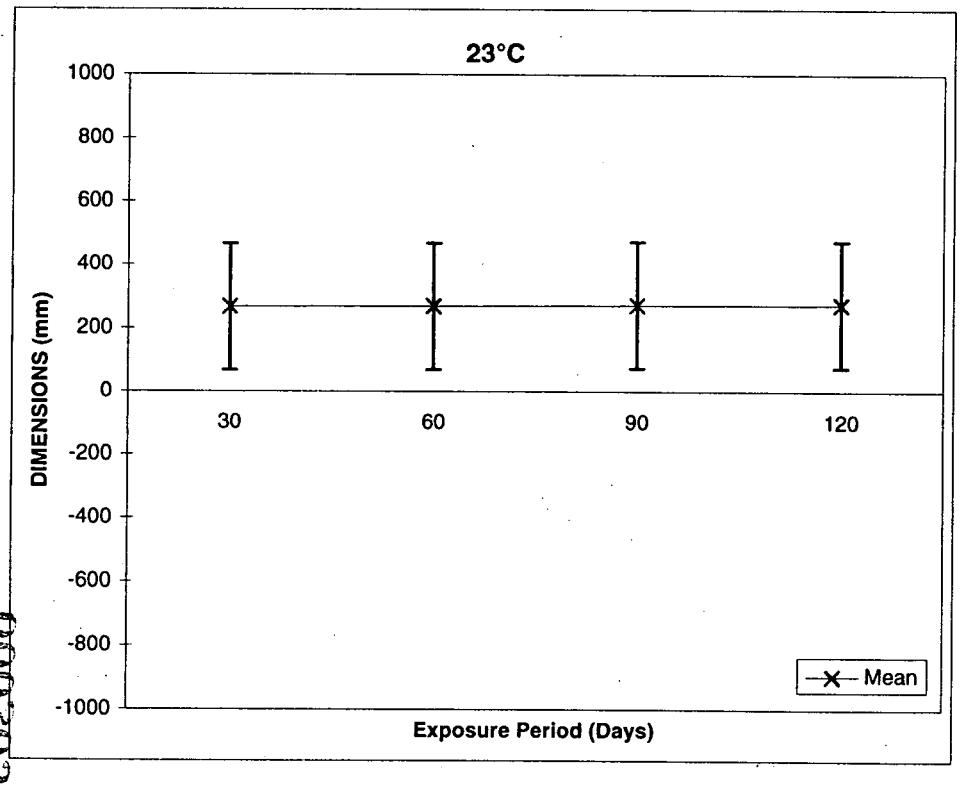
CHEMICAL COMPATIBILITY TEST RESULTS

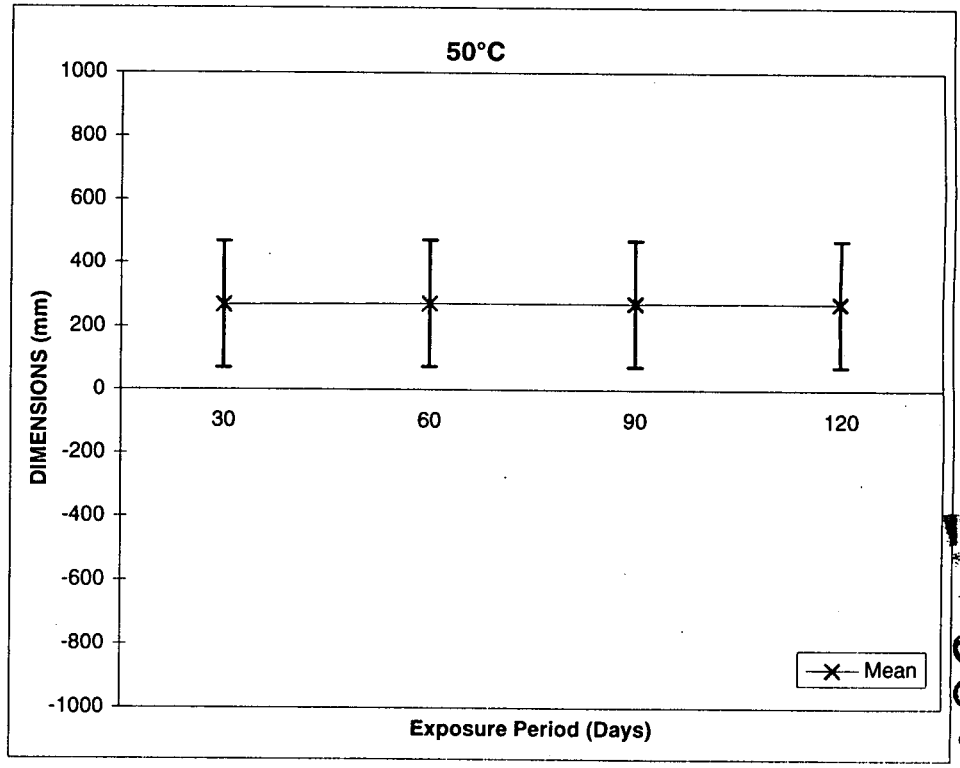
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: LENGTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	267.52	267.07	267.07	267.29		267.24	0.2	0.0	274.74	267.32	263.94	269.07		268.77	4.5	0.0	CR
30	267.48	267.01	267.03	267.21		267.18	0.2	0.0	274.78	267.35	263.91	269.10		268.79	4.5	0.0	CR
60	264.01	273.18	266.09	273.86		269.29	5.0	0.8	280.79	268.74	272.05	270.06		272.91	5.4	1.5	CR
90	270.49	276.86	270.13	273.36		272.71	3.1	2.0	276.66	272.56	271.95	269.38		272.64	3.0	1.4	CR
120	270.38	276.41	276.53	276.32		274.91	3.0	2.9	269.58	273.91	272.73	275.28		272.88	2.4	1.5	CR





© 1996 GEOSYNTEC CONSULTANTS

000203

3827

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

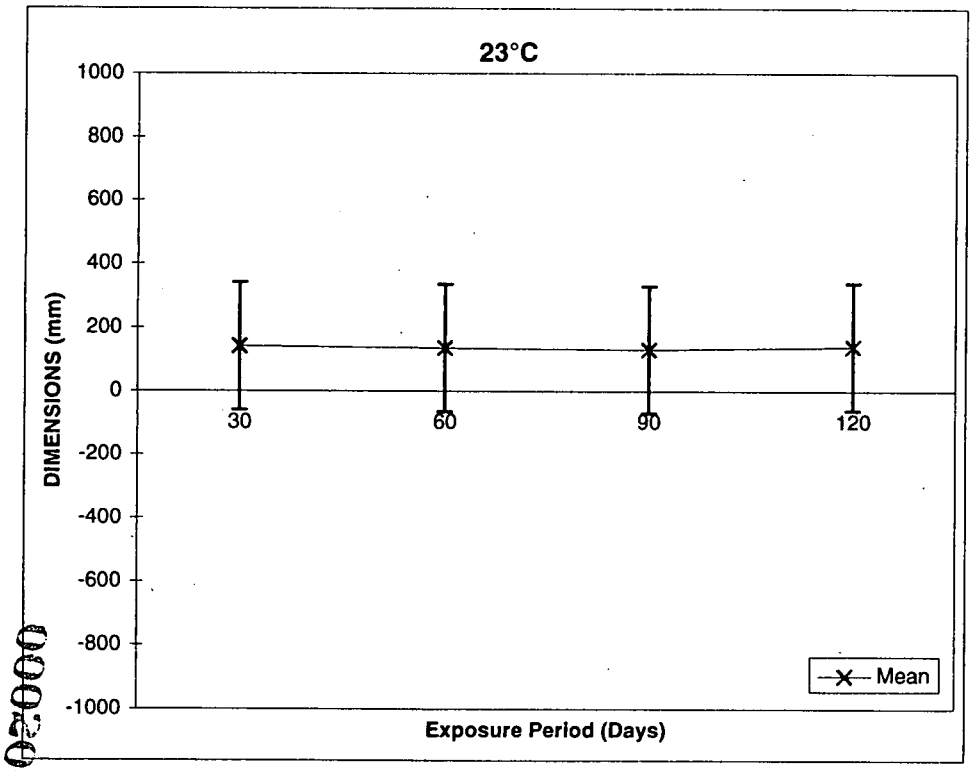
CHEMICAL COMPATIBILITY TEST RESULTS

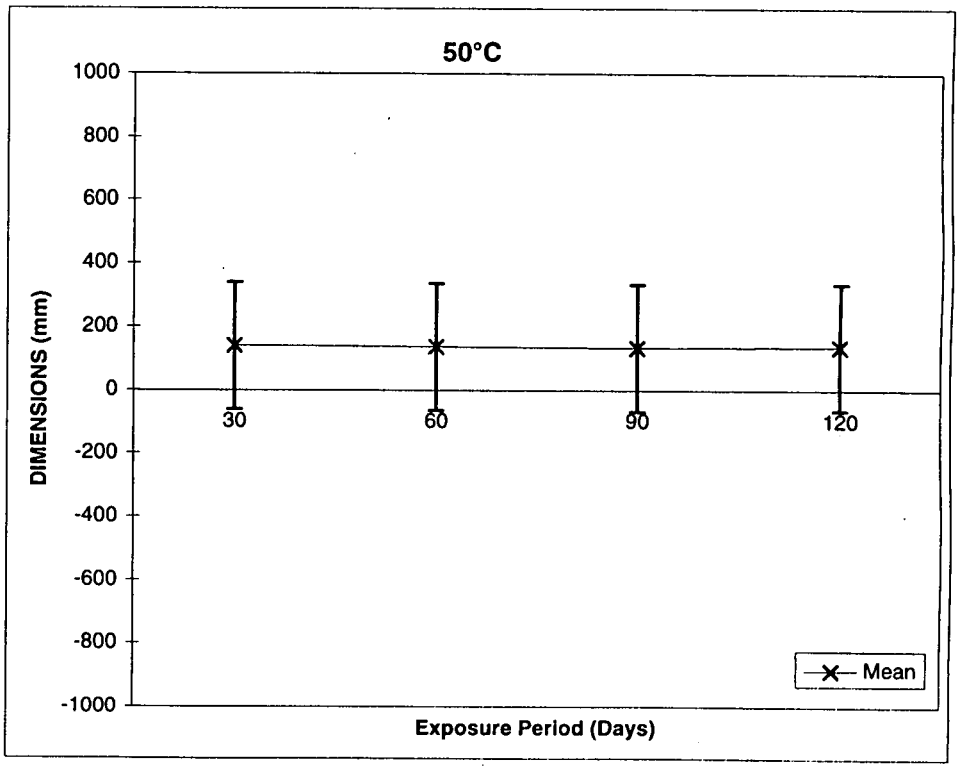
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: WIDTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	141.15	141.56	144.26	140.05		141.76	1.8	0.0	141.92	143.70	139.01	133.90		139.63	4.3	0.0	CR
30	141.11	141.52	144.20	140.01		141.71	1.8	0.0	141.90	143.68	139.06	133.93		139.64	4.3	0.0	CR
60	141.08	131.69	136.09	132.75		135.40	4.2	-4.5	140.09	132.01	131.23	144.03		136.84	6.2	-2.0	CR
90	135.30	131.68	127.42	128.12		130.63	3.6	-7.8	133.08	134.08	133.65	134.18		133.75	0.5	-4.2	CR
120	132.86	145.60	141.68	138.29		139.61	5.4	-1.5	140.21	135.49	133.61	136.21		136.38	2.8	-2.3	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

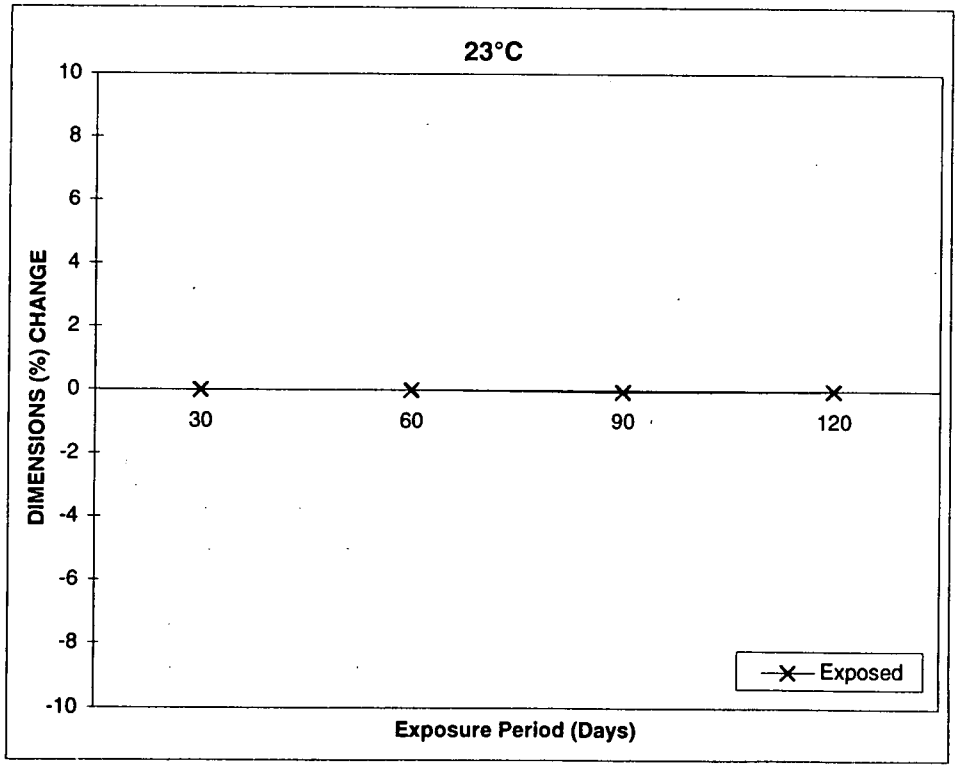
CHEMICAL COMPATIBILITY TEST RESULTS

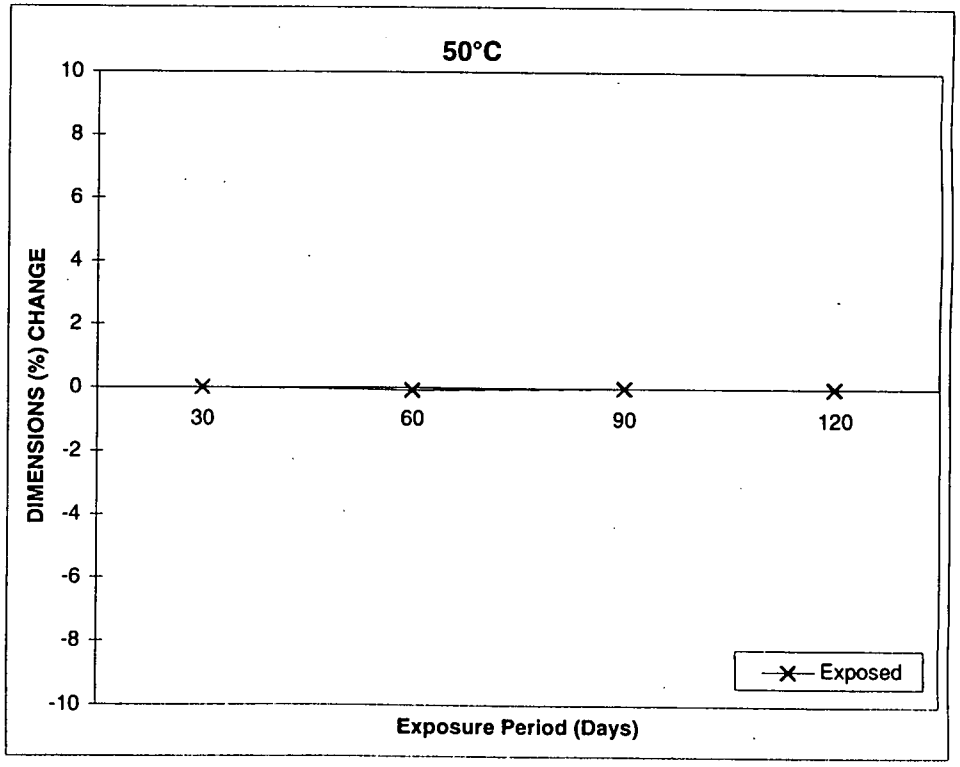
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: LENGTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	256.96	266.28	266.74	266.84		264.21	4.8	0.000	267.76	266.98	268.11	267.23		267.52	0.5	0.000	CR
30	256.98	266.30	266.70	266.81		264.20	4.8	-0.003	267.80	266.97	268.13	267.25		267.54	0.5	0.007	CR
Control	267.52	267.48	268.73	267.46		267.80	0.6	0.000	265.06	266.90	266.75	266.00		266.18	0.8	0.000	CR
60	267.54	267.50	268.71	267.41		267.79	0.6	-0.003	265.10	266.93	266.78	265.04		265.96	1.0	-0.081	CR
Control	270.20	269.46	267.87	269.07		269.15	1.0	0.000	266.13	268.06	268.55	268.90		267.91	1.2	0.000	CR
90	270.17	269.24	267.72	268.91		269.01	1.0	-0.052	266.18	268.10	268.31	269.02		267.90	1.2	-0.003	CR
Control	269.32	268.12	268.96	268.82		268.81	0.5	0.000	268.46	267.58	267.95	266.97		267.74	0.6	0.000	CR
120	269.28	268.10	268.89	268.79		268.77	0.5	-0.015	268.48	267.61	267.98	266.91		267.75	0.7	0.002	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000203

382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

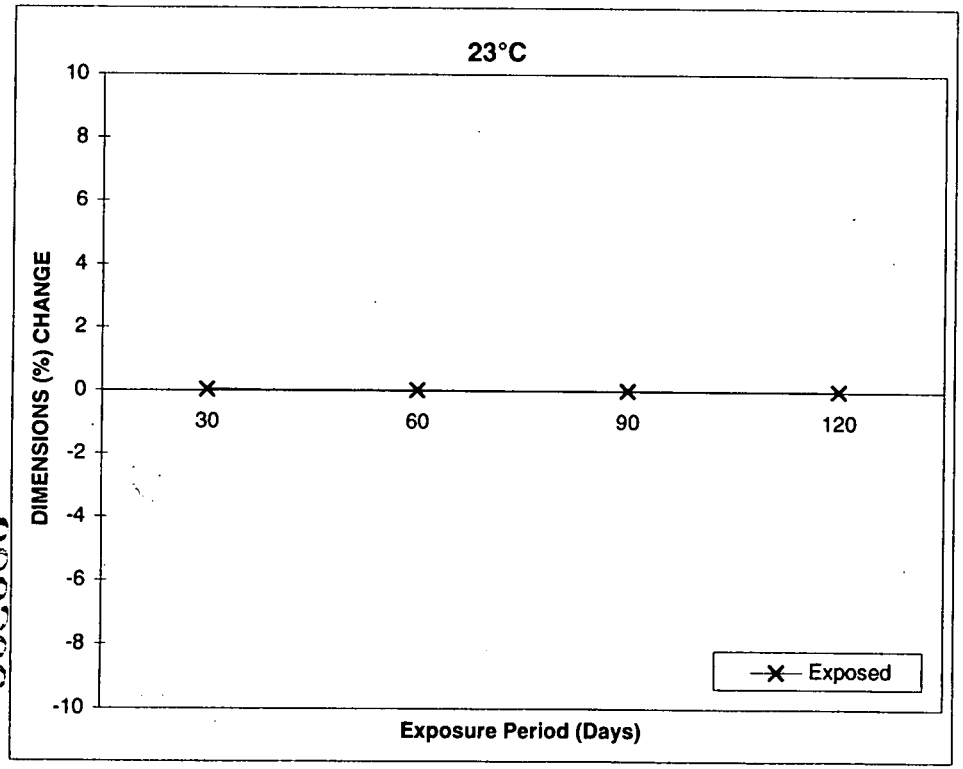
CHEMICAL COMPATIBILITY TEST RESULTS

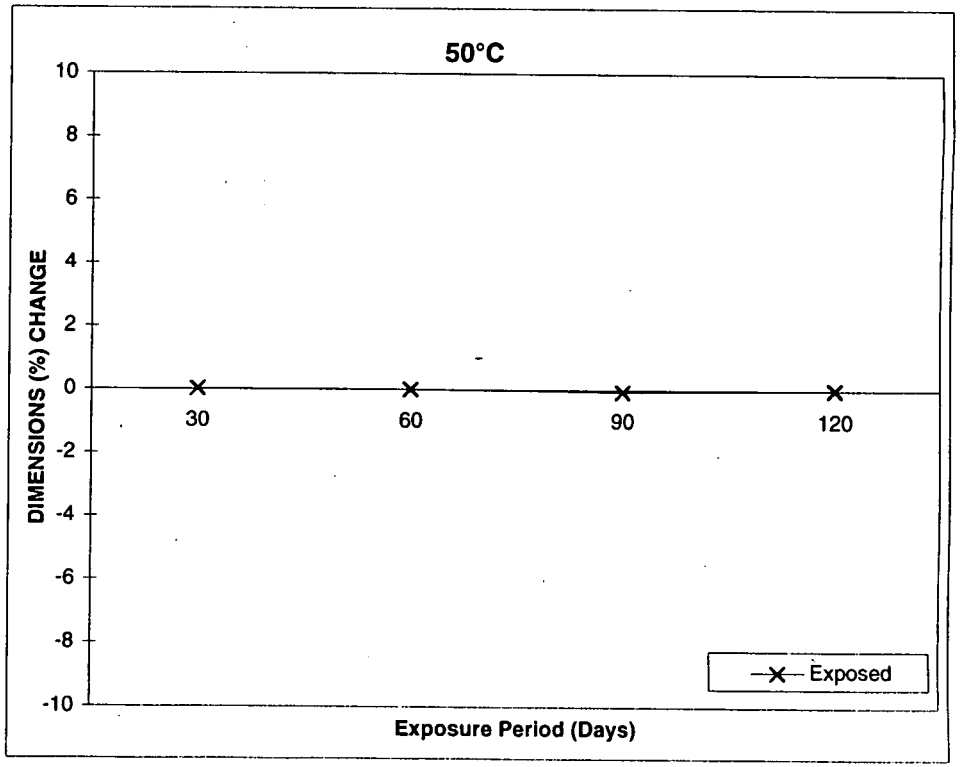
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: WIDTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	140.26	142.46	142.42	140.62		141.44	1.2	0.000	132.06	123.52	131.75	135.18		130.63	5.0	0.000	CR
30	140.29	142.49	142.50	140.68		141.49	1.2	0.035	132.08	123.56	131.79	135.20		130.66	5.0	0.023	CR
Control	140.76	140.20	142.92	137.08		140.24	2.4	0.000	133.14	133.69	133.80	130.86		132.87	1.4	0.000	CR
60	140.79	140.29	142.93	137.11		140.28	2.4	0.029	133.15	133.71	133.83	130.87		132.89	1.4	0.013	CR
Control	140.20	141.51	140.63	142.65		141.25	1.1	0.000	131.61	134.36	133.30	132.93		133.05	1.1	0.000	CR
90	140.15	141.46	140.74	142.70		141.26	1.1	0.011	131.61	134.08	133.22	132.96		132.97	1.0	-0.062	CR
Control	139.79	141.16	141.15	142.12		141.06	1.0	0.000	133.29	132.02	132.00	131.71		132.26	0.7	0.000	CR
120	139.71	141.18	141.21	142.21		141.08	1.0	0.016	133.21	132.11	132.03	131.74		132.27	0.6	0.013	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

902000

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

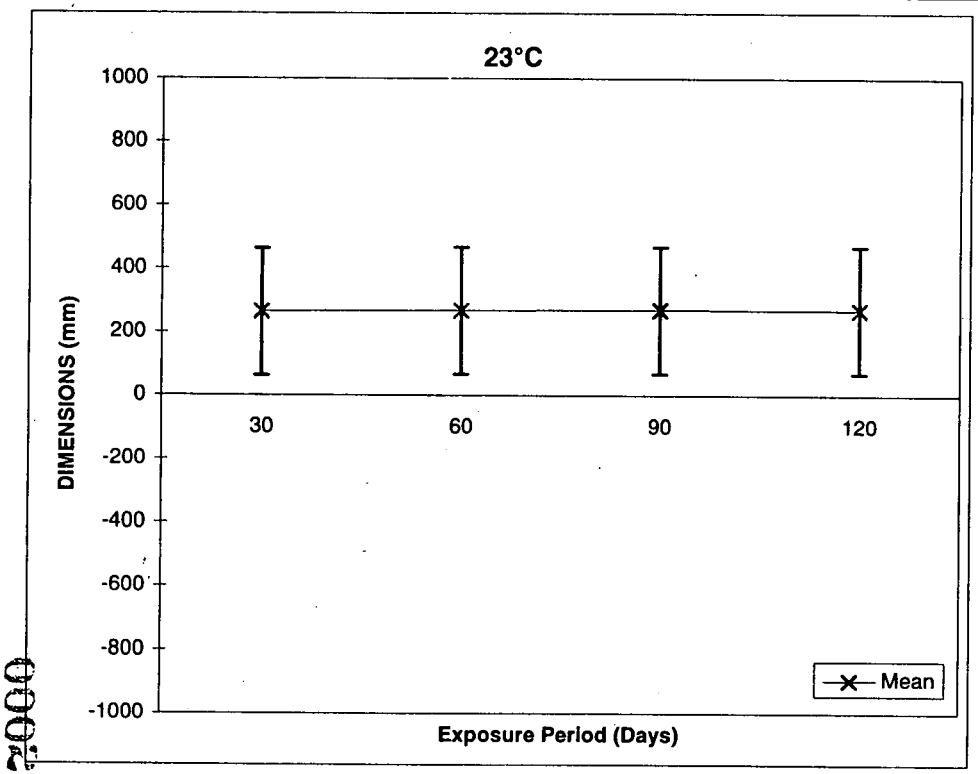
CHEMICAL COMPATIBILITY TEST RESULTS

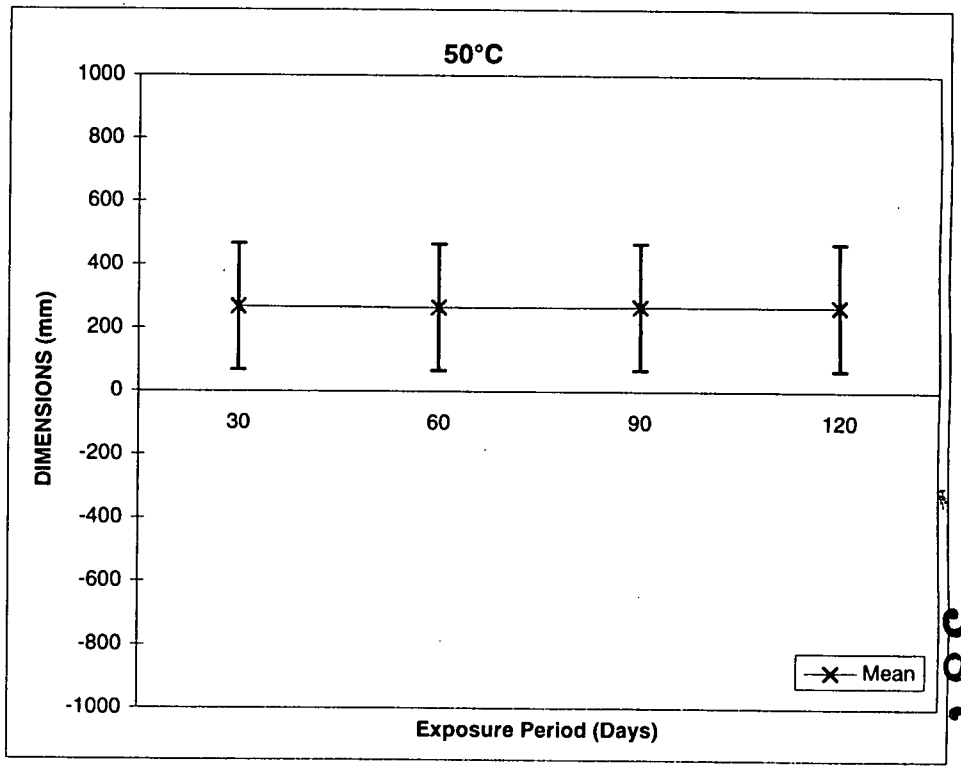
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: LENGTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	256.96	266.28	266.74	266.84		264.21	4.8	0.0	267.76	266.98	268.11	267.23		267.52	0.5	0.0	CR
30	256.98	266.30	266.70	266.81		264.20	4.8	0.0	267.80	266.97	268.13	267.25		267.54	0.5	0.0	CR
60	267.54	267.50	268.71	267.41		267.79	0.6	1.4	265.10	266.93	266.78	265.04		265.96	1.0	-0.6	CR
90	270.17	269.24	267.72	268.91		269.01	1.0	1.8	266.18	268.10	268.31	269.02		267.90	1.2	0.1	CR
120	269.28	268.10	268.89	268.79		268.77	0.5	1.7	268.48	267.61	267.98	266.91		267.75	0.7	0.1	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

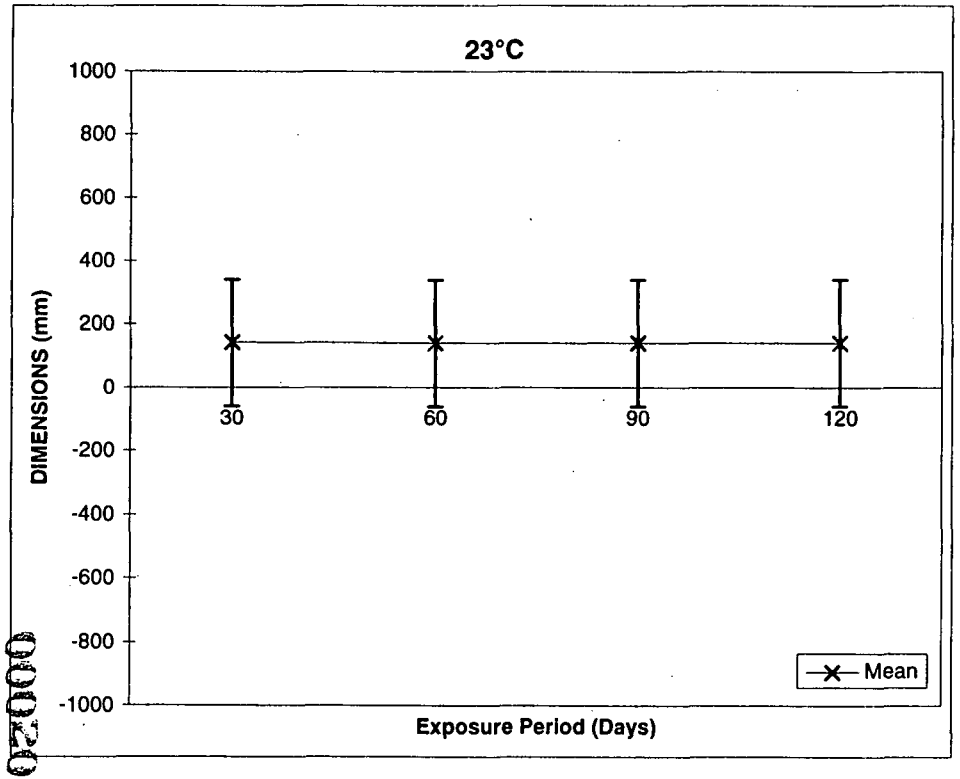
CHEMICAL COMPATIBILITY TEST RESULTS

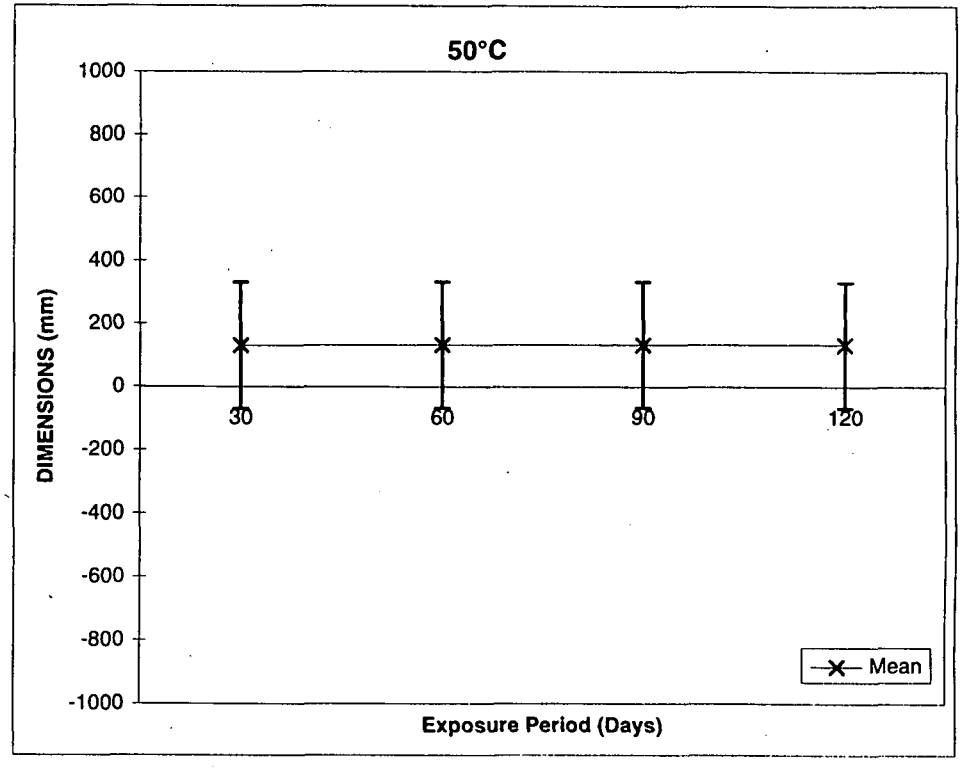
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: WIDTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	140.26	142.46	142.42	140.62		141.44	1.2	0.0	132.06	123.52	131.75	135.18		130.63	5.0	0.0	CR
30	140.29	142.49	142.50	140.68		141.49	1.2	0.0	132.08	123.56	131.79	135.20		130.66	5.0	0.0	CR
60	140.79	140.29	142.93	137.11		140.28	2.4	-0.8	133.15	133.71	133.83	130.87		132.89	1.4	1.7	CR
90	140.15	141.46	140.74	142.70		141.26	1.1	-0.1	131.61	134.08	133.22	132.96		132.97	1.0	1.8	CR
120	139.71	141.18	141.21	142.21		141.08	1.0	-0.3	133.21	132.11	132.03	131.74		132.27	0.6	1.3	CR





© 1996 GEOSYNTEC CONSULTANTS

002208

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

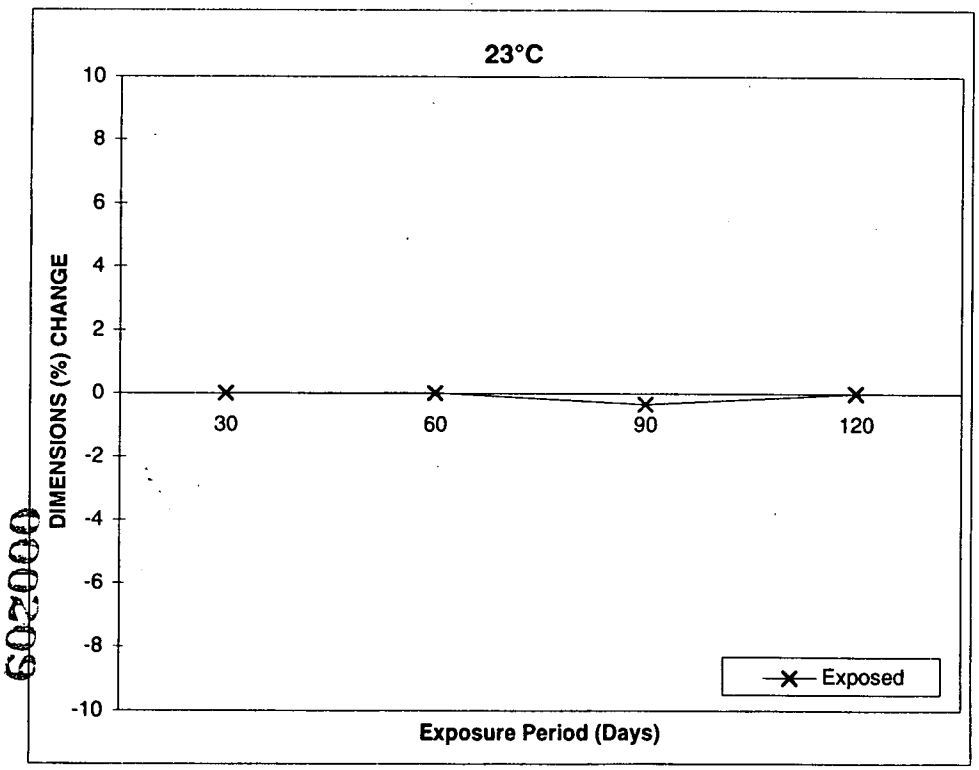
CHEMICAL COMPATIBILITY TEST RESULTS

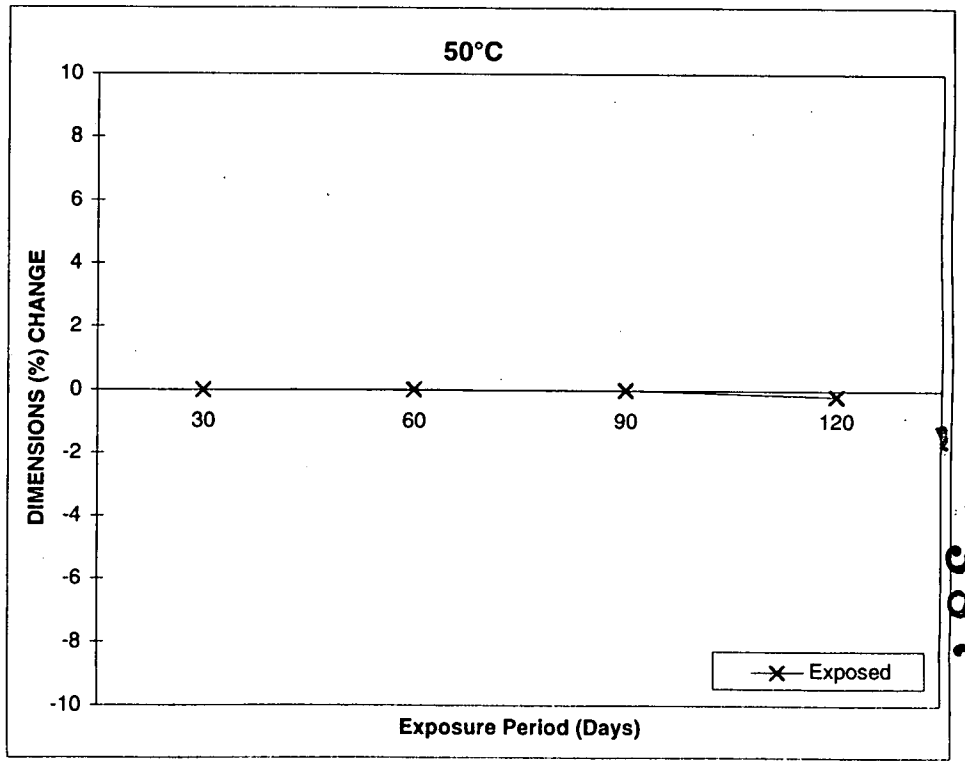
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: LENGTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	266.59	265.87	266.65	267.35		266.62	0.6	0.000	266.06	265.04	266.99	265.38		265.87	0.9	0.000	CR
30	266.58	265.91	266.67	267.39		266.64	0.6	0.008	266.08	265.10	266.98	265.31		265.87	0.9	0.000	CR
Control	264.00	266.67	265.65	266.27		265.65	1.2	0.000	267.89	266.04	268.10	267.42		267.36	0.9	0.000	CR
60	264.01	266.71	265.69	266.31		265.68	1.2	0.012	267.93	266.11	268.14	267.48		267.42	0.9	0.020	CR
Control	266.45	266.71	267.59	268.77		267.38	1.0	0.000	267.41	267.16	266.67	266.67		266.98	0.4	0.000	CR
90	266.24	263.14	267.60	269.00		266.50	2.5	-0.331	267.81	267.12	266.69	266.35		266.99	0.6	0.006	CR
Control	267.91	267.91	266.76	266.76		267.34	0.7	0.000	267.92	265.64	268.12	268.12		267.45	1.2	0.000	CR
120	267.93	267.94	266.78	266.74		267.35	0.7	0.005	267.90	265.60	266.15	268.15		266.95	1.3	-0.187	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000209

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

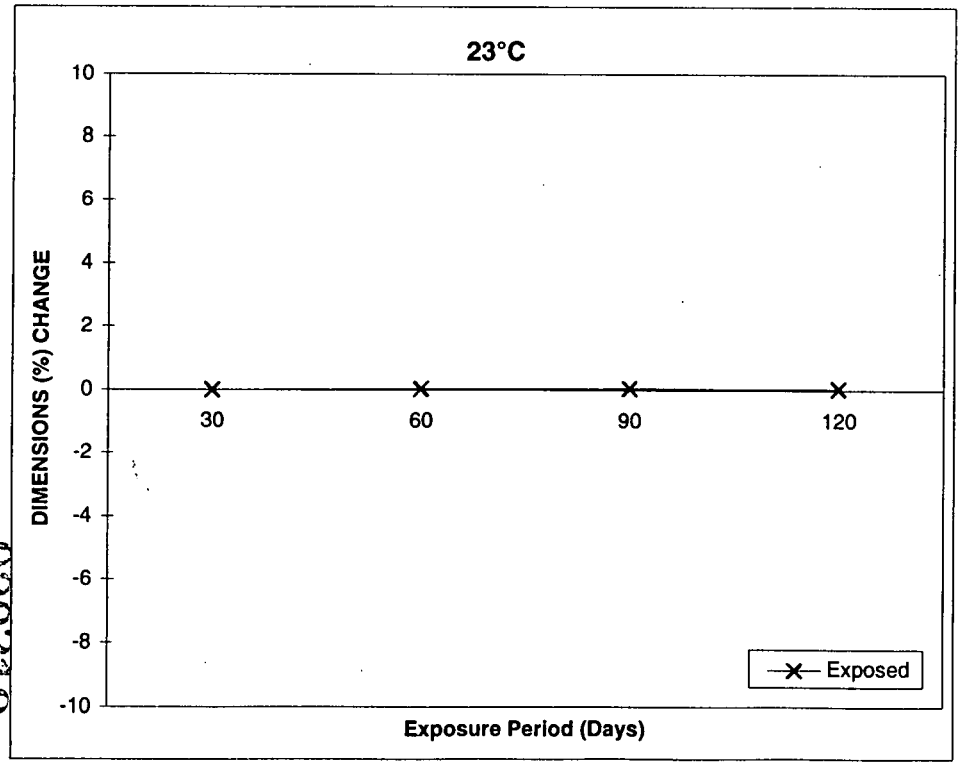
CHEMICAL COMPATIBILITY TEST RESULTS

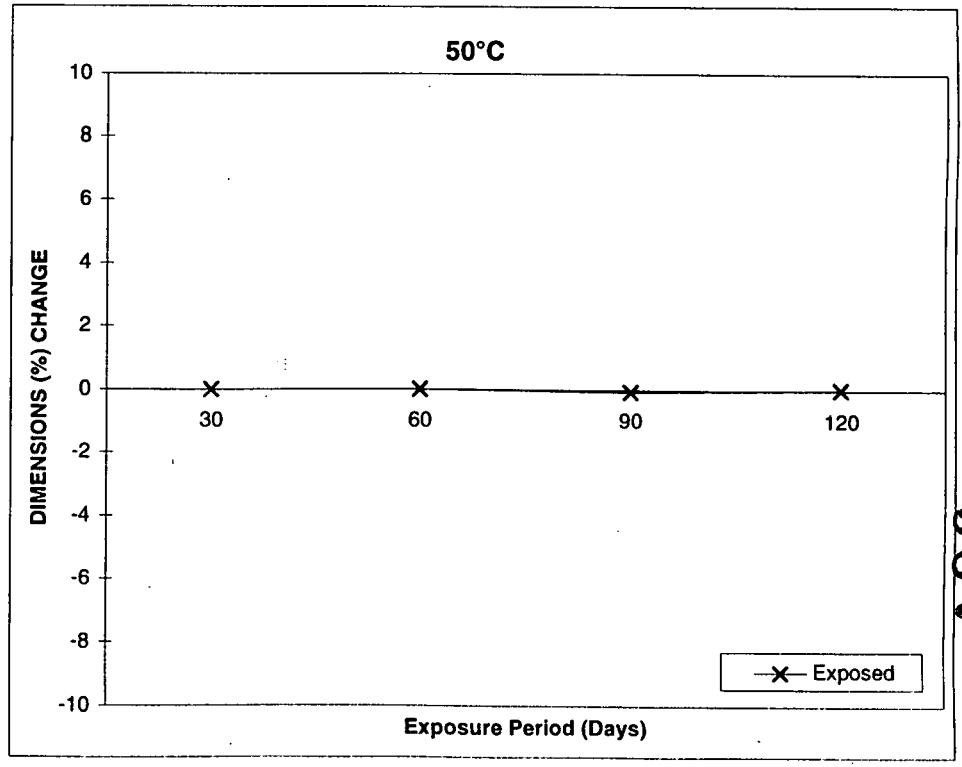
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: WIDTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	134.32	131.20	132.62	132.67		132.70	1.3	0.000	132.25	133.35	132.28	133.21		132.77	0.6	0.000	CR
30	134.34	131.18	132.61	132.64		132.69	1.3	-0.008	132.24	133.32	132.21	133.28		132.76	0.6	-0.008	CR
Control	132.56	132.96	133.92	133.32		133.19	0.6	0.000	134.99	130.92	133.08	130.67		132.42	2.0	0.000	CR
60	132.59	132.99	133.94	133.35		133.22	0.6	0.021	134.95	130.90	133.14	130.68		132.42	2.0	0.002	CR
Control	131.42	134.29	132.69	131.79		132.55	1.3	0.000	132.10	132.03	131.60	133.70		132.36	0.9	0.000	CR
90	131.42	134.49	132.64	131.88		132.61	1.4	0.045	132.10	131.90	131.56	133.50		132.27	0.9	-0.070	CR
Control	134.01	134.34	134.14	134.79		134.32	0.3	0.000	132.09	133.50	133.51	133.23		133.08	0.7	0.000	CR
120	134.06	134.38	134.20	134.81		134.36	0.3	0.032	132.11	133.51	133.51	133.26		133.10	0.7	0.011	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

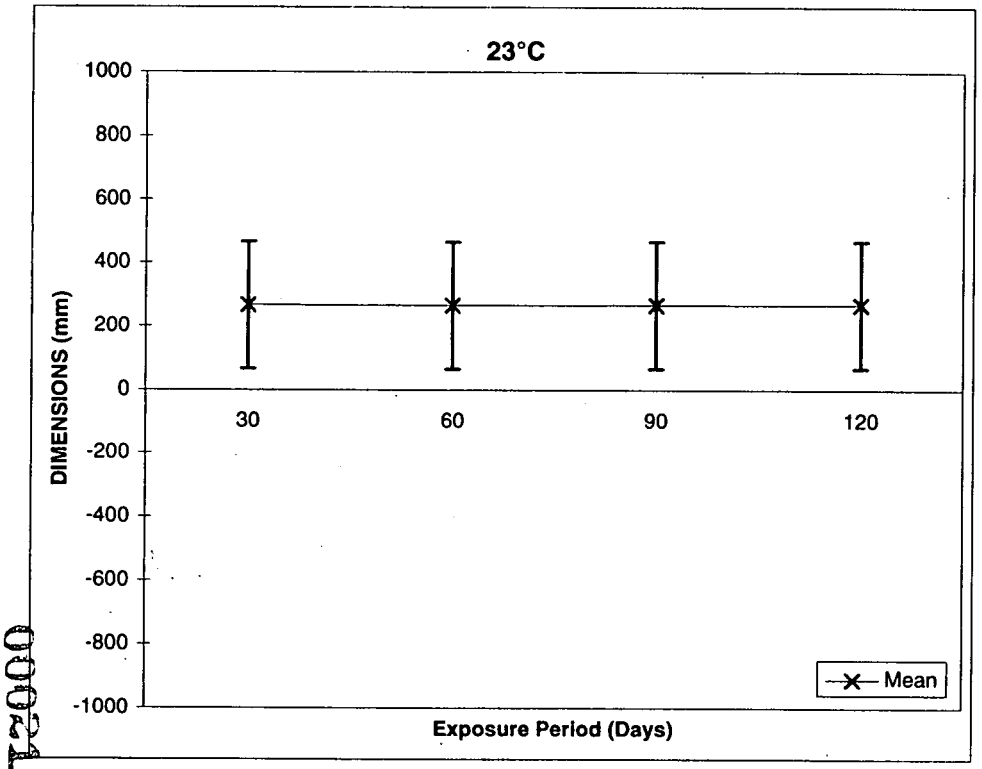
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

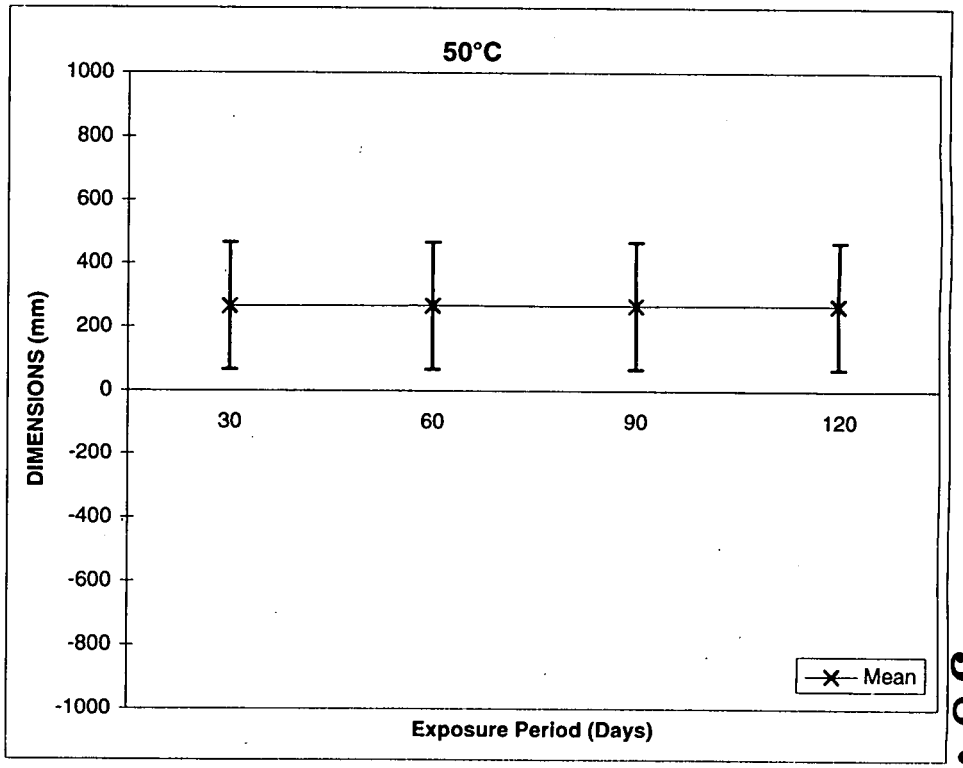
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*EPA 9090*	*MATERIAL TYPE:*	*POLYFLEX*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: LENGTH

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	266.59	265.87	266.65	267.35		266.62	0.6	0.0	266.06	265.04	266.99	265.38		265.87	0.9	0.0	CR
30	266.58	265.91	266.67	267.39		266.64	0.6	0.0	266.08	265.10	266.98	265.31		265.87	0.9	0.0	CR
60	264.01	266.71	265.69	266.31		265.68	1.2	-0.4	267.93	266.11	268.14	267.48		267.42	0.9	0.6	CR
90	266.24	263.14	267.60	269.00		266.50	2.5	0.0	267.81	267.12	266.69	266.35		266.99	0.6	0.4	CR
120	267.93	267.94	266.78	266.74		267.35	0.7	0.3	267.90	265.60	266.15	268.15		266.95	1.3	0.4	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

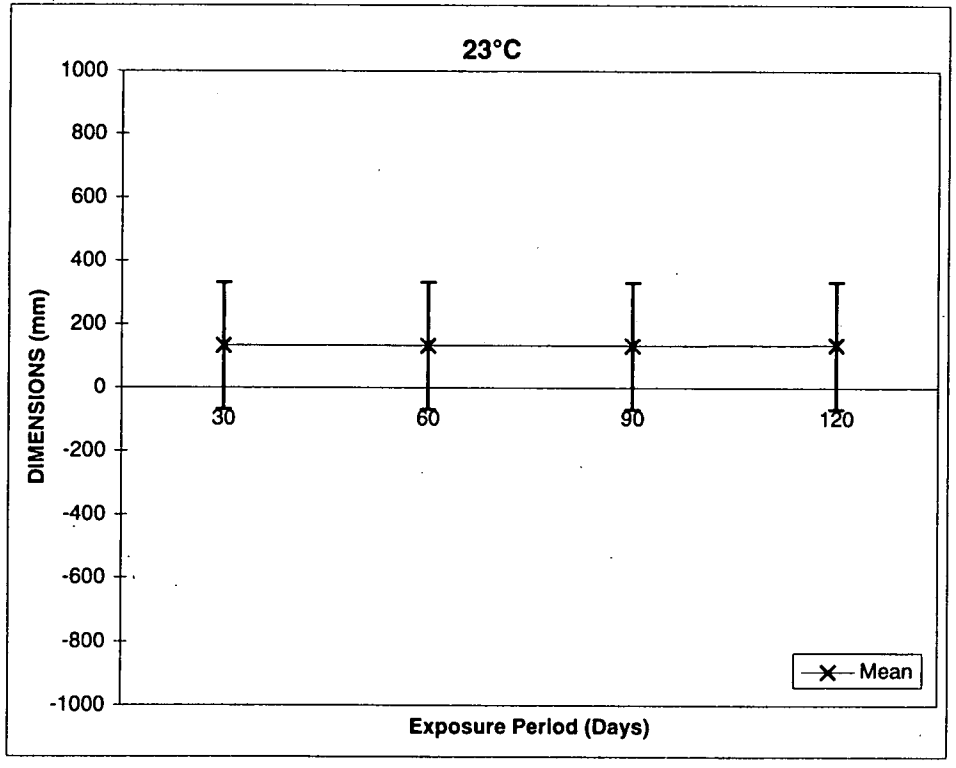
CHEMICAL COMPATIBILITY TEST RESULTS

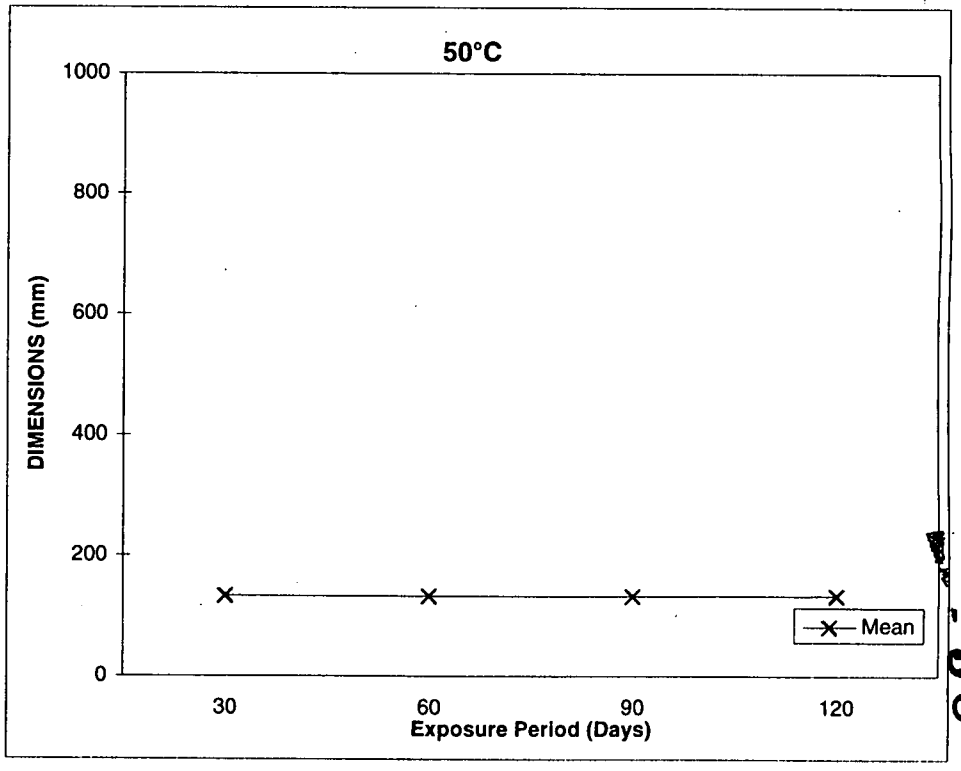
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: WIDTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	134.32	131.20	132.62	132.67		132.70	1.3	0.0	132.25	133.35	132.28	133.21		132.77	0.6	0.0	CR
30	134.34	131.18	132.61	132.64		132.69	1.3	0.0	132.24	133.32	132.21	133.28		132.76	0.6	0.0	CR
60	132.59	132.99	133.94	133.35		133.22	0.6	0.4	134.95	130.90	133.14	130.68		132.42	2.0	-0.3	CR
90	131.42	134.49	132.64	131.88		132.61	1.4	-0.1	132.10	131.90	131.56	133.50		132.27	0.9	-0.4	CR
120	134.06	134.38	134.20	134.81		134.36	0.3	1.3	132.11	133.51	133.51	133.26		133.10	0.7	0.2	CR





© 1996 GEOSYNTEC CONSULTANTS

000212

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

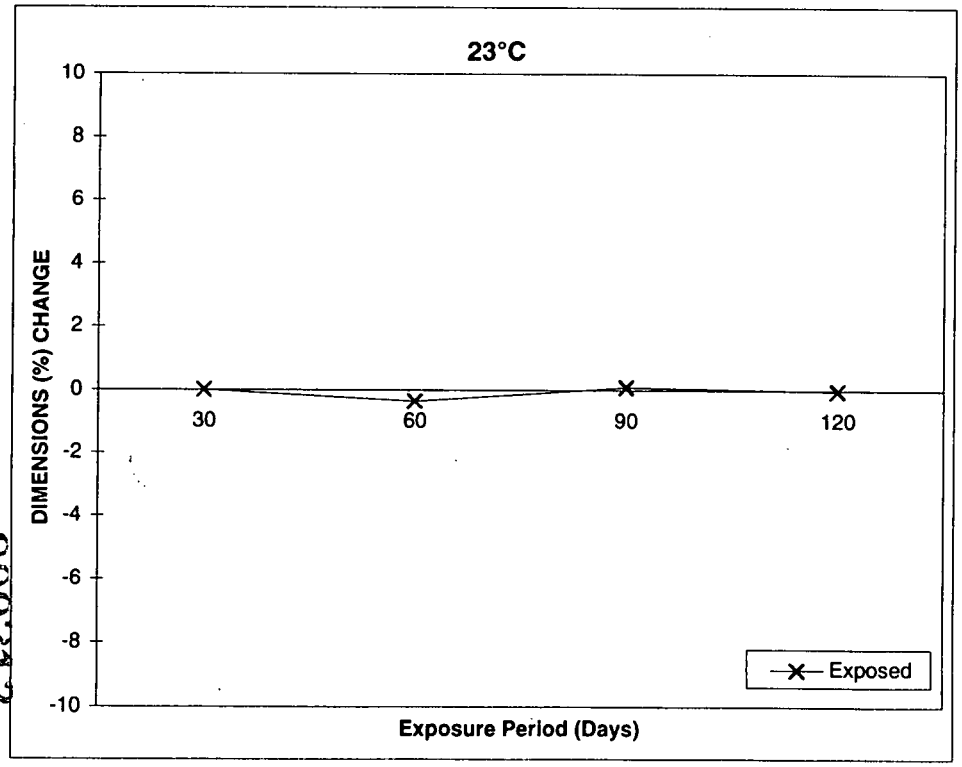
CHEMICAL COMPATIBILITY TEST RESULTS

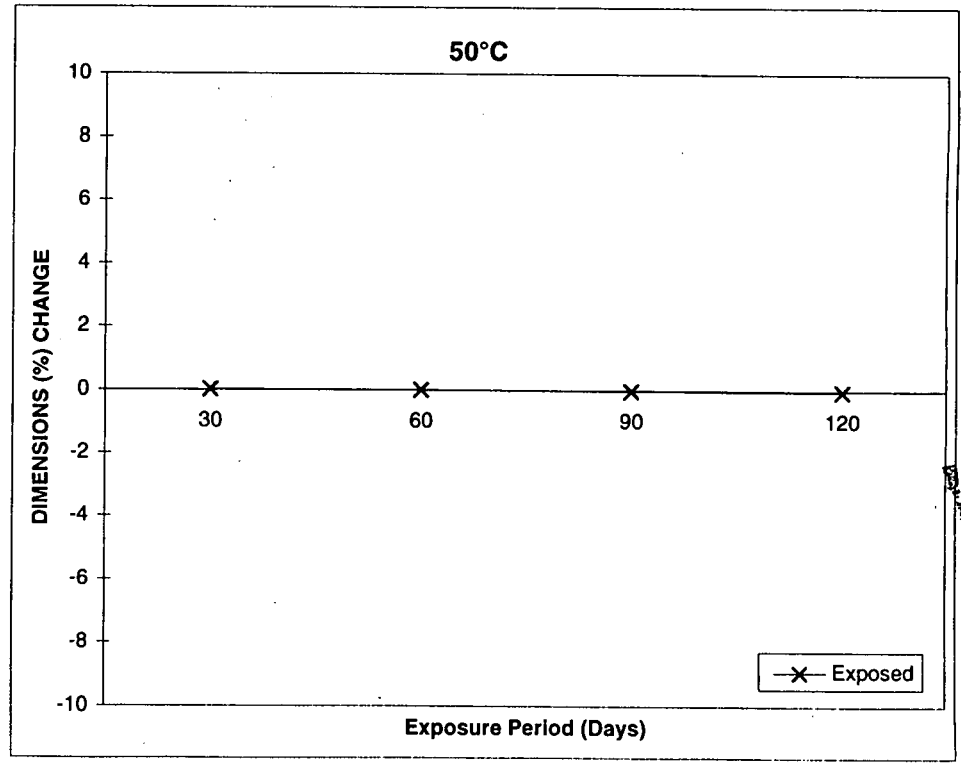
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: LENGTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	269.73	268.89	269.05	271.90		269.89	1.4	0.000	267.78	269.06	269.36	266.83		268.26	1.2	0.000	CR
30	269.71	268.84	269.11	271.98		269.91	1.4	0.006	267.79	269.07	269.41	266.89		268.29	1.2	0.012	CR
Control	267.97	270.19	268.69	269.60		269.11	1.0	0.000	269.60	267.48	268.16	268.14		268.35	0.9	0.000	CR
60	267.98	270.14	265.01	269.54		268.17	2.3	-0.351	269.58	267.52	268.15	268.16		268.35	0.9	0.003	CR
Control	271.09	268.26	268.26	267.80		268.85	1.5	0.000	266.79	267.92	267.08	269.18		267.74	1.1	0.000	CR
90	271.46	268.99	267.90	267.98		269.08	1.7	0.086	266.42	267.98	267.04	269.25		267.67	1.2	-0.026	CR
Control	267.05	268.83	270.66	268.32		268.72	1.5	0.000	270.48	270.66	270.77	267.97		269.97	1.3	0.000	CR
120	267.11	268.89	270.11	268.46		268.64	1.2	-0.027	270.41	270.49	270.68	267.91		269.87	1.3	-0.036	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000213

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

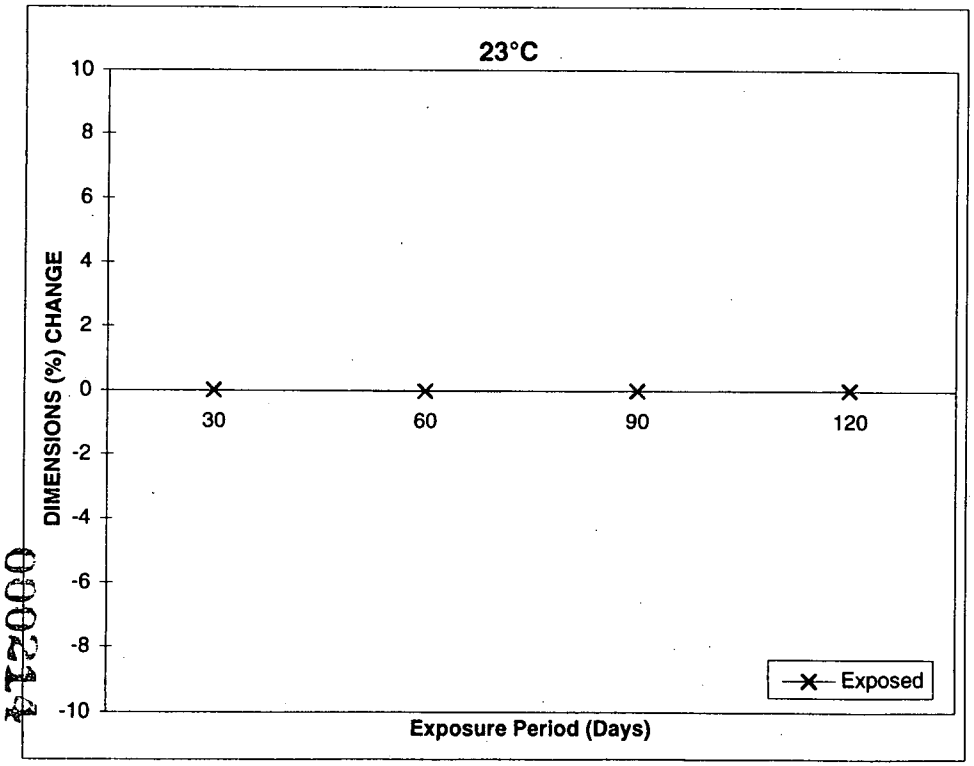
CHEMICAL COMPATIBILITY TEST RESULTS

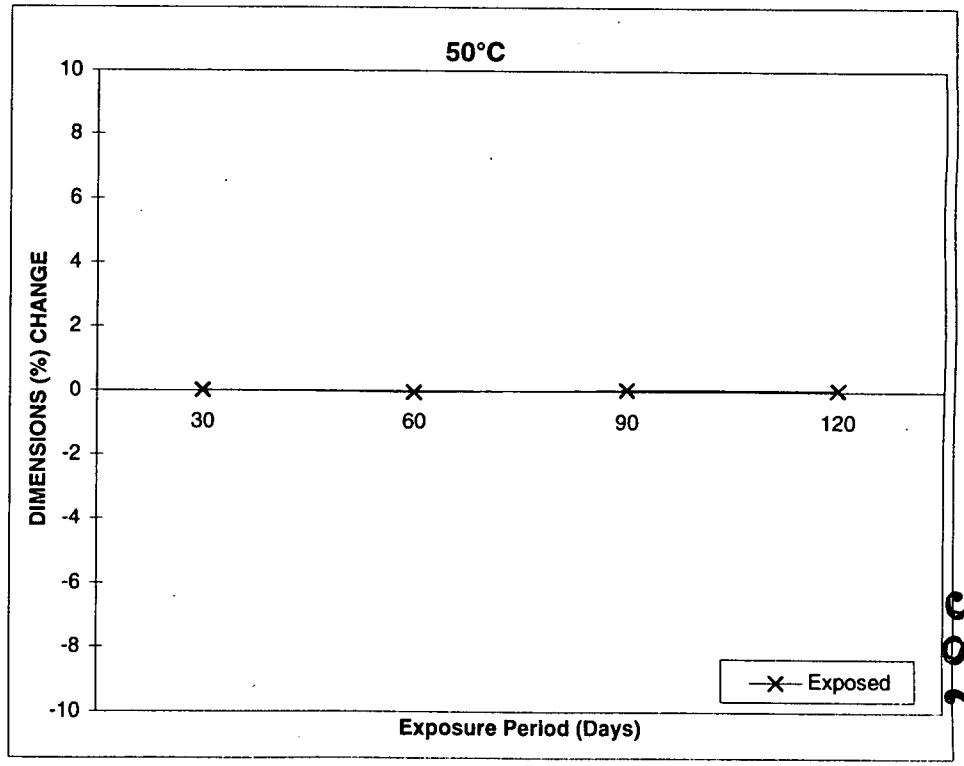
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: WIDTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	134.21	131.82	132.51	133.87		133.10	1.1	0.000	130.73	133.44	132.14	134.16		132.62	1.5	0.000	CR
30	134.23	131.84	132.50	133.89		133.12	1.1	0.009	130.74	133.47	132.19	134.19		132.65	1.5	0.023	CR
Control	131.64	133.10	133.81	133.21		132.94	0.9	0.000	133.15	134.44	132.78	131.20		132.89	1.3	0.000	CR
60	131.60	133.08	133.78	133.19		132.91	0.9	-0.021	133.12	134.41	132.79	131.04		132.84	1.4	-0.040	CR
Control	132.51	133.40	133.72	135.28		133.73	1.2	0.000	133.76	133.50	133.14	132.00		133.10	0.8	0.000	CR
90	132.36	133.45	133.75	135.36		133.73	1.2	0.002	133.74	133.30	133.56	132.08		133.17	0.7	0.053	CR
Control	131.43	133.32	133.23	132.83		132.70	0.9	0.000	133.44	131.13	133.33	131.54		132.36	1.2	0.000	CR
120	131.52	133.51	133.18	132.71		132.73	0.9	0.021	133.48	131.25	133.31	131.69		132.43	1.1	0.055	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

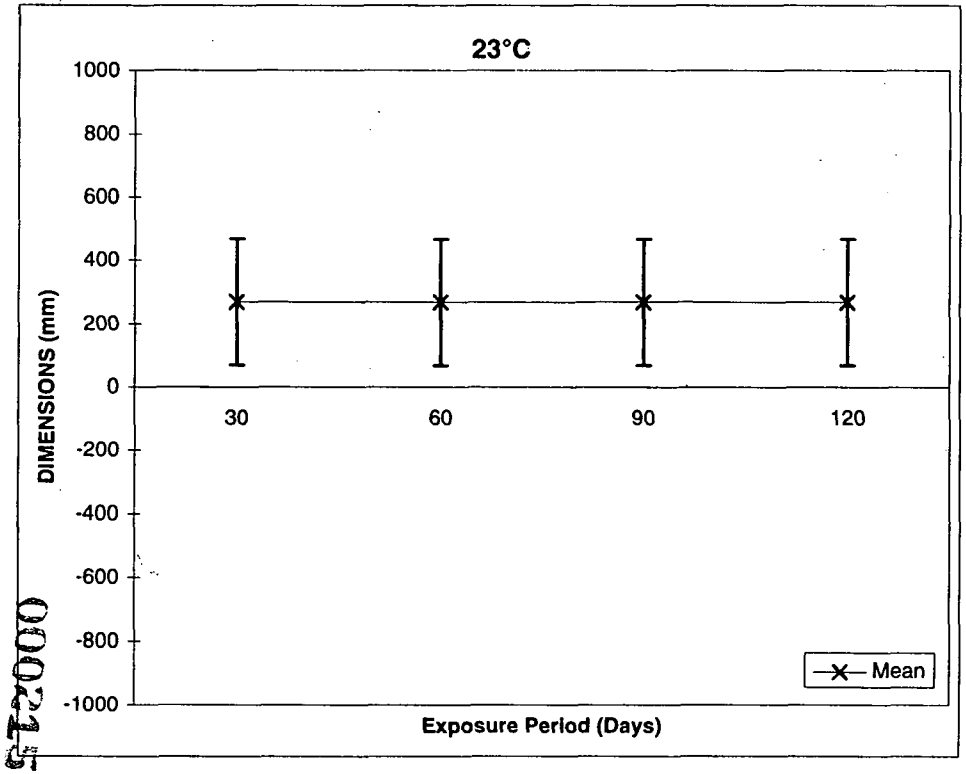
CHEMICAL COMPATIBILITY TEST RESULTS

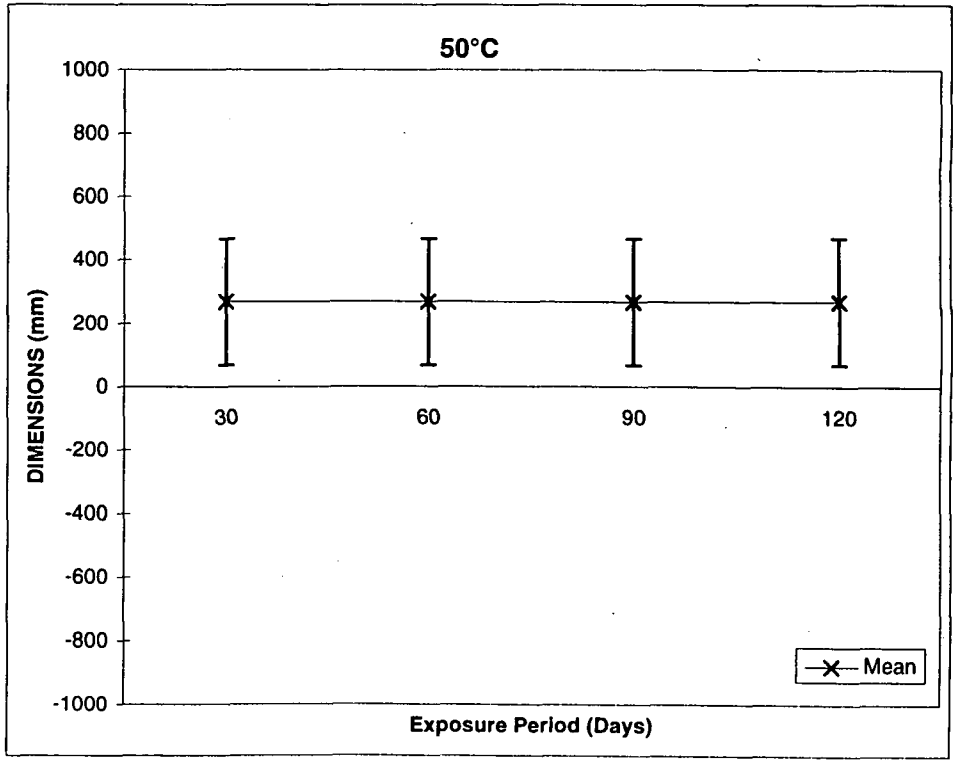
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: LENGTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	269.73	268.89	269.05	271.90		269.89	1.4	0.0	267.78	269.06	269.36	266.83		268.26	1.2	0.0	CR
30	269.71	268.84	269.11	271.98		269.91	1.4	0.0	267.79	269.07	269.41	266.89		268.29	1.2	0.0	CR
60	267.98	270.14	265.01	269.54		268.17	2.3	-0.6	269.58	267.52	268.15	268.16		268.35	0.9	0.0	CR
90	271.46	268.99	267.90	267.98		269.08	1.7	-0.3	266.42	267.98	267.04	269.25		267.67	1.2	-0.2	CR
120	267.11	268.89	270.11	268.46		268.64	1.2	-0.5	270.41	270.49	270.68	267.91		269.87	1.3	0.6	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

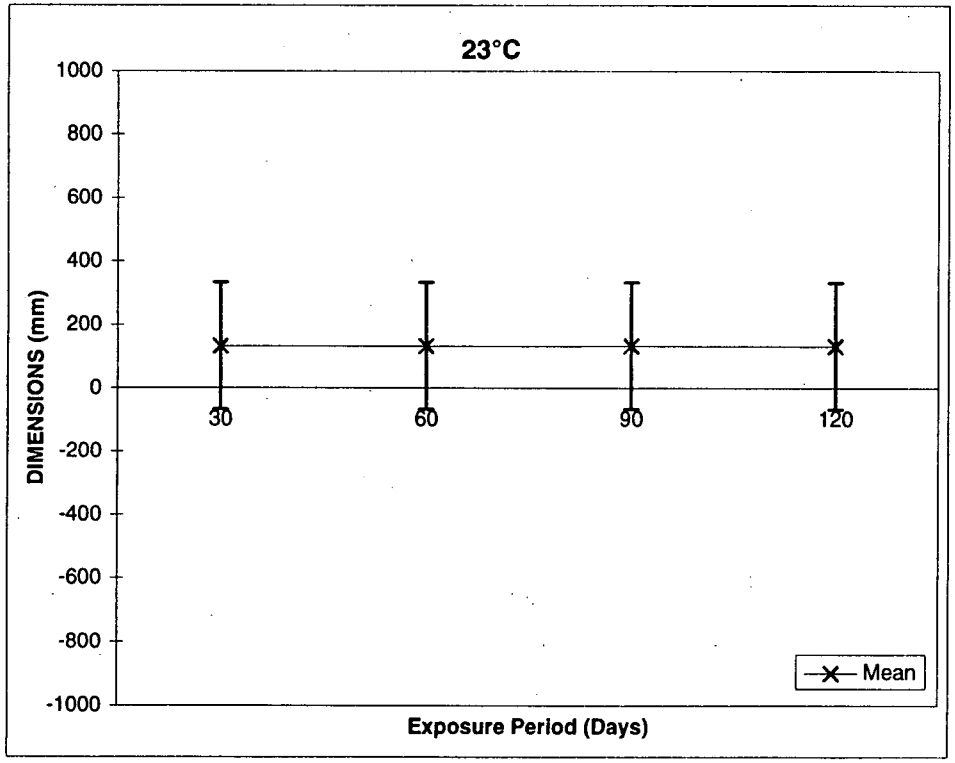
CHEMICAL COMPATIBILITY TEST RESULTS

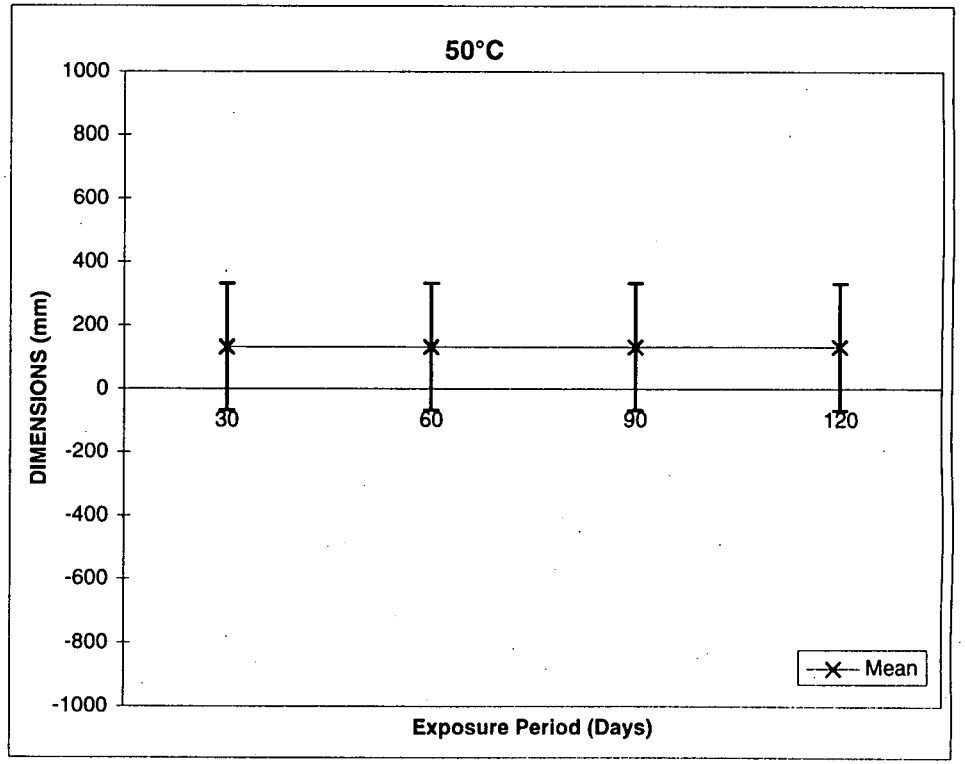
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): DIMENSIONS (mm)
DIRECTION: WIDTH

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	134.21	131.82	132.51	133.87		133.10	1.1	0.0	130.73	133.44	132.14	134.16		132.62	1.5	0.0	CR
30	134.23	131.84	132.50	133.89		133.12	1.1	0.0	130.74	133.47	132.19	134.19		132.65	1.5	0.0	CR
60	131.60	133.08	133.78	133.19		132.91	0.9	-0.1	133.12	134.41	132.79	131.04		132.84	1.4	0.2	CR
90	132.36	133.45	133.75	135.36		133.73	1.2	0.5	133.74	133.30	133.56	132.08		133.17	0.7	0.4	CR
120	131.52	133.51	133.18	132.71		132.73	0.9	-0.3	133.48	131.25	133.31	131.69		132.43	1.1	-0.1	CR





© 1996 GEOSYNTEC CONSULTANTS

2.4 SPECIFIC GRAVITY

2.4 Specific Gravity

Rationale for Test

Specific gravity is the ratio of the density of a material to the density of water. In USEPA 9090 tests, specific gravity is measured to provide an indication of the amount of swelling or shrinkage a geomembrane has undergone as the result of absorption of leachate constituents or extraction of geomembrane constituents. The specific gravity of the geomembrane was measured using a direct measurement of mass and an indirect measurement of volume (liquid displacement).

Results and Discussion

Correlating well with the mass, thickness, and dimension data, specific gravities of the geomembranes were constant (within the limits of measurement of the test methodology and the inherent variability in HDPE resin characteristics) during the 120 days of exposure to the test leachate. In addition, all of the mean specific gravity values were within one standard deviation of the control value means.

Conclusion

The test leachate did not measurably impact the specific gravity of the geomembranes during the 120 day exposure period.

draft

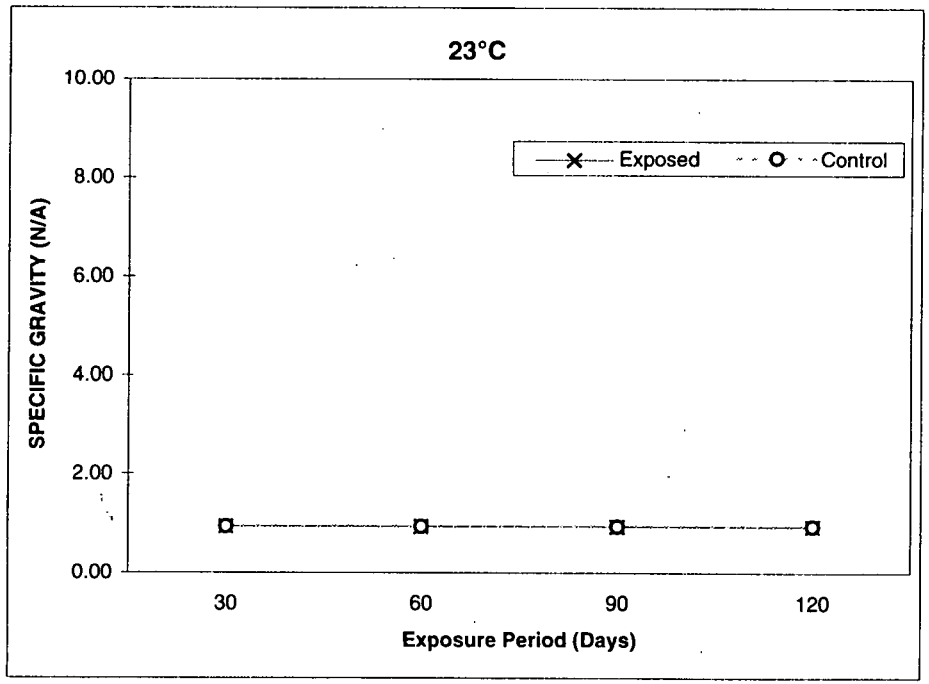
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

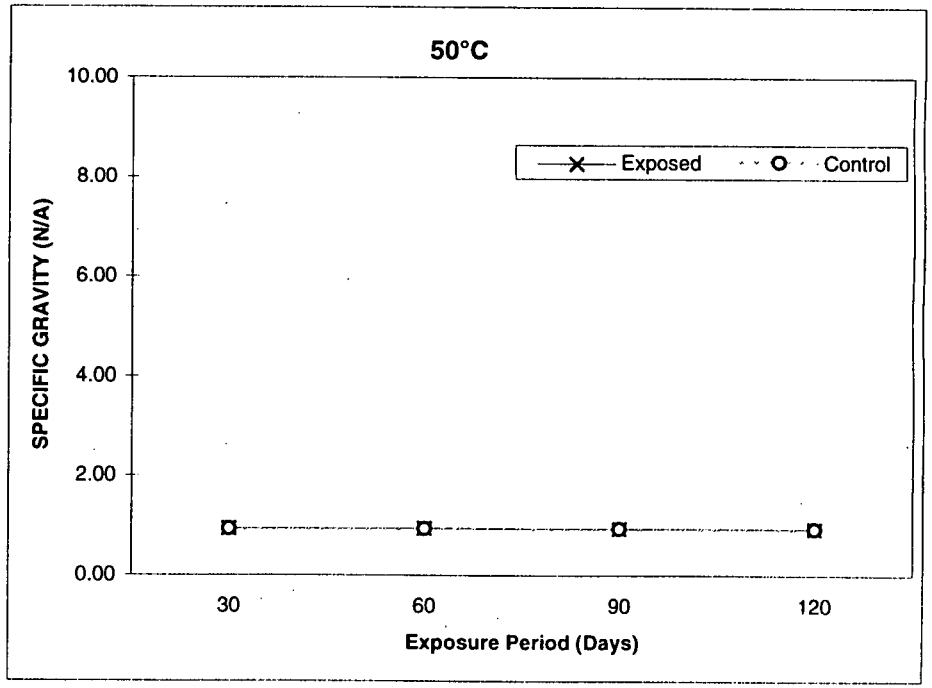
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D792*	*MATERIAL TYPE:*	*GSE - SLT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): SPECIFIC GRAVITY (N/A)
DIRECTION: N/A

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	0.9442	0.9431	0.9444	0.9458	0.9433	0.9442	0.0011	0.000	0.9442	0.9431	0.9444	0.9458	0.9433	0.9442	0.0011	0.000	CR
30	0.9451	0.9472	0.9464	0.9461	0.9458	0.9461	0.0008	0.208	0.9452	0.9461	0.9458	0.9463	0.9462	0.9459	0.0004	0.186	CR
Control	0.9442	0.9431	0.9444	0.9458	0.9433	0.9442	0.0011	0.000	0.9442	0.9431	0.9444	0.9458	0.9433	0.9442	0.0011	0.000	WM
60	0.9469	0.9453	0.9455	0.9450	0.9468	0.9459	0.0009	0.184	0.9475	0.9472	0.9476	0.9481	0.9473	0.9475	0.0004	0.358	CR
Control	0.9436	0.9439	0.9442	0.9438	0.9442	0.9439	0.0003	0.000	0.9436	0.9439	0.9442	0.9438	0.9442	0.9439	0.0003	0.000	WM
90	0.9462	0.9457	0.9457	0.9450	0.9459	0.9457	0.0004	0.186	0.9465	0.9467	0.9443	0.9469	0.9466	0.9462	0.0011	0.239	WM
Control	0.9456	0.9454	0.9444	0.9448	0.9455	0.9451	0.0005	0.000	0.9456	0.9454	0.9444	0.9448	0.9455	0.9451	0.0005	0.000	WM
120	0.9450	0.9450	0.9459	0.9453	0.9451	0.9453	0.0004	0.013	0.9460	0.9459	0.9462	0.9462	0.9464	0.9461	0.0002	0.106	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000218

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

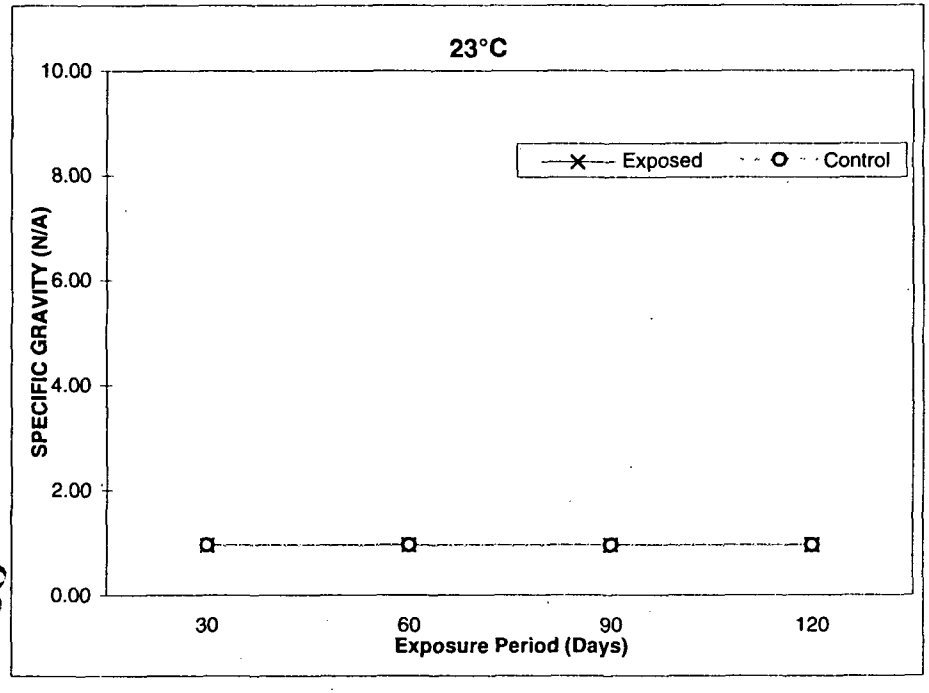
CHEMICAL COMPATIBILITY TEST RESULTS

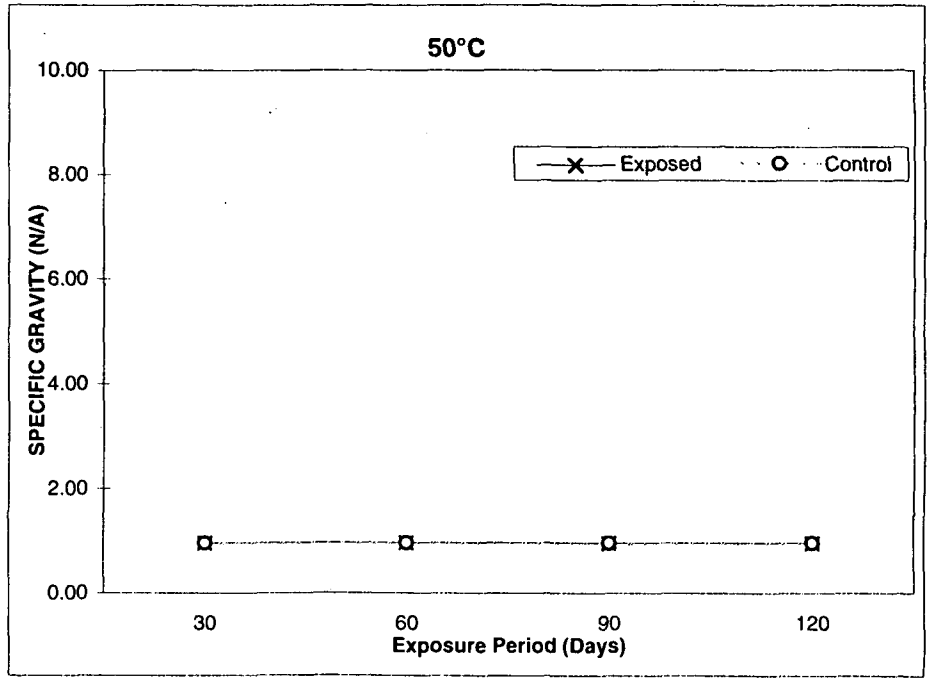
CLIENT: FERMCO
METHOD: ASTM D792
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): SPECIFIC GRAVITY (N/A)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.9511	0.9521	0.9522	0.9513	0.9513	0.9516	0.0005	0.000	0.9511	0.9521	0.9522	0.9513	0.9513	0.9516	0.0005	0.000	CR
30	0.9518	0.9537	0.9522	0.9531	0.9527	0.9527	0.0007	0.116	0.9519	0.9531	0.9521	0.9534	0.9534	0.9528	0.0007	0.124	CR
Control	0.9511	0.9521	0.9522	0.9513	0.9513	0.9516	0.0005	0.000	0.9511	0.9521	0.9522	0.9513	0.9513	0.9516	0.0005	0.000	WM
60	0.9546	0.9533	0.9534	0.9548	0.9530	0.9538	0.0008	0.233	0.9543	0.9547	0.9536	0.9531	0.9538	0.9539	0.0006	0.242	CR
Control	0.9510	0.9511	0.9509	0.9508	0.9512	0.9510	0.0002	0.000	0.9510	0.9511	0.9509	0.9508	0.9512	0.9510	0.0002	0.000	WM
90	0.9524	0.9521	0.9525	0.9517	0.9516	0.9521	0.0004	0.111	0.9535	0.9530	0.9529	0.9531	0.9530	0.9531	0.0002	0.221	WM
Control	0.9515	0.9510	0.9514	0.9514	0.9514	0.9513	0.0002	0.000	0.9515	0.9510	0.9514	0.9514	0.9514	0.9513	0.0002	0.000	WM
120	0.9512	0.9514	0.9516	0.9515	0.9514	0.9514	0.0001	0.008	0.9524	0.9521	0.9525	0.9519	0.9525	0.9523	0.0003	0.099	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

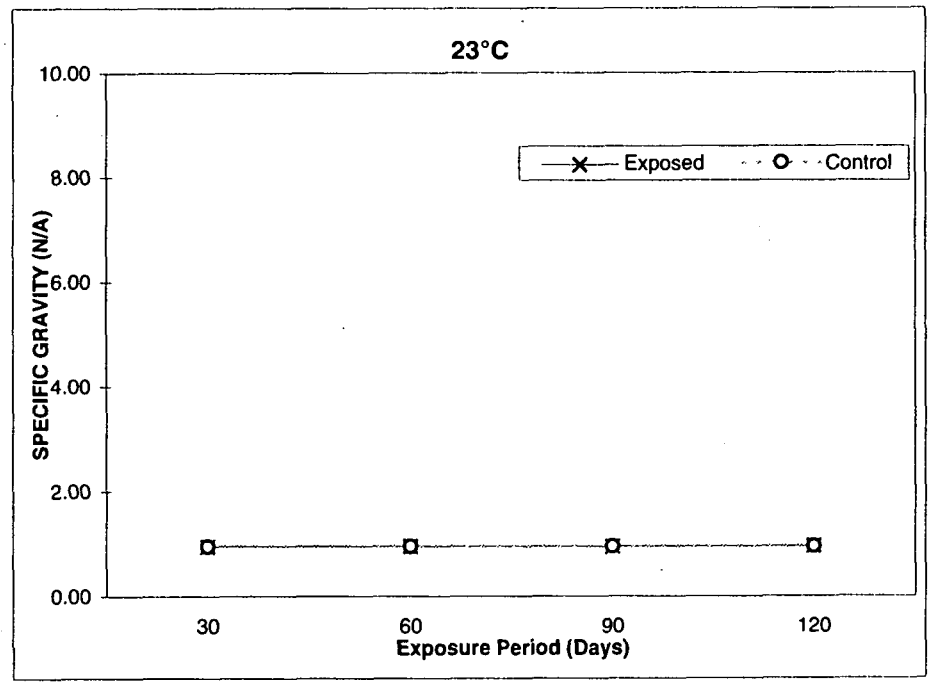
CHEMICAL COMPATIBILITY TEST RESULTS

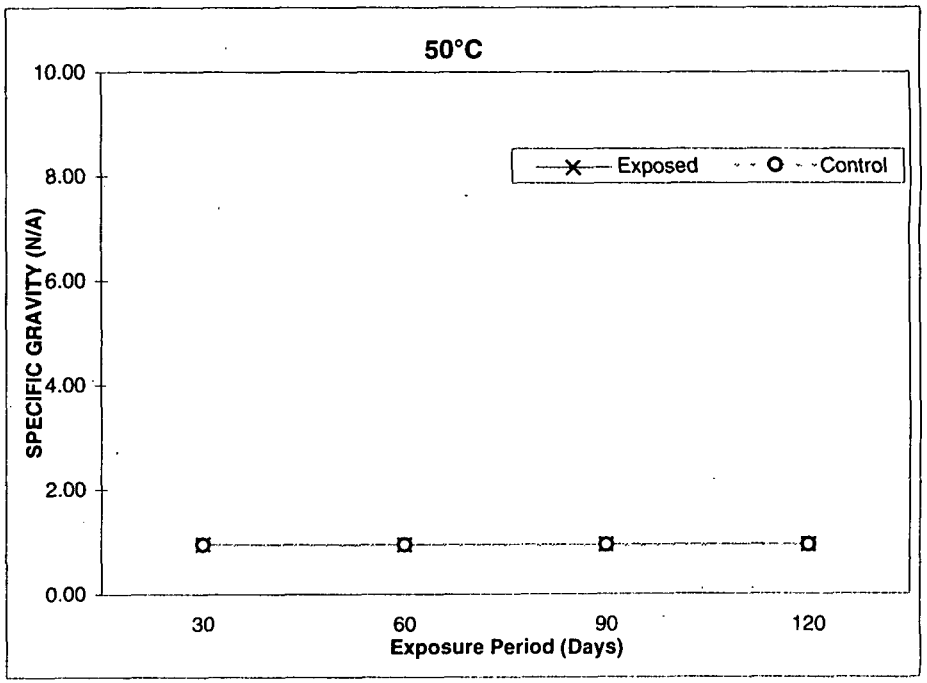
CLIENT: FERMCO
METHOD: ASTM D792
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): SPECIFIC GRAVITY (N/A)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.9506	0.9514	0.9510	0.9507	0.9518	0.9511	0.0005	0.000	0.9506	0.9514	0.9510	0.9507	0.9518	0.9511	0.0005	0.000	CR
30	0.9514	0.9523	0.9525	0.9521	0.9523	0.9521	0.0004	0.107	0.9521	0.9525	0.9527	0.9527	0.9518	0.9524	0.0004	0.132	CR
Control	0.9506	0.9514	0.9510	0.9507	0.9518	0.9511	0.0005	0.000	0.9506	0.9514	0.9510	0.9507	0.9518	0.9511	0.0005	0.000	WM
60	0.9522	0.9532	0.9530	0.9530	0.9529	0.9529	0.0004	0.185	0.9519	0.9521	0.9532	0.9517	0.9534	0.9525	0.0008	0.143	CR
Control	0.9497	0.9500	0.9499	0.9500	0.9494	0.9498	0.0003	0.000	0.9497	0.9500	0.9499	0.9500	0.9494	0.9498	0.0003	0.000	WM
90	0.9517	0.9514	0.9512	0.9509	0.9512	0.9513	0.0003	0.156	0.9520	0.9522	0.9525	0.9517	0.9517	0.9520	0.0003	0.234	WM
Control	0.9522	0.9521	0.9509	0.9516	0.9504	0.9514	0.0008	0.000	0.9522	0.9521	0.9509	0.9516	0.9504	0.9514	0.0008	0.000	WM
120	0.9599	0.9507	0.9501	0.9505	0.9504	0.9523	0.0042	0.092	0.9514	0.9512	0.9517	0.9511	0.9508	0.9512	0.0003	-0.021	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

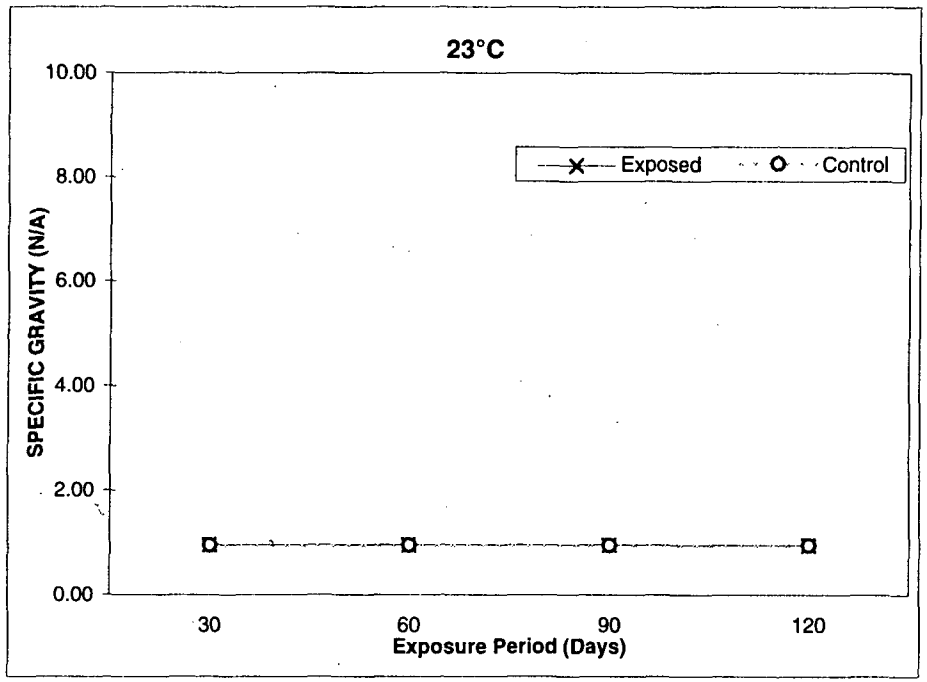
CHEMICAL COMPATIBILITY TEST RESULTS

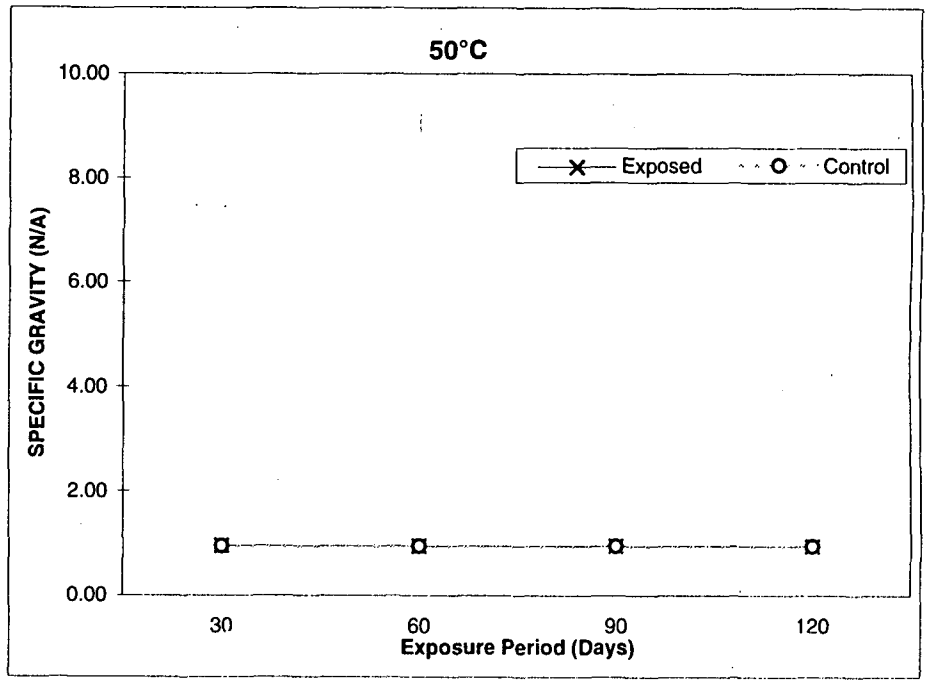
CLIENT: FERMCO
METHOD: ASTM D792
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): SPECIFIC GRAVITY (N/A)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.9549	0.9548	0.9549	0.9556	0.9558	0.9552	0.0005	0.000	0.9549	0.9548	0.9549	0.9556	0.9558	0.9552	0.0005	0.000	CR
30	0.9571	0.9568	0.9556	0.9569	0.9575	0.9568	0.0007	0.165	0.9570	0.9569	0.9574	0.9574	0.9552	0.9568	0.0009	0.165	CR
Control	0.9549	0.9548	0.9549	0.9556	0.9558	0.9552	0.0005	0.000	0.9549	0.9548	0.9549	0.9556	0.9558	0.9552	0.0005	0.000	WM
60	0.9572	0.9563	0.9561	0.9562	0.9563	0.9564	0.0004	0.128	0.9560	0.9560	0.9561	0.9561	0.9569	0.9562	0.0004	0.107	CR
Control	0.9545	0.9547	0.9539	0.9545	0.9538	0.9543	0.0004	0.000	0.9545	0.9547	0.9539	0.9545	0.9538	0.9543	0.0004	0.000	WM
90	0.9574	0.9559	0.9556	0.9559	0.9602	0.9570	0.0019	0.285	0.9563	0.9562	0.9563	0.9560	0.9565	0.9563	0.0002	0.207	WM
Control	0.9561	0.9555	0.9554	0.9554	0.9549	0.9555	0.0004	0.000	0.9561	0.9555	0.9554	0.9554	0.9549	0.9555	0.0004	0.000	WM
120	0.9549	0.9544	0.9548	0.9546	0.9550	0.9547	0.0002	-0.075	0.9556	0.9551	0.9550	0.9547	0.9551	0.9551	0.0003	-0.038	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

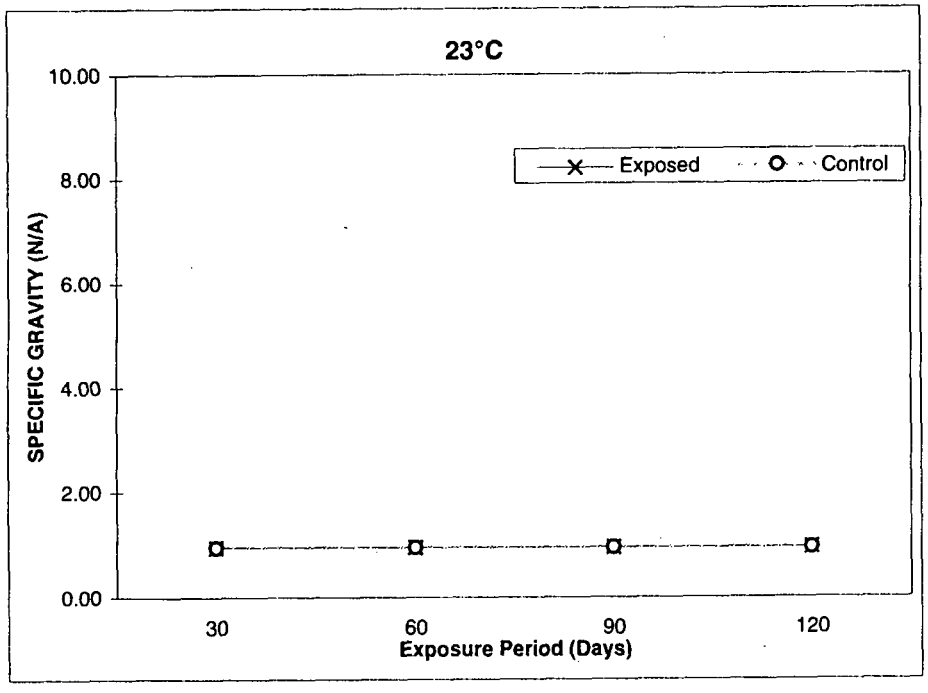
CHEMICAL COMPATIBILITY TEST RESULTS

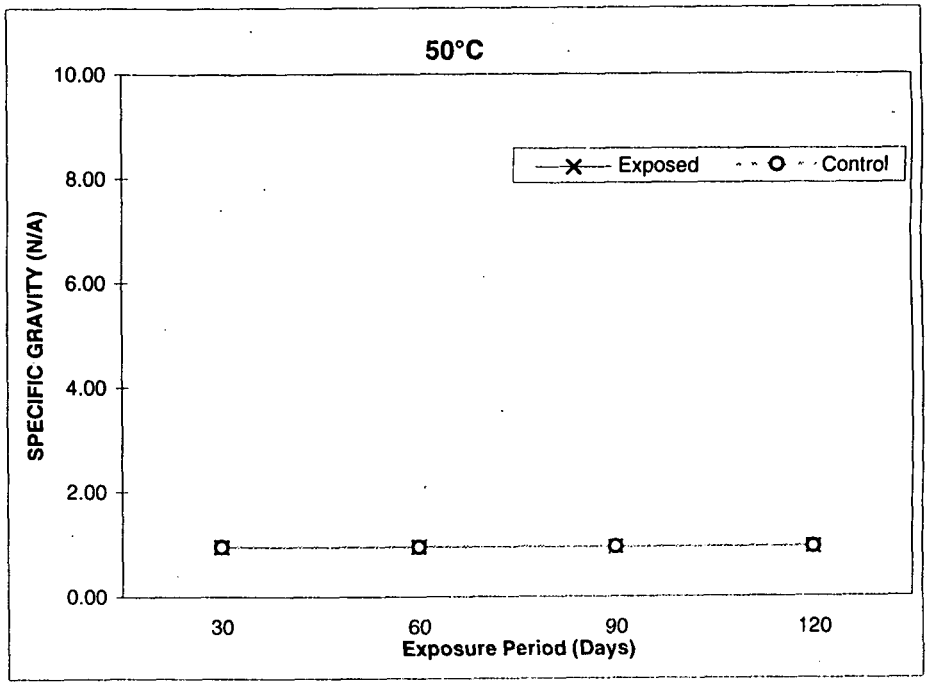
CLIENT: FERMCO
METHOD: ASTM D792
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): SPECIFIC GRAVITY (N/A)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.9540	0.9548	0.9537	0.9556	0.9531	0.9542	0.0010	0.000	0.9540	0.9548	0.9537	0.9556	0.9531	0.9542	0.0010	0.000	CR
30	0.9554	0.9550	0.9551	0.9534	0.9540	0.9546	0.0008	0.036	0.9549	0.9550	0.9550	0.9545	0.9542	0.9547	0.0004	0.050	CR
Control	0.9540	0.9548	0.9537	0.9556	0.9531	0.9542	0.0010	0.000	0.9540	0.9548	0.9537	0.9556	0.9531	0.9542	0.0010	0.000	WM
60	0.9532	0.9526	0.9528	0.9520	0.9527	0.9527	0.0004	-0.166	0.9535	0.9525	0.9533	0.9529	0.9528	0.9530	0.0004	-0.130	CR
Control	0.9552	0.9532	0.9542	0.9539	0.9545	0.9542	0.0007	0.000	0.9552	0.9532	0.9542	0.9539	0.9545	0.9542	0.0007	0.000	WM
90	0.9533	0.9529	0.9526	0.9529	0.9535	0.9530	0.0004	-0.122	0.9535	0.9538	0.9538	0.9535	0.9537	0.9537	0.0002	-0.057	WM
Control	0.9563	0.9556	0.9571	0.9556	0.9559	0.9561	0.0006	0.000	0.9563	0.9556	0.9571	0.9556	0.9559	0.9561	0.0006	0.000	WM
120	0.9527	0.9523	0.9519	0.9520	0.9523	0.9522	0.0003	-0.404	0.9531	0.9524	0.9526	0.9527	0.9526	0.9527	0.0003	-0.358	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000222

387

2.5 Volatiles Loss

Rationale for Test

The volatiles loss test is conducted to assess the amount of volatile constituents contained in geomembranes. The volatiles loss test is a gravimetric measurement in which the specimens are weighed after being retrieved from the leachate and cleaned. They are then heated in an oven for two hours and re-weighed. The mass lost by the samples after heating is their volatiles loss. Volatile constituents may include either constituents of the leachate, such as moisture and low concentrations of organic chemicals, or volatile constituents of the geomembranes, such as low molecular weight polyethylene (i.e., wax) or processing aids used during production of the geomembranes. Consequently, if leachate-exposed samples have higher volatiles loss values than corresponding control samples, the samples may have either absorbed volatile constituents from the leachate or initially contained more wax and processing aids than the unexposed sample. Wax is an artifact of the manufacturing process of HDPE geomembranes and may not be uniformly distributed throughout a roll of geomembrane.

Results and Discussion

The results of the leachate/liner compatibility testing program indicate that the geomembrane samples have volatiles loss values for the 30, 60, 90, and 120 days that are all higher than their control values.

The following observations were made regarding the volatiles loss values of each of the exposed geomembrane samples (discussed individually because they displayed unique behavior):

GSE-SLT Geomembranes. The samples exposed at 23°C (73°F) showed a linear increase in volatiles loss from the 30-day exposure period to the 120-day exposure period. The 50°C (122°F) samples experienced a greater increase, but with some variability. The volatiles loss values of the exposed samples were outside of one standard deviation of the mean value of the control samples.

draft

NSC Geomembrane. All of the exposed samples experienced an increase in volatiles loss. However, the results were variable (i.e., no trends occurred for both 23°C (73°F) and 50°C (122°F) data sets between consecutive exposure periods). In general, the 50°C (122°F) samples experienced a slightly greater increase than the 23°C (73°F) samples. For the 23°C (73°F) samples, the 30-day and 90-day sample values were within one standard deviation of the mean control value. For the 50°C (122°F) samples, the 60-day and 90-day sample values were within one standard deviation of the mean control values.

GSE-Gundle Geomembrane. All of the exposed samples had higher volatiles loss values than the mean control values. However, the results were variable (i.e., no trends were observed). In addition, all of the mean volatiles loss values were more than one standard deviation from the mean control values. Finally, the 23°C (73°F) samples experienced a greater overall increase in volatiles loss compared to the 50°C (122°F) samples.

PolyFlex Geomembrane. All of the exposed samples had higher volatiles loss values than the mean control values. The volatiles loss of the geomembranes was generally stable relative to the GSE-Gundle, GSE-SLT, Serrot, and NSC geomembranes. The 50°C (122°F) samples generally had greater volatiles loss than the 23°C (73°F) samples. All of the exposed samples had mean volatiles loss values that were outside of one standard deviation of the mean control values.

Serrot Geomembrane. All of the exposed samples had higher volatiles loss values than the mean control values. Both the 23°C (73°F) and 50°C (122°F) samples show a decreasing trend occurring from the 30-day to the 90-day exposure periods. At 120-day an abrupt increase occurred, with a larger change occurring in the 23°C (73°F) samples. Finally, all of the exposed values were outside of one standard deviation of the mean control values.

Since the aforementioned physical properties did not change from their pre-exposure values, the increased volatiles values for the exposed samples are likely due to moisture and possibly residual detergent from the coupon cleaning process on the surface of the samples. Small amounts of water may become trapped in areas such as

small scratches in the surface of the sample that cannot be removed until the test drying begins. If the geomembranes had absorbed organic constituents from the test leachate, it is likely that the mass, thickness, dimensions, and specific gravity would have all increased as a result. As discussed previously, all three of these properties remained constant during the 120-day exposure period. Also, since the test leachate has low concentrations of organic constituents (see Appendix A), it is unlikely that the increase in volatiles loss is due to absorption of organic leachate constituents. In addition, previous experience indicates that volatiles loss values typically display significant variability, due to experimental variation, and material variability.

Conclusion

The exposed geomembranes experienced an increase in volatiles loss. However, the increase is likely due to moisture or detergent residue on the surface of the samples since the test leachate does not contain significant quantities of organic constituents, and the mass thickness, dimensions, and specific gravity of the geomembranes did not change.

draft

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

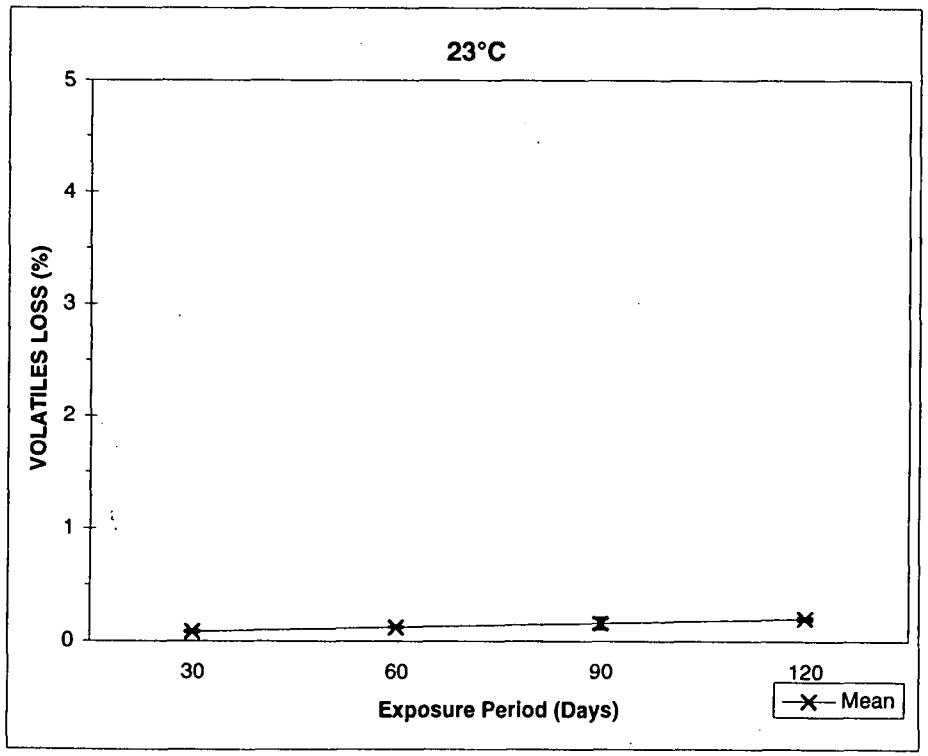
CHEMICAL COMPATIBILITY TEST RESULTS

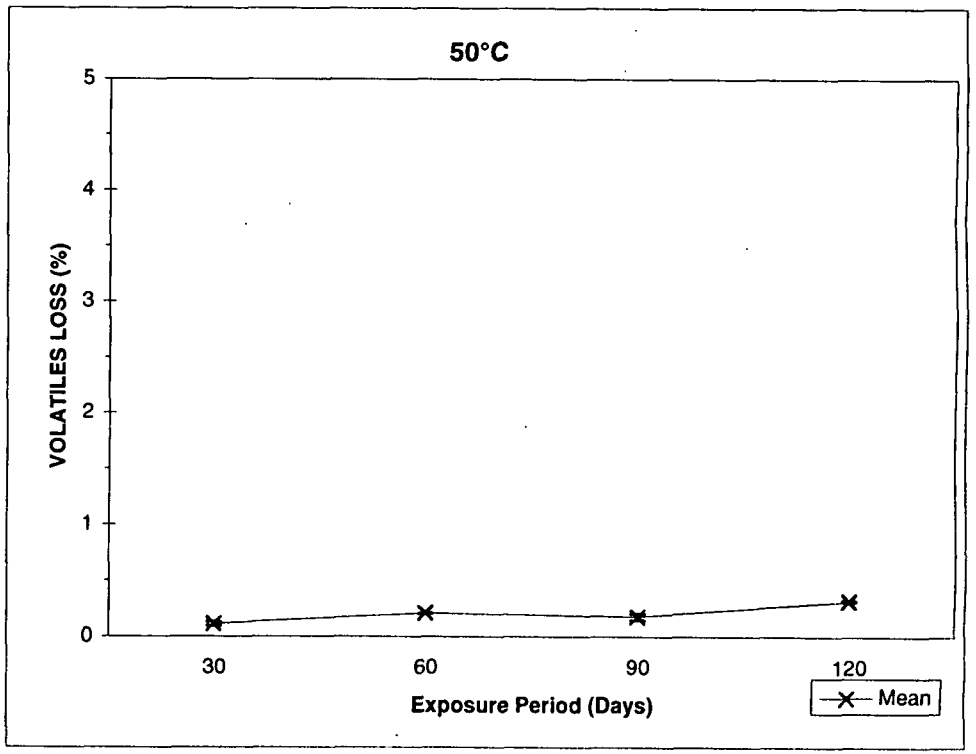
CLIENT: FERMCO
METHOD: ASTM D3030
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): VOLATILES LOSS (%)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.0525	0.0589				0.0557	0.0045	0.0	0.0525	0.0589				0.0557	0.0045	0.0	CR
30	0.0800	0.0880				0.0840	0.0057	50.8	0.1010	0.1250				0.1130	0.0170	102.9	CR
60	0.1230	0.1260				0.1245	0.0021	123.5	0.2080	0.2110				0.2095	0.0021	276.1	CR
90	0.1930	0.1230				0.1580	0.0495	183.7	0.2000	0.1560				0.1780	0.0311	219.6	CR
120	0.2100	0.1940				0.2020	0.0113	262.7	0.3260	0.3180				0.3220	0.0057	478.1	CR





© 1996 GEOSYNTEC CONSULTANTS

Note: Error bars represent one standard deviation at mean sample value.

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

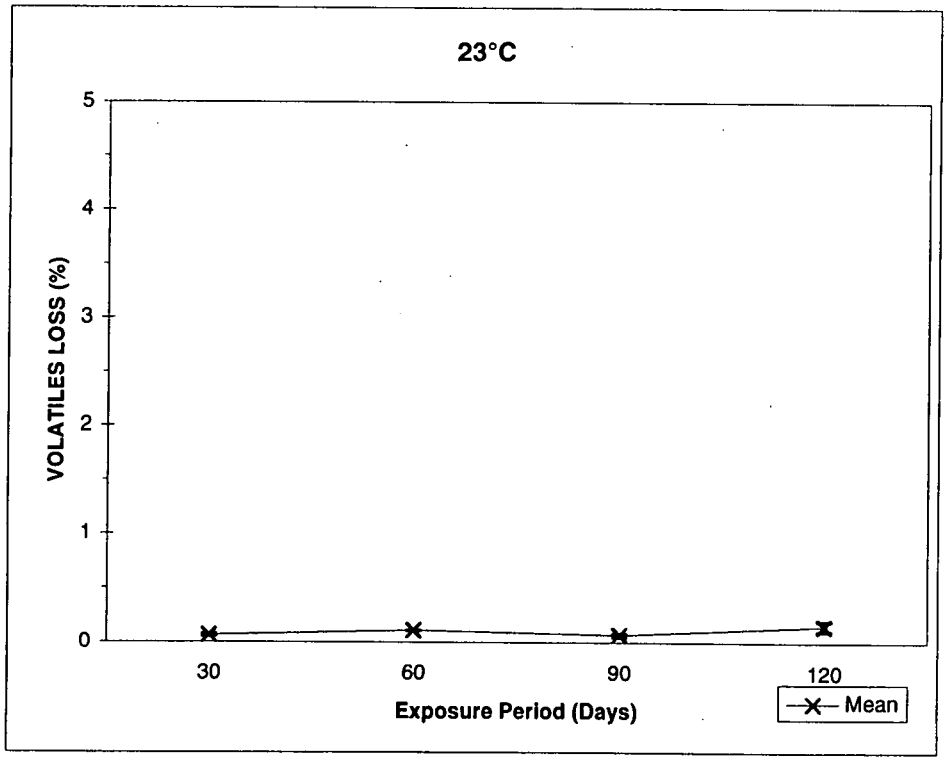
CHEMICAL COMPATIBILITY TEST RESULTS

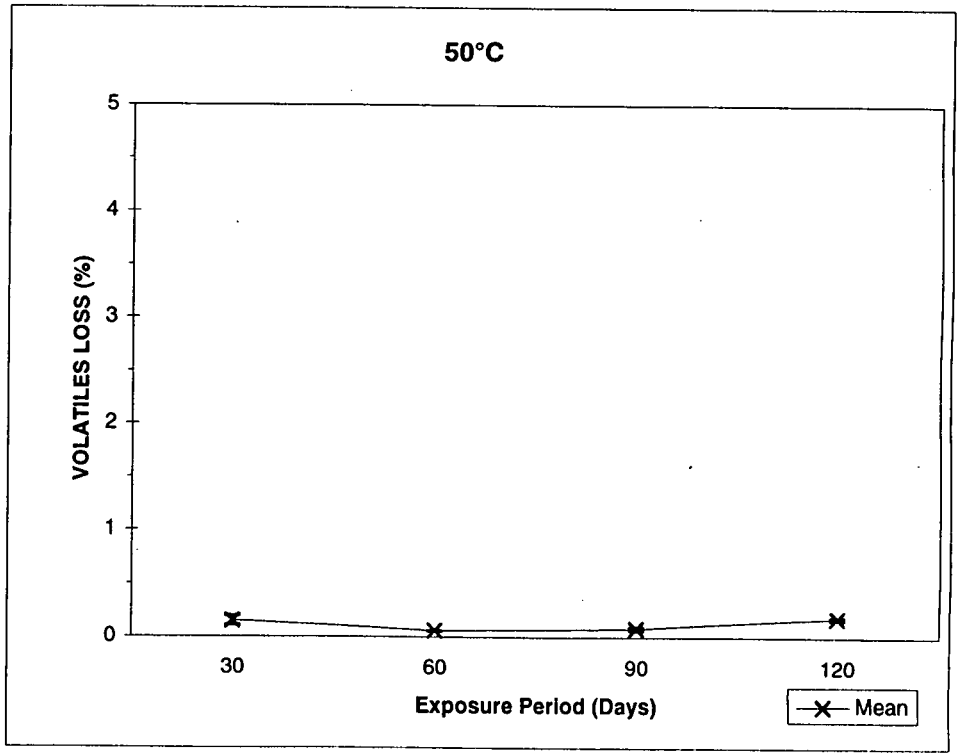
CLIENT: FERMCO
METHOD: ASTM D3030
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): VOLATILES LOSS (%)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.0316	0.0814				0.0565	0.0352	0.0	0.0316	0.0814				0.0565	0.0352	0.0	CR
30	0.0760	0.0610				0.0685	0.0106	21.2	0.1840	0.1210				0.1525	0.0445	169.9	CR
60	0.1140	0.1110				0.1125	0.0021	99.1	0.0590	0.0610				0.0600	0.0014	6.2	CR
90	0.0580	0.0820				0.0700	0.0170	23.9	0.0720	0.0920				0.0820	0.0141	45.1	CR
120	0.1230	0.1870				0.1550	0.0453	174.3	0.1900	0.1700				0.1800	0.0141	218.6	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

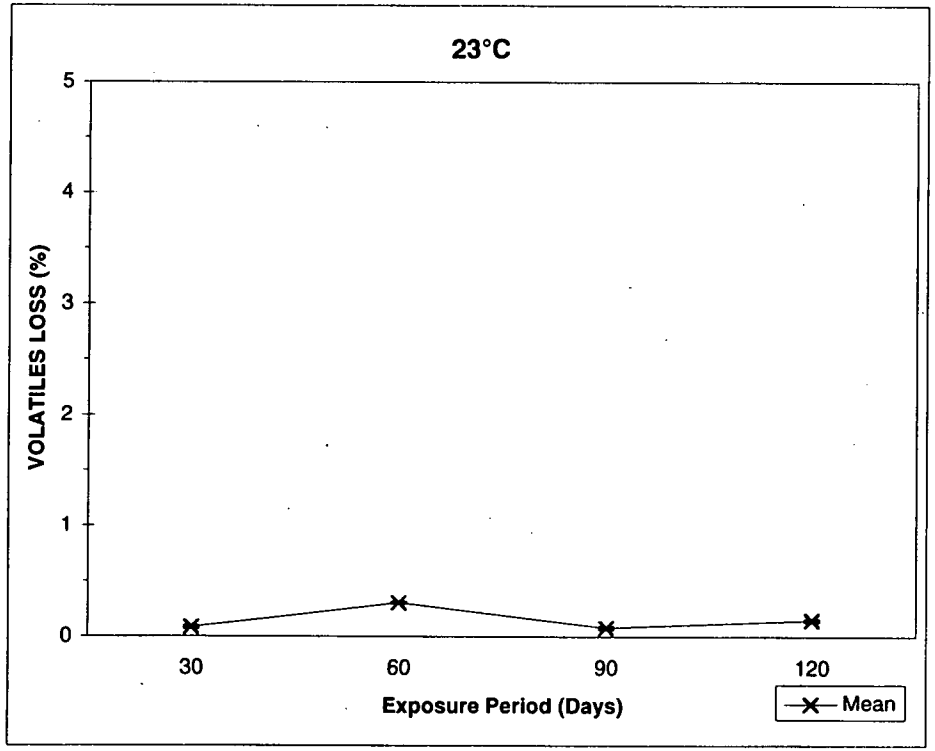
CHEMICAL COMPATIBILITY TEST RESULTS

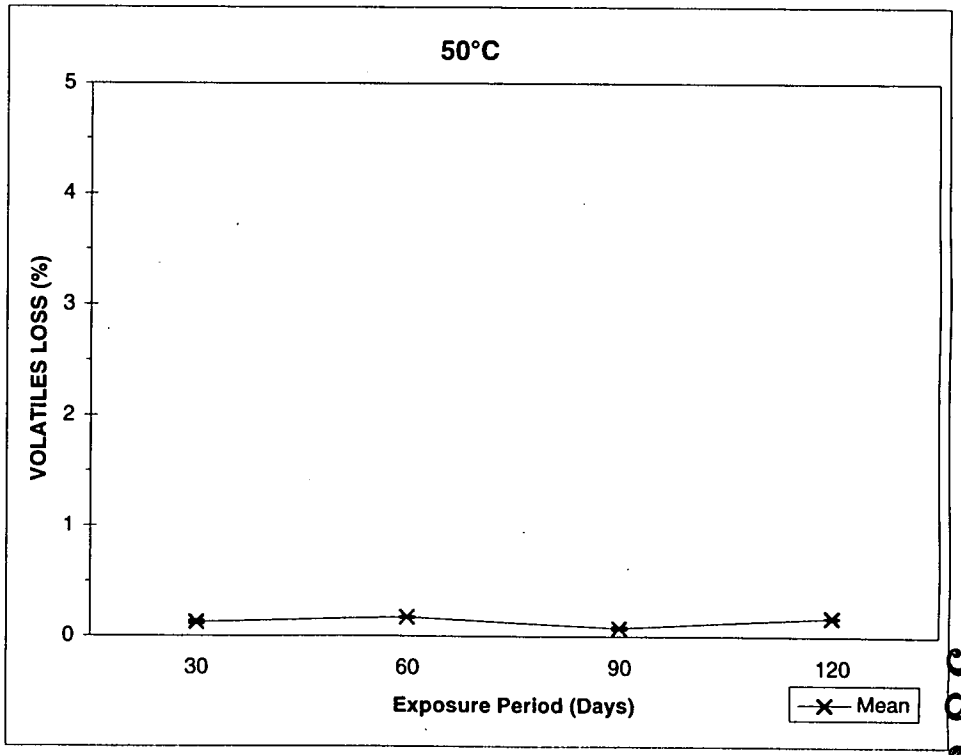
CLIENT: FERMCO
METHOD: ASTM D3030
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): VOLATILES LOSS (%)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.0098	0.0260				0.0179	0.0115	0.0	0.0098	0.0260				0.0179	0.0115	0.0	CR
30	0.0910	0.0760				0.0835	0.0106	366.5	0.1380	0.1200				0.1290	0.0127	620.7	CR
60	0.3120	0.3050				0.3085	0.0049	1623.5	0.1770	0.1720				0.1745	0.0035	874.9	CR
90	0.0880	0.0720				0.0800	0.0113	346.9	0.0830	0.0690				0.0760	0.0099	324.6	CR
120	0.1450	0.1560				0.1505	0.0078	740.8	0.1750	0.1740				0.1745	0.0007	874.9	CR





© 1996 GEOSYNTEC CONSULTANTS

Note: Error bars represent one standard deviation at mean sample value.

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

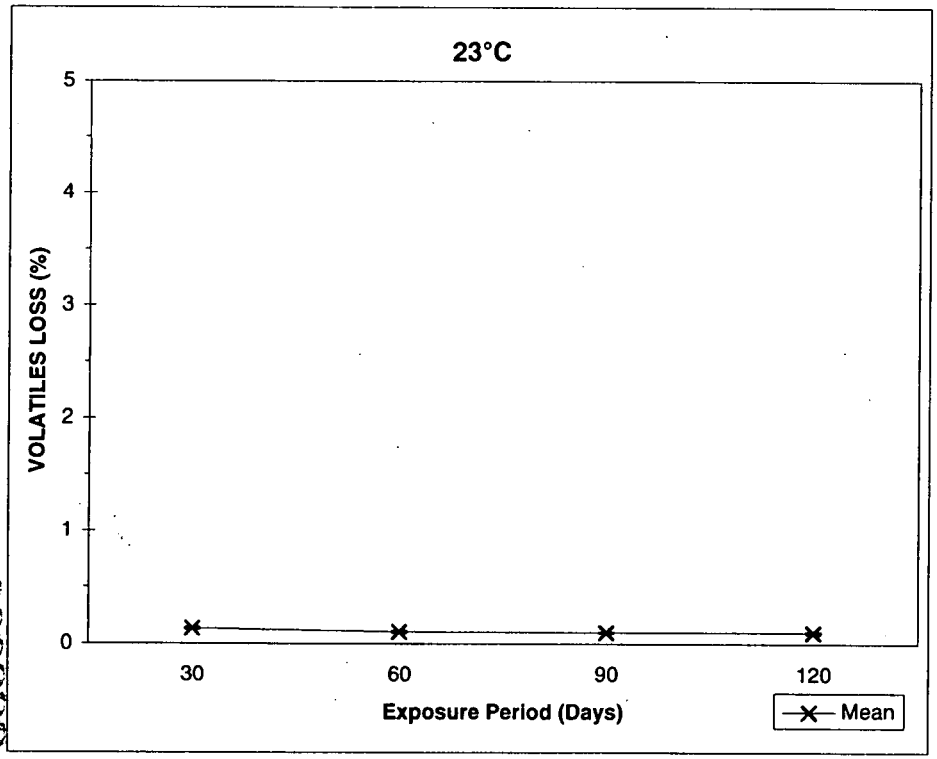
CHEMICAL COMPATIBILITY TEST RESULTS

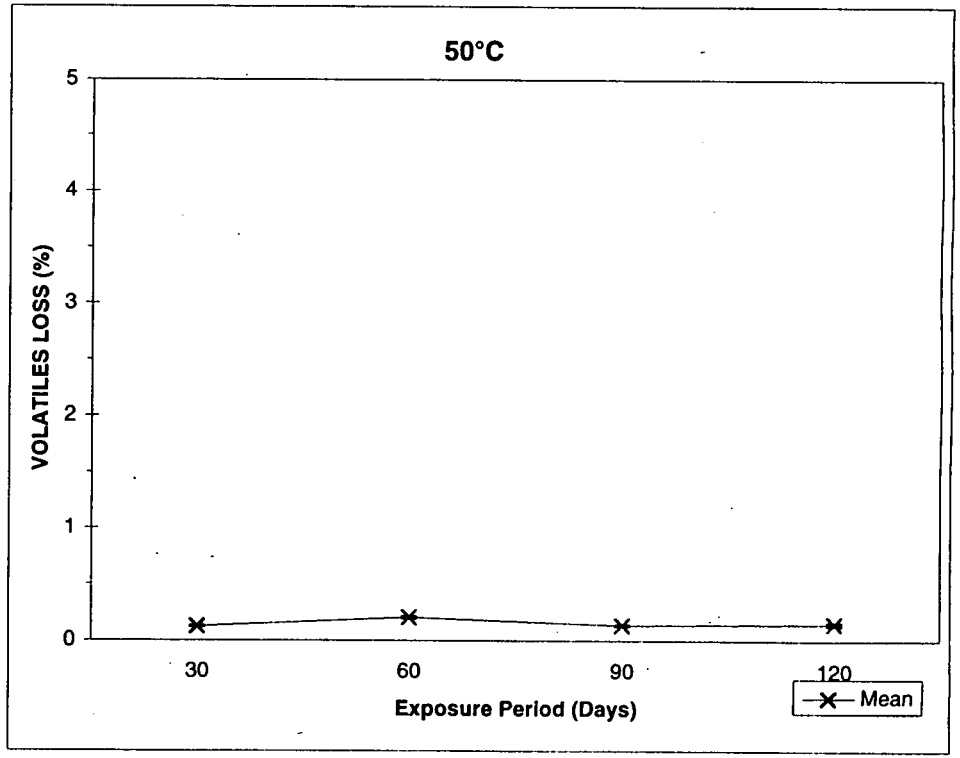
CLIENT: FERMCO
METHOD: ASTM D3030
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): VOLATILES LOSS (%)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.0129	0.0211				0.0170	0.0058	0.0	0.0129	0.0211				0.0170	0.0058	0.0	CR
30	0.1390	0.1310				0.1350	0.0057	694.1	0.1230	0.1280				0.1255	0.0035	638.2	CR
60	0.1010	0.1090				0.1050	0.0057	517.6	0.2030	0.2100				0.2065	0.0049	1114.7	CR
90	0.0990	0.0990				0.0990	0.0000	482.4	0.1360	0.1390				0.1375	0.0021	708.8	CR
120	0.0970	0.1050				0.1010	0.0057	494.1	0.1610	0.1450				0.1530	0.0113	800.0	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

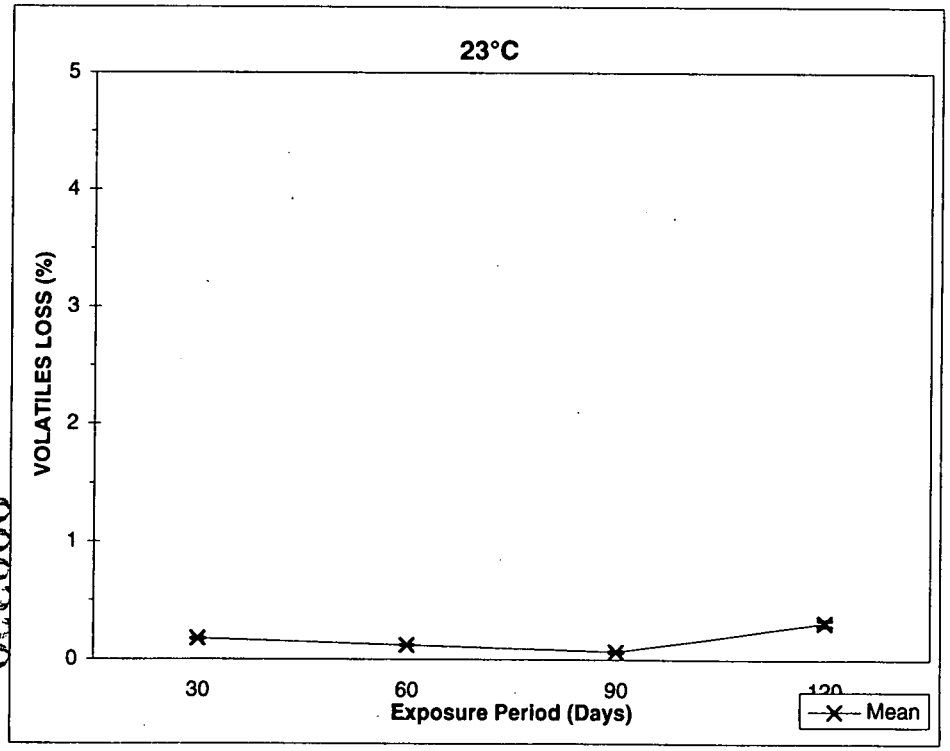
CHEMICAL COMPATIBILITY TEST RESULTS

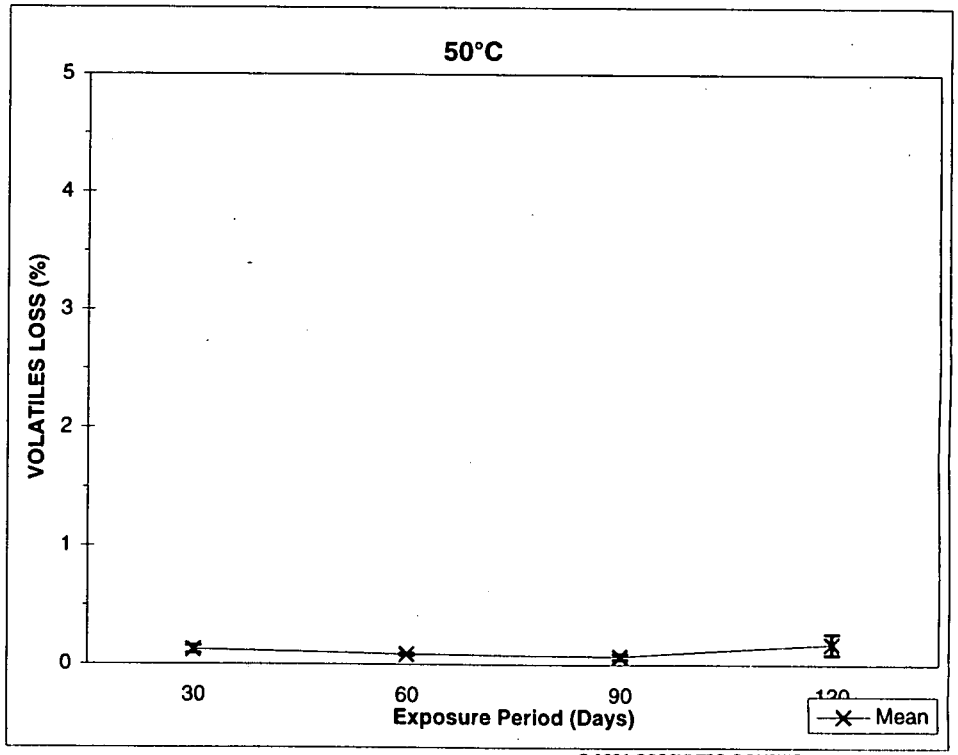
CLIENT: FERMCO
METHOD: ASTM D3030
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): VOLATILES LOSS (%)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.0162	0.0500				0.0331	0.0239	0.0	0.0162	0.0500				0.0331	0.0239	0.0	CR
30	0.1830	0.1800				0.1815	0.0021	448.3	0.1030	0.1490				0.1260	0.0325	280.7	CR
60	0.1230	0.1250				0.1240	0.0014	274.6	0.0810	0.0920				0.0865	0.0078	161.3	CR
90	0.0730	0.0620				0.0675	0.0078	103.9	0.0880	0.0540				0.0710	0.0240	114.5	CR
120	0.2990	0.3350				0.3170	0.0255	857.7	0.2410	0.1140				0.1775	0.0898	436.3	CR





© 1996 GEOSYNTEC CONSULTANTS

Note: Error bars represent one standard deviation at mean sample value.

2.6 Extractables Content

Rationale for Test

The extractables content test is conducted to assess the quantity of constituents that can be removed from geomembranes by solvent-extraction (methyl ethyl ketone is the solvent prescribed by the USEPA Method 9090 test procedure). However, HDPE geomembranes do not contain chemical species, such as plasticizers, that can be readily extracted. HDPE geomembranes do contain antioxidants and some very low molecular weight polyethylenes material, i.e., wax (waxes were discussed in Section 2.5). Antioxidants can potentially be removed from the geomembranes by the extraction procedure. However, antioxidant concentration in HDPE geomembranes is very low (typically less than one percent). In addition, antioxidants tend to be large molecules, which inhibits their extraction from materials. Therefore, it is unlikely that antioxidants account for a significant percentage of the total extractables content.

The low molecular weight polyethylene material (wax) in HDPE geomembranes is an artifact of the production process and is not an integral part of the HDPE matrix. Thus, wax does not contribute to the performance of the HDPE geomembranes. Wax tends to be randomly distributed in HDPE geomembranes, thereby making assessment of the percentage of wax in HDPE unreliable. Therefore, extractables content values of HDPE geomembranes typically exhibit significant scatter because: (i) wax tends to represent the majority of material removed by the extraction procedure; and (ii) it is randomly distributed in HDPE geomembranes.

Results and Discussion

The following observations were made regarding the extractables content results of the geomembrane samples:

GSE-SLT Geomembrane. Extractables content values of the exposed samples were higher than the mean control values. However, data consistency was poor (i.e., there were no discernable trends). In addition, all of the mean exposure values were greater than one standard deviation from the mean values of the control

samples. Finally, the 23°C (73°F) samples generally had higher extractable content values compared to the 50°C (122°F) samples.

NSC Geomembrane. Extractables content values of the exposed samples were higher than those of the control sample. However, as with the GSE-SLT geomembrane, data consistency was poor. Only the 60-day 23°C (73°F) and 60-day 50°C (122°F) samples were within one standard deviation of the control value means. Finally, the 23°C (73°F) samples appeared to have greater variability, compared to the 50°C (122°F) samples.

GSE-Gundle Geomembrane. The exposed samples had higher extractables content values than the control samples. However, there was no discernable data trend. Only the 120-day samples were within one standard deviation of the control value means.

PolyFlex Geomembrane. The exposed samples had higher extractables content values than the control values. However, as within the GSE-Gundle, GSE-SLT, and NSC geomembranes, data consistency was poor. The magnitude of change for the 23°C (73°F) samples was similar to that for the 50°C (122°F) samples. All of the mean extractables content values of the exposed samples were more than one standard deviation from the control value means.

Serrot Geomembrane. The exposed samples had higher extractables content values than the control samples. No data trends were observed. All of the exposed samples had mean values that were more than one standard deviation from the control value means. The magnitude of the percent change values of the 23°C (73°F) samples were higher than those of the 50°C (122°F) samples.

The observations given above suggest that there was significant variability in the extractables content values. This finding is typical for extractables content values of HDPE geomembranes tested in USEPA Method 9090 test programs. However, several comments can be made regarding the higher values of the exposed samples relative to the control samples.

Draft

The exposed samples were ultrasonically cleaned to help remove trace levels of residual radioactivity from the coupons. This high-energy cleaning process may have made the wax more easily removable (i.e., some the subsurface wax may have migrated to the surface, bringing it into more direct contact with the extraction solvent). In addition, the elevated temperature (of the 50°C (122°F) exposure) may have also contributed to some of the wax migrating to the surface of the geomembranes, and the non-uniform distribution of wax in a roll of geomembrane may cause inter-exposure period scatter. Also, the generally poor inter-exposure period correlation indicates that the higher values of exposed samples are probably not due to the leachate, because the action of the leachate would likely be progressive, resulting in a uniform trend. Furthermore, these results are not in agreement with the mass, thickness, dimensions, and specific gravity results, which were constant during the 120 days of the exposure test. Therefore, it is unlikely that the increase in extractables content is due to the action of the test leachate, but rather to a combination of the physical process of cleaning, the elevated exposure temperature, and the random distribution of wax in the geomembranes.

Conclusion

The extractables content values of the exposed geomembranes were higher than the control values. However, the increase is not likely due to the action of the leachate, but rather, to the process of ultrasonic cleaning, the elevated exposure temperature, and the random distribution of wax in the geomembranes.

draft

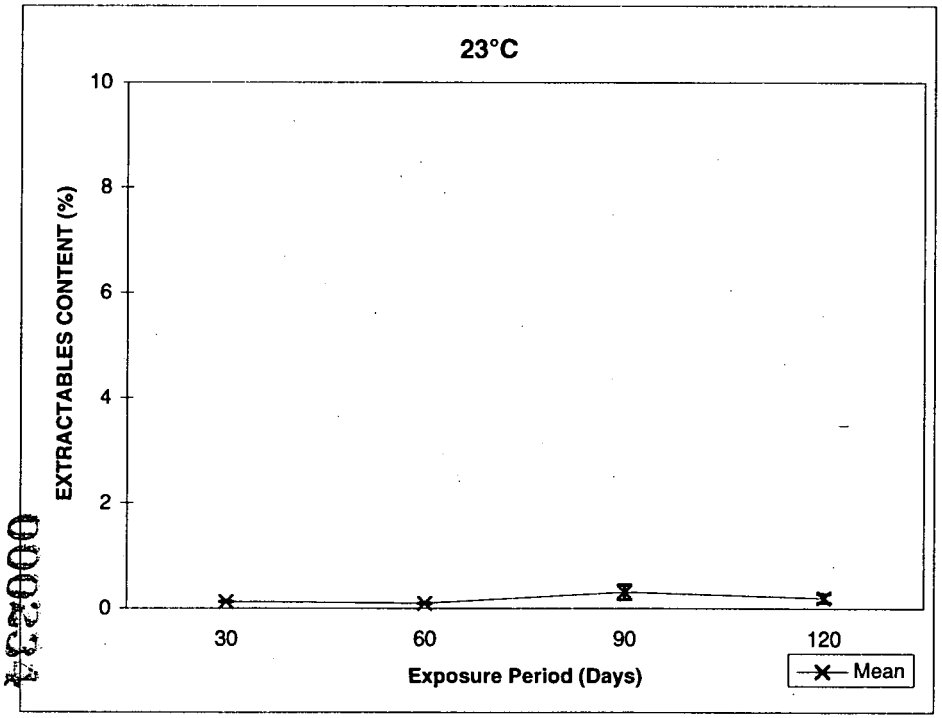
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

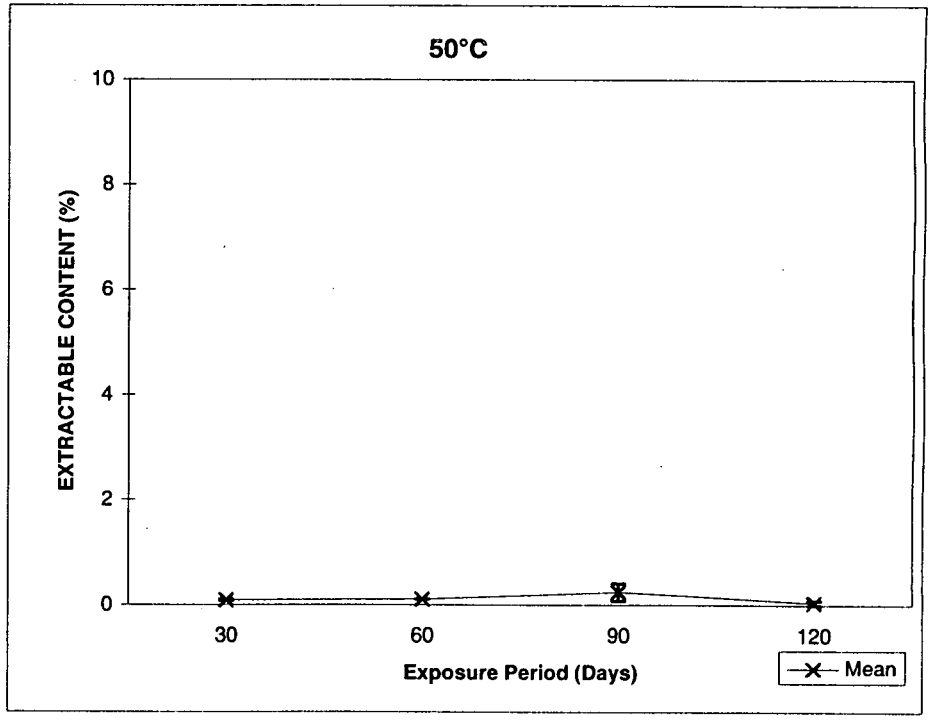
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D3421*	*MATERIAL TYPE:*	*GSE - SLT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): EXTRACTABLES CONTENT (%)
DIRECTION: N/A

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	0.035	0.039				0.037	0.003	0.0	0.035	0.039				0.037	0.003	0.0	CR
30	0.131	0.124				0.128	0.005	244.6	0.105	0.084				0.095	0.015	155.4	CR
60	0.102	0.096				0.099	0.004	167.6	0.112	0.103				0.108	0.006	190.5	CR
90	0.215	0.418				0.317	0.144	755.4	0.129	0.370				0.250	0.170	574.3	CR
120	0.263	0.142				0.203	0.086	447.3	0.011	0.074				0.043	0.045	14.9	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

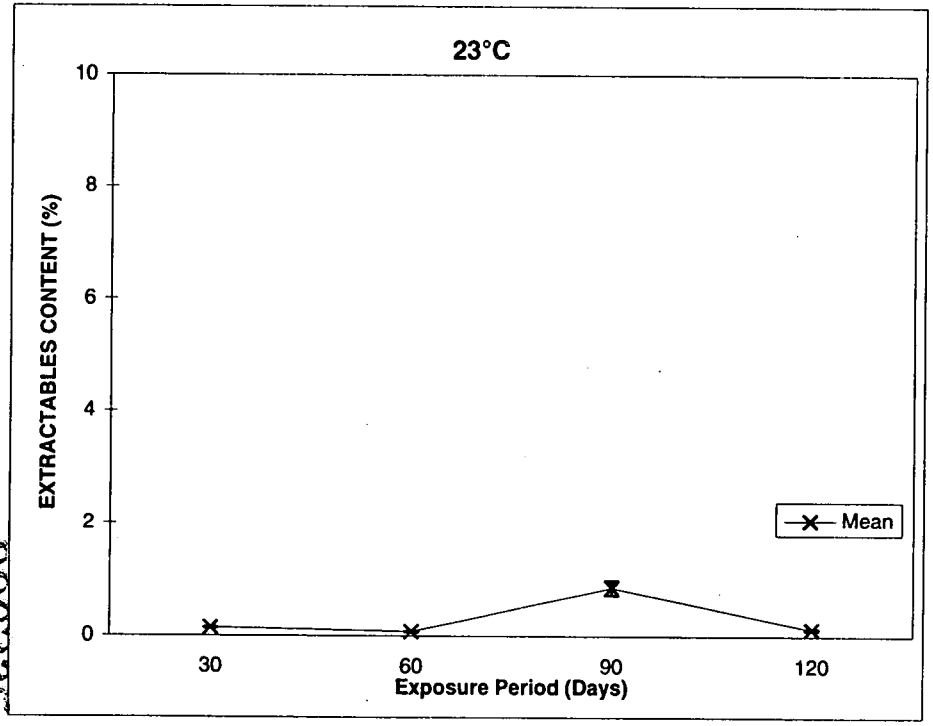
CHEMICAL COMPATIBILITY TEST RESULTS

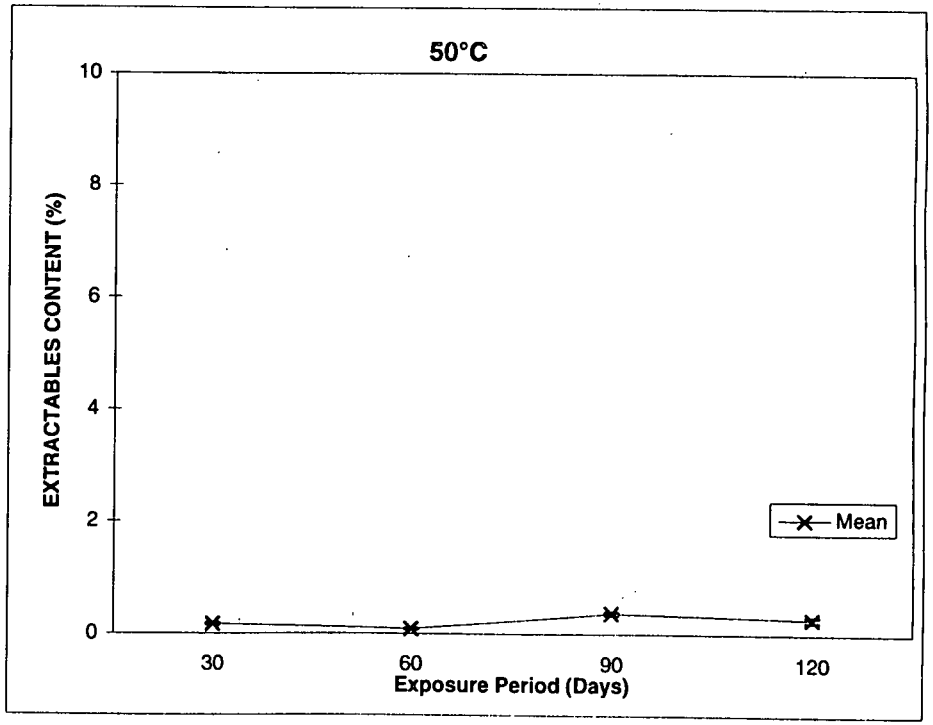
CLIENT: FERMCO
METHOD: ASTM D3421
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): EXTRACTABLES CONTENT (%)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.041	0.097				0.069	0.040	0.0	0.041	0.097				0.069	0.040	0.0	CR
30	0.148	0.145				0.147	0.002	112.3	0.184	0.160				0.172	0.017	149.3	CR
60	0.075	0.081				0.078	0.004	13.0	0.082	0.089				0.086	0.005	23.9	CR
90	0.768	0.943				0.856	0.124	1139.9	0.350	0.385				0.368	0.025	432.6	CR
120	0.133	0.116				0.125	0.012	80.4	0.309	0.241				0.275	0.048	298.6	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

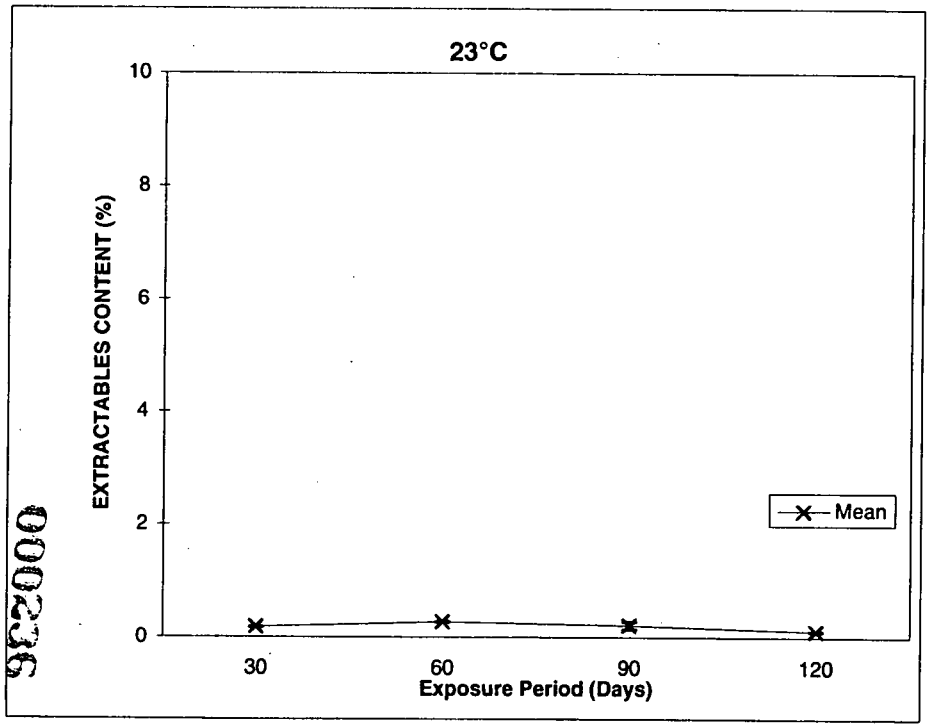
CHEMICAL COMPATIBILITY TEST RESULTS

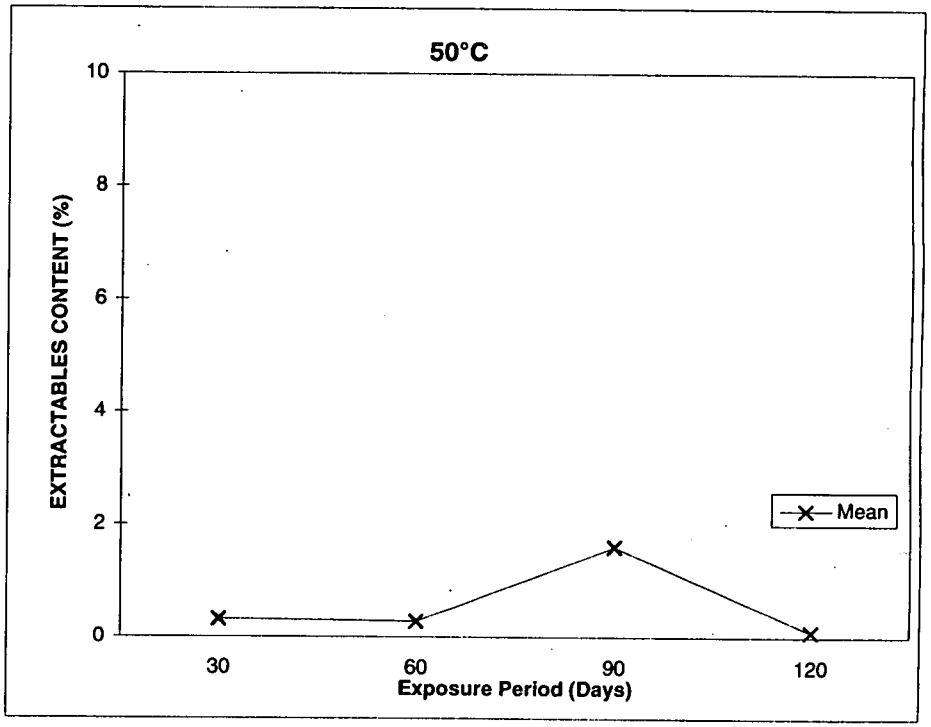
CLIENT: FERMCO
METHOD: ASTM D3421
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): EXTRACTABLES CONTENT (%)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.124	0.036				0.080	0.062	0.0	0.124	0.036				0.080	0.062	0.0	CR
30	0.183	0.188				0.186	0.004	131.9	0.332	0.311				0.322	0.015	301.9	CR
60	0.285	0.276				0.281	0.006	250.6	0.291	0.263				0.277	0.020	246.3	CR
90	0.169	0.267				0.218	0.069	172.5	0.267	2.940				1.604	1.890	1904.4	CR
120	0.108	0.118				0.113	0.007	41.2	0.063	0.129				0.096	0.047	20.0	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000236

382

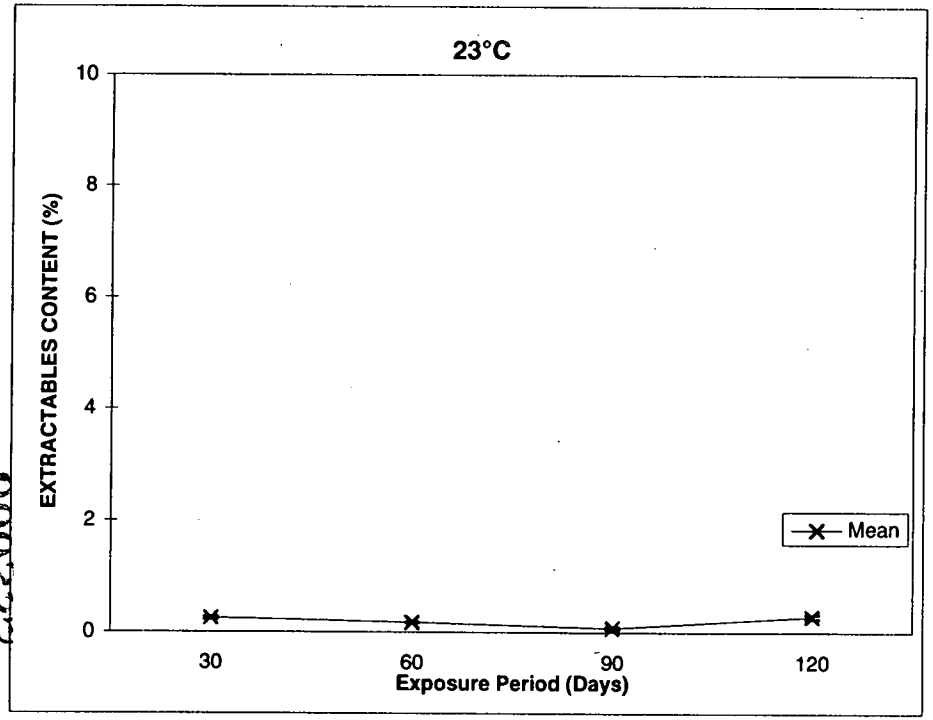
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

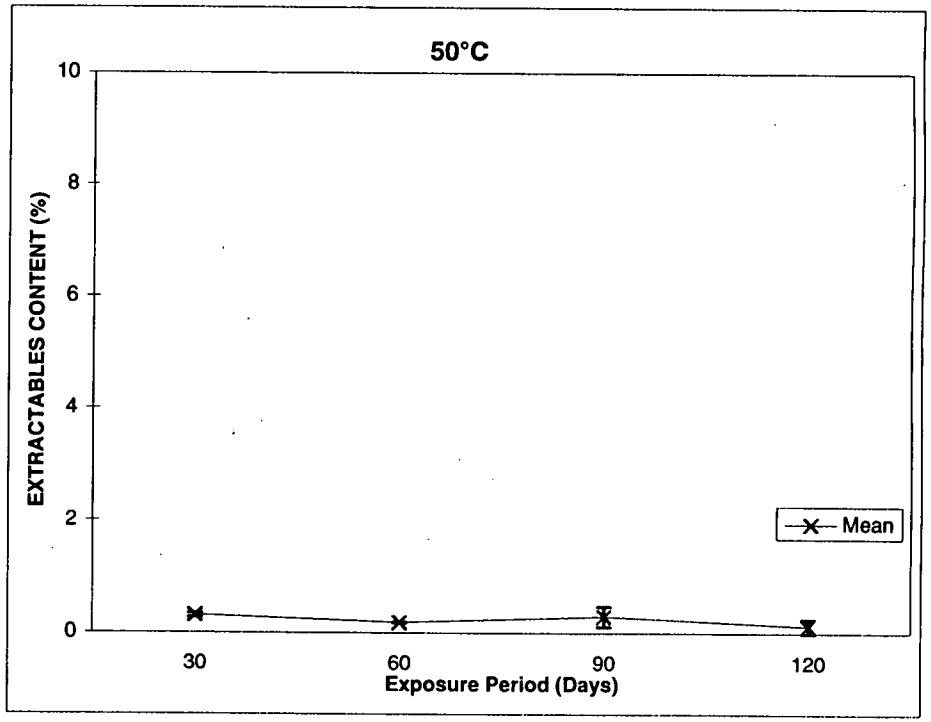
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D3421*	*MATERIAL TYPE:*	*POLYFLEX*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): EXTRACTABLES CONTENT (%)
DIRECTION: N/A

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	0.071	0.061				0.066	0.007	0.0	0.071	0.061				0.066	0.007	0.0	CR
30	0.235	0.270				0.253	0.025	282.6	0.342	0.289				0.316	0.037	378.0	CR
60	0.175	0.169				0.172	0.004	160.6	0.179	0.187				0.183	0.006	177.3	CR
90	0.061	0.093				0.077	0.023	16.7	0.164	0.425				0.295	0.185	346.2	CR
120	0.256	0.313				0.285	0.040	331.1	0.209	0.032				0.121	0.125	82.6	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000237

T-382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

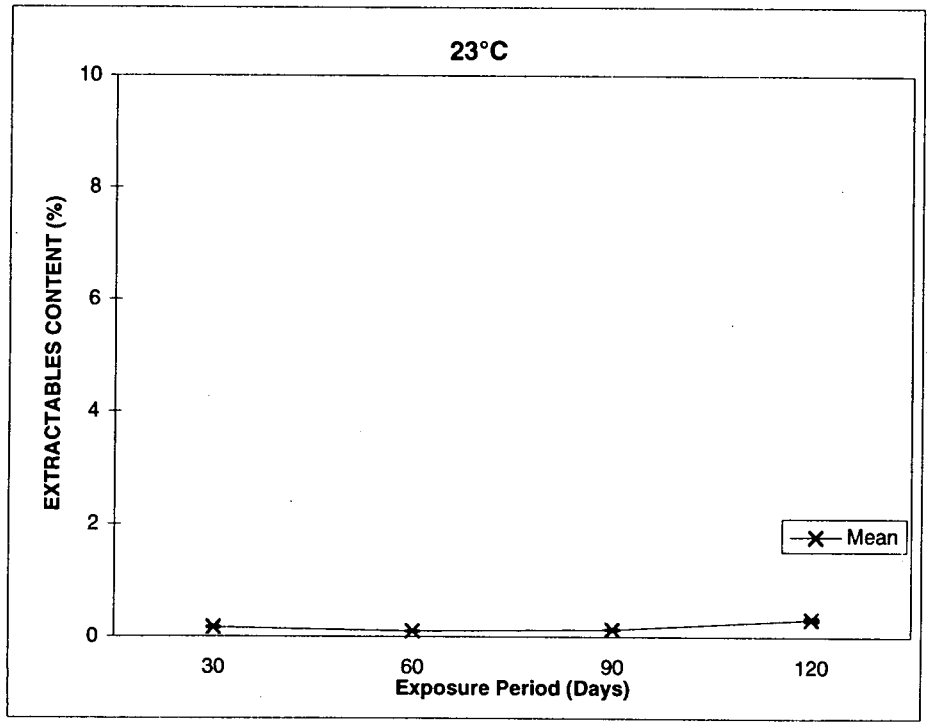
CHEMICAL COMPATIBILITY TEST RESULTS

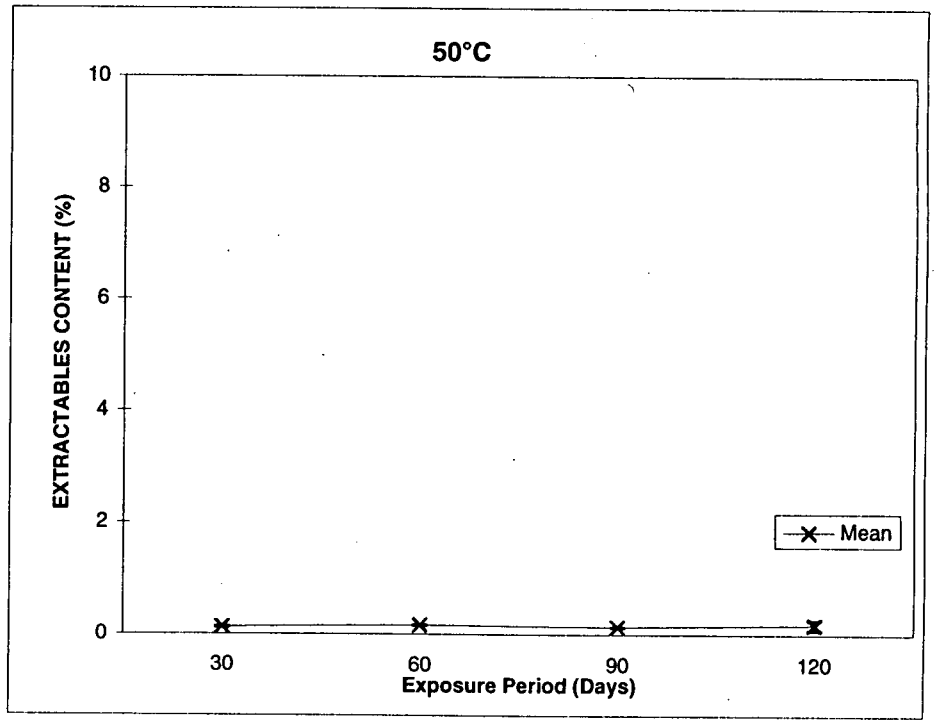
CLIENT: FERMCO
METHOD: ASTM D3421
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): EXTRACTABLES CONTENT (%)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	0.052	0.082				0.067	0.021	0.0	0.052	0.082				0.067	0.021	0.0	CR
30	0.171	0.164				0.168	0.005	150.0	0.137	0.123				0.130	0.010	94.0	CR
60	0.103	0.098				0.101	0.004	50.0	0.162	0.171				0.167	0.006	148.5	CR
90	0.131	0.138				0.135	0.005	100.7	0.137	0.135				0.136	0.001	103.0	CR
120	0.299	0.335				0.317	0.025	373.1	0.241	0.114				0.178	0.090	164.9	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000238

382

2.7 Stress and Strain at Yield

Directionality

When a geomembrane is manufactured, the molecules of polyethylene are oriented slightly in the direction that the geomembrane is extruded. Geomembranes may therefore have different strength characteristics in the direction of orientation than in other directions. Thus, mechanical properties of geomembranes are tested in the direction of extrusion (i.e., roll direction) and in the direction normal to extrusion (i.e., cross-roll direction).

Rationale of Test

Stress at yield is the stress that is required to inelastically deform a material. It is the point at which molecules that are parallel to each other start to slip and slide past each other. Strain at yield is the lineal increase in a specimen that occurs at the yield stress. For a given HDPE geomembrane, stress and strain at yield display opposite behavior (i.e., when stress at yield increases, strain at yield decreases). Conversely, when stress at yield decreases, strain at yield should increase. Stress and strain at yield are generally not sensitive to surface condition, (e.g., scratches). However, when volatile organic chemicals are absorbed into a sample, the forces that hold parallel polyethylene molecules together are weakened, and, consequently, less stress is required to cause them to slide past each other (i.e., stress at yield is reduced). Conversely, exposure to ultraviolet and ionizing radiation in the absence of oxygen may cause the surface molecules to crosslink, which would tend to increase stress at yield and reduce strain at yield.

Results and Discussion

The following observations were made regarding the stress at yield and strain at yield of the geomembranes.

GSE-SLT Geomembrane. The stress at yield values for both the roll and cross-roll direction samples had small percent changes from the control values. However,

data were inconsistent (i.e., no observable trend). Most of the mean values for the exposed samples were greater than one standard deviation of the mean value of the control samples. The percent changes were generally larger for the 23°C (73°F) samples compared to the 50°C (122°F) samples.

Strain at yield values for the exposed samples were consistent (i.e., no apparent trend) with stress at yield. In addition, most of the strain at yield values for exposed samples were within one standard deviation of the control samples. The percent changes of the 23°C (73°F) samples were greater than those of the 50°C (122°F) samples. The inverse relationship of stress and strain was not evident in the results.

NSC Geomembrane. The roll direction stress at yield values were generally constant. Most of the values for the exposed samples were within one standard deviation of the control value means. The 23°C (73°F) and 50°C (122°F) samples displayed similar behavior. The cross-roll direction samples experienced larger percent changes than the roll-direction samples. The 23°C (73°C) and 50°F (122°F) cross-roll direction samples values were constant, but slightly higher than the control values for the 30-day and 60-day periods. However, the 60-day 23°C (73°F) and 50°C (122°F) samples fell slightly below the control values. The differences between the 23°C (73°F) and 50°C (122°F) samples values and their respective control sample values were nearly the same.

Strain at yield values of the exposed roll direction samples were nearly constant during the 120-day test, and most of the values for the exposed samples were within one standard deviation of the control value means. The inverse relationship of stress and strain was not evident, since both stress and strain results for the roll direction samples were generally constant.

Percent changes in strain at yield of the cross-roll direction samples were slightly greater than percent changes of the roll direction samples. The values of the exposed samples were approximately within one standard deviation of control value means. The differences between 23°C (73°F) samples and the 50°C (122°F) samples values and their respective control sample values were nearly the same.

The inverse relationship of stress and strain was not observed in the results of the cross-roll direction samples.

GSE-Gundle Geomembrane. The stress at yield values were nearly constant for both the roll-direction and the cross-roll direction samples, with the single exception of the 23°C (73°F) roll direction sample, which underwent a percent change from positive 4.7 percent at the 30-day exposure period to a percent change of negative 9.7 percent at the 120-day exposure period. Most of the mean values (with the exception of the 23°C (73°F) roll direction sample) for the exposed samples were within one standard deviation of the control value means. There were no significant differences between the 23°C (73°F) and 50°C (122°F) data.

In general, strain at yield results were less consistent than the stress at yield results. Most of the percent change values were outside of one standard deviation of the mean values of the control samples. Moreover, the inverse relationship of stress and strain was not evident in these results.

Polyflex Geomembrane. Stress at yield values of the roll direction and cross-roll direction exposed samples were slightly variable. However, the percent changes were generally small. Most of the values for the exposed samples were slightly outside of one standard deviation of the mean values for the control samples. There were no significant differences between the 23°C (73°F) and 50°C (122°F) results.

Strain at yield values in the roll-direction were generally constant, and the data were consistent between consecutive exposure periods. Moreover, the mean values for the exposed samples were within one standard deviation of the control value means. There were no significant differences between the results of 23°C (73°F) and the 50°C (122°F) samples. The inverse relationship of stress and strain was not observed since both stress and strain at yield were nearly constant.

The strain at yield values of the 30-day and 60-day 23°C (73°F) cross-roll direction samples were approximately 11 percent below the control values. At the 90-day and 120-day exposure periods, the exposed sample values were nearly the

draft

same as the control values. The 23°C (73°F) and 50°C (122°F) results were similar, having mean values which were within one standard deviation of the control value means. The inverse relationship of stress and strain was not observed in these samples.

Serrot Geomembranes. Stress at yield values of the roll direction samples were nearly constant during 120 days of leachate exposure. In addition, most of the mean value of the exposed samples were within one standard deviation of the control value means. The cross-roll direction samples exhibited similar results. There were no significant differences between the results of the 23°C (73°F) and 50°C (122°F) samples.

Strain at yield values of both roll and cross-roll deviation samples were similar. The percent changes were small, and most of the mean values of the exposed samples were within one standard deviation of the control value means, although there were some inconsistencies in the data. There were no significant differences in behavior between the 23°C (73°F) and 50°C (122°F) samples. Finally, the inverse relationship between stress and strain was not evident in these results.

The results of the stress at yield and strain at yield are similar for all five of the geomembranes. In general, trends in the data were not observed. This suggests that any differences between the control samples and exposed sample values are most likely due to material variability. This is further supported by the similarities between the 23°C (73°F) and 50°C (122°F) samples results. Moreover, the inverse relationship between stress and strain was not evident in these test results. (In the NSC and Polyflex cases, stress at yield and strain at yield were essentially constant throughout the 120-day exposure test.) These results, which indicate that the geomembranes and leachate did not measurably interact, are supported by the results of physical properties tests.

Conclusion

The stress at yield and strain at yield data indicate that geomembranes were not measurably impacted by the test leachate during the 120 day exposure period.

draft

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

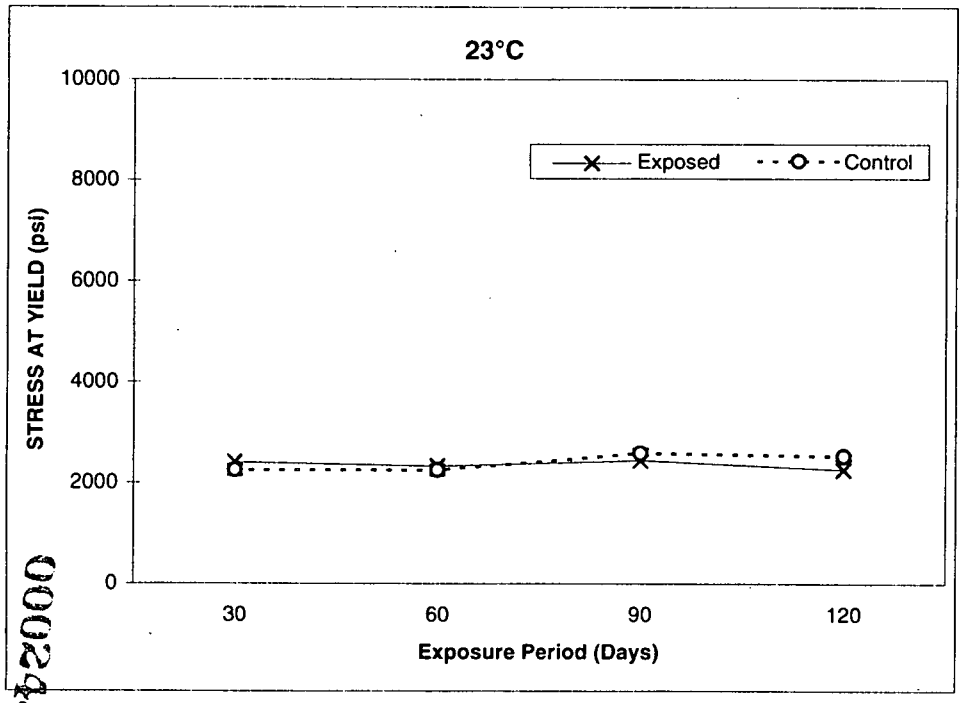
CHEMICAL COMPATIBILITY TEST RESULTS

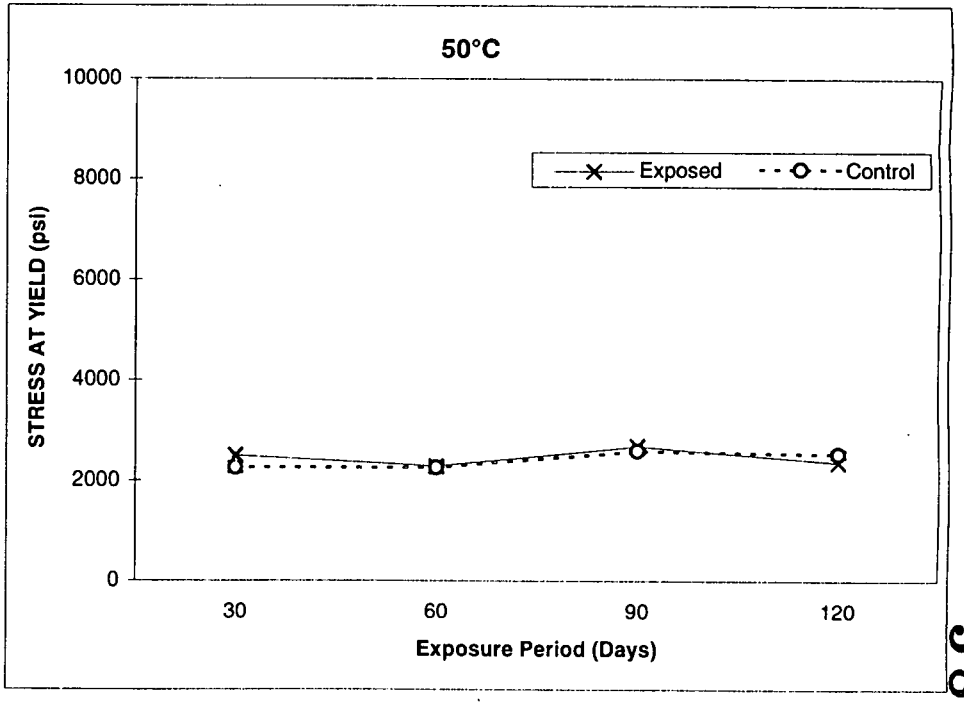
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT YIELD (psi)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	2252.5	2255.0	2162.5	2187.5	2420.0	2256	100	0.000	2252.5	2255.0	2162.5	2187.5	2420.0	2256	100	0.000	VV
30	2492.5	2367.5	2387.5	2370.0	2422.5	2408	52	6.761	2457.5	2482.5	2510.0	2522.5	2495.0	2494	25	10.552	VV
Control	2252.5	2255.0	2162.5	2187.5	2420.0	2256	100	0.000	2252.5	2255.0	2162.5	2187.5	2420.0	2256	100	0.000	WM
60	2255.0	2275.0	2322.5	2380.0	2437.5	2334	75	3.480	2250.0	2315.0	2260.0	2245.0	2317.5	2278	36	0.975	VV
Control	2535.0	2595.0	2625.0	2625.0	2572.5	2591	38	0.000	2535.0	2595.0	2625.0	2625.0	2572.5	2591	38	0.000	WM
90	2305.0	2497.5	2445.0	2475.0	2517.5	2448	84	-5.501	2652.5	2657.5	2670.0	2665.0	2755.0	2680	42	3.455	VV
Control	2612.5	2556.3	2581.3	2450.0	2462.5	2533	73	0.000	2612.5	2556.3	2581.3	2450.0	2462.5	2533	73	0.000	WM
120	2200.0	2250.0	2300.0	2275.0	2300.0	2265	42	-10.563	2350.0	2375.0	2362.5	2375.0	2362.5	2365	10	-6.614	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

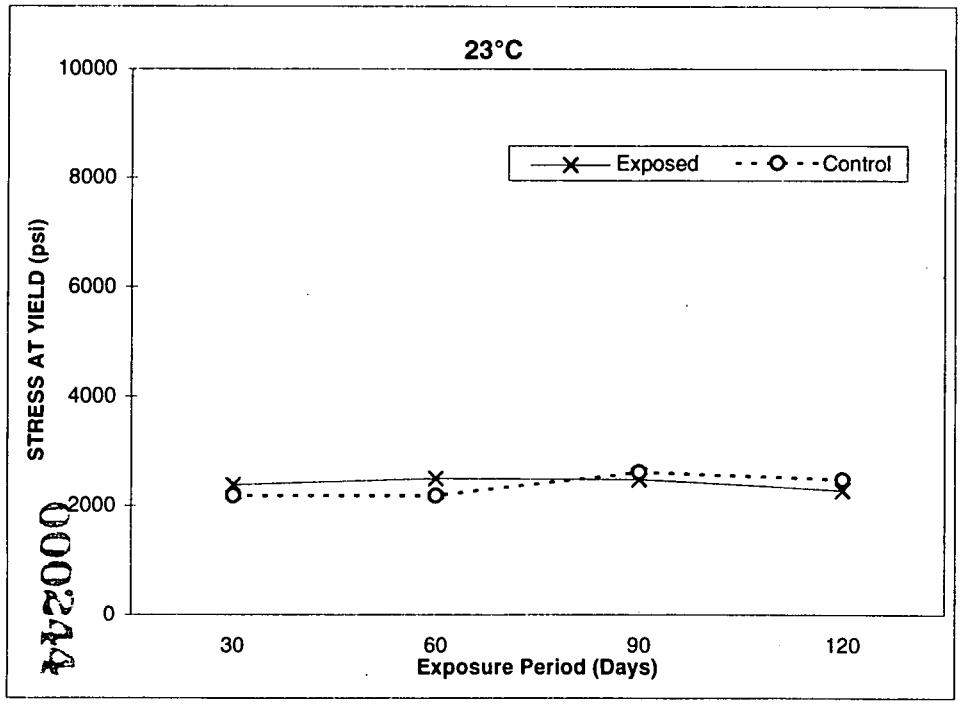
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

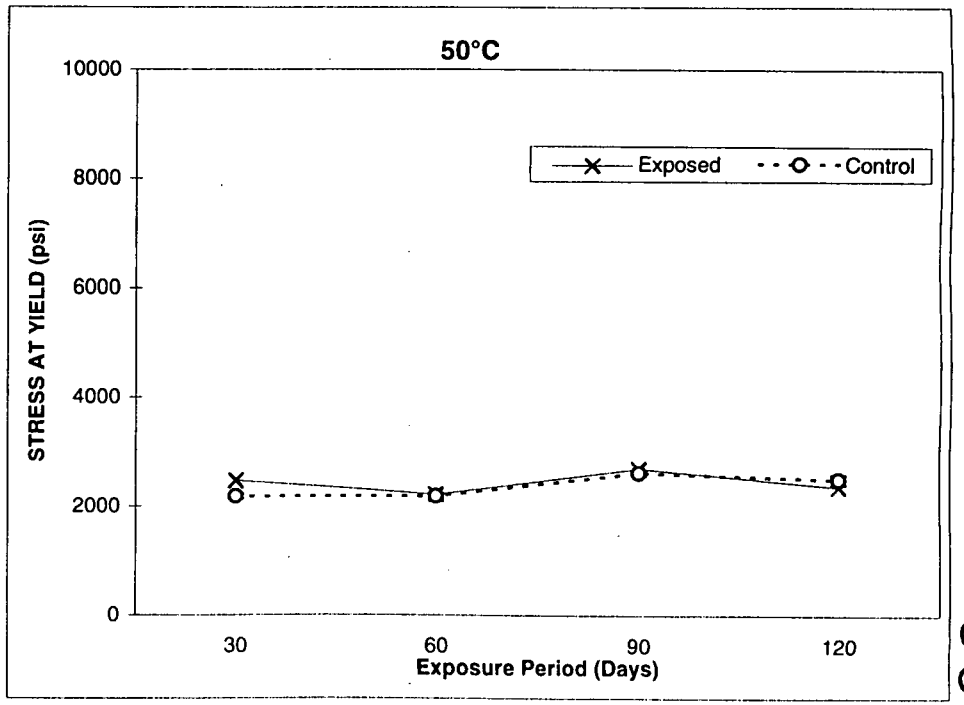
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*GSE - SLT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRESS AT YIELD (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	2195.0	2100.0	2207.5	2212.5	2202.5	2184	47	0.000	2195.0	2100.0	2207.5	2212.5	2202.5	2184	47	0.000	VV
30	2365.0	2377.5	2402.5	2360.0	2370.0	2375	17	8.770	2495.0	2597.5	2435.0	2410.0	2390.0	2466	84	12.915	VV
Control	2195.0	2100.0	2207.5	2212.5	2202.5	2184	47	0.000	2195.0	2100.0	2207.5	2212.5	2202.5	2184	47	0.000	WM
60	2297.5	2510.0	2590.0	2532.5	2535.0	2493	113	14.174	2220.0	2197.5	2177.5	2222.5	2252.5	2214	28	1.397	VV
Control	2562.5	2632.5	2617.5	2612.5	2635.0	2612	29	0.000	2562.5	2632.5	2617.5	2612.5	2635.0	2612	29	0.000	WM
90	2385.0	2542.5	2425.0	2515.0	2525.0	2479	69	-5.111	2662.5	2727.5	2675.0	2720.0	2667.5	2691	31	3.005	VV
Control	2562.5	2481.3	2362.5	2512.5	2481.3	2480	74	0.000	2562.5	2481.3	2562.5	2481.3	2362.5	2490	82	0.000	WM
120	2225.0	2275.0	2262.5	2275.0	2350.0	2278	45	-8.165	2375.0	2375.0	2375.0	2362.5	2287.5	2355	38	-5.422	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

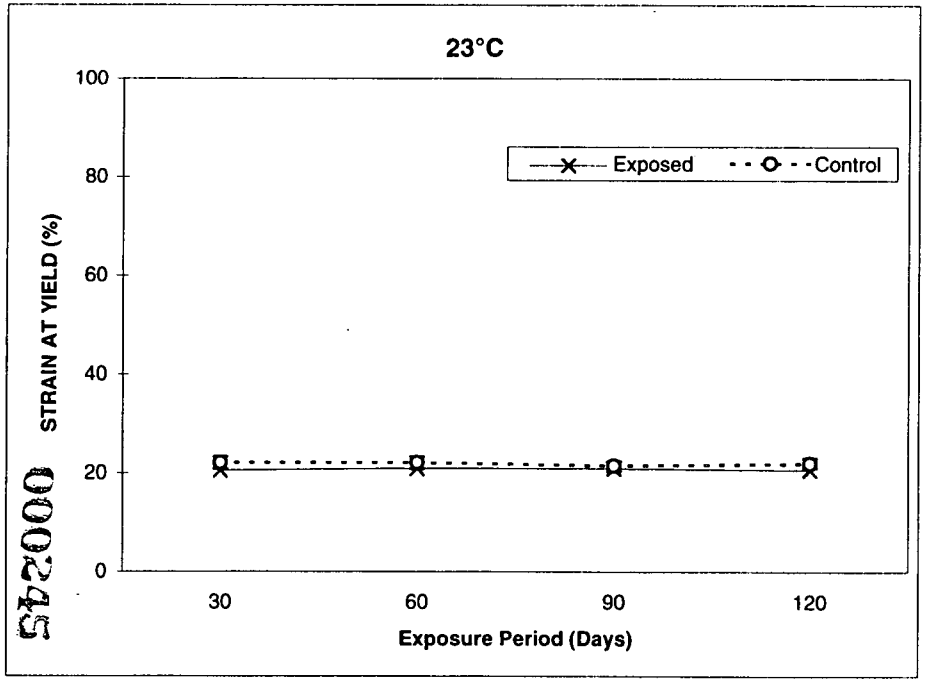
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

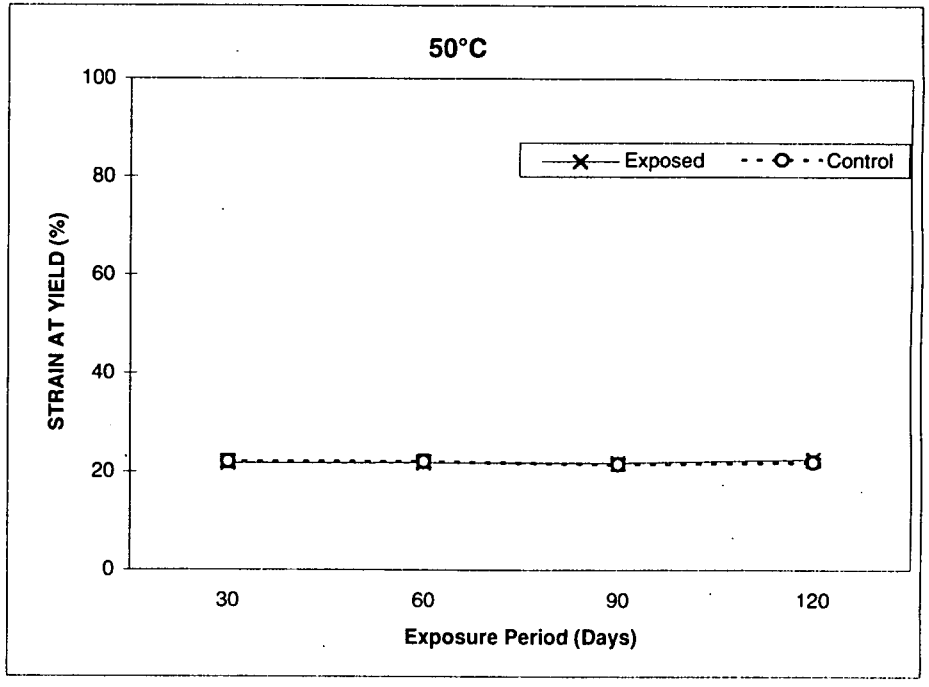
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*GSE - SLT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRAIN AT YIELD (%)
DIRECTION: ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	21.7	21.0	23.7	23.1	21.0	22.1	1.2	0.0	21.7	21.0	23.7	23.1	21.0	22.1	1.2	0.0	VV
30	20.4	19.9	20.4	21.7	20.5	20.6	0.7	-7.0	21.7	21.2	21.2	22.4	22.4	21.8	0.6	-1.6	VV
Control	21.7	21.0	23.7	23.1	21.0	22.1	1.2	0.0	21.7	21.0	23.7	23.1	21.0	22.1	1.2	0.0	WM
60	22.3	21.2	20.9	20.4	19.9	20.9	0.9	-5.4	20.4	21.7	21.8	22.8	22.4	21.8	0.9	-1.3	VV
Control	23.0	22.3	21.7	20.4	20.5	21.6	1.1	0.0	23.0	22.3	21.7	20.4	20.5	21.6	1.1	0.0	WM
90	20.5	22.4	21.2	20.4	20.4	21.0	0.9	-2.8	21.7	21.2	23.0	21.7	21.8	21.9	0.7	1.3	VV
Control	23.0	22.3	21.2	22.5	21.1	22.0	0.9	0.0	23.0	22.3	21.2	22.5	21.1	22.0	0.9	0.0	WM
120	21.8	19.8	19.8	20.4	21.8	20.7	1.0	-5.8	22.4	23.1	21.7	23.0	23.0	22.6	0.6	2.8	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

002045

2 of 3

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

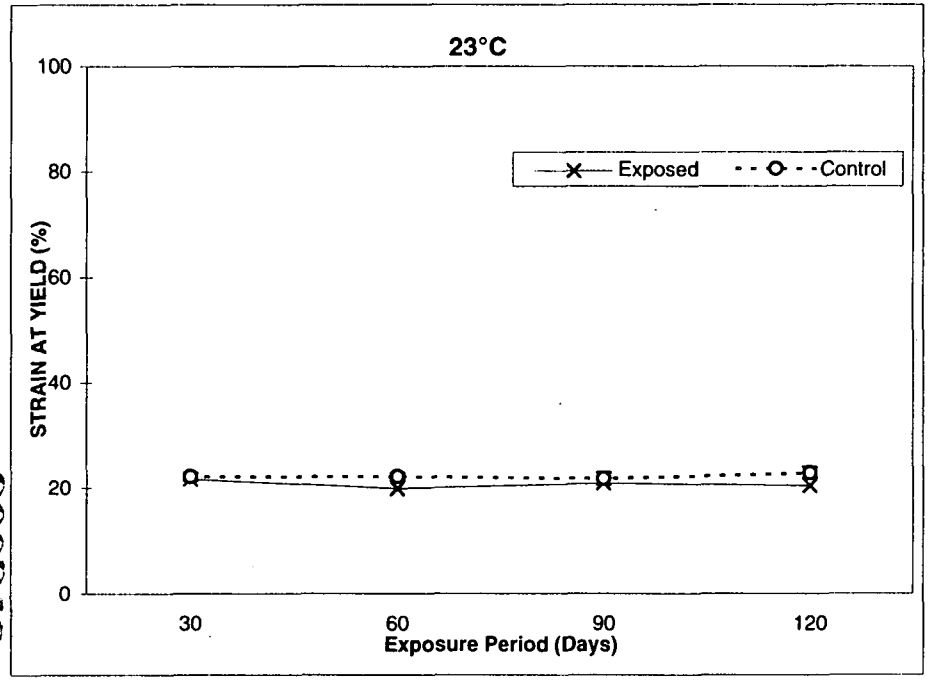
CHEMICAL COMPATIBILITY TEST RESULTS

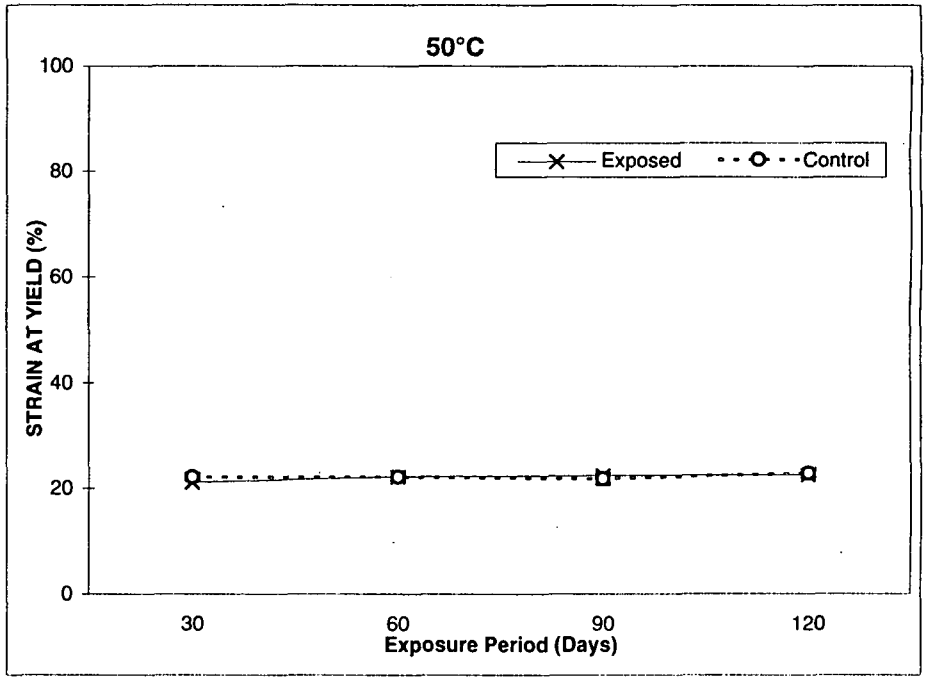
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT YIELD (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	22.3	23.2	21.3	22.3	21.8	22.2	0.7	0.0	22.3	23.2	21.3	22.3	21.8	22.2	0.7	0.0	VV
30	21.7	21.8	21.8		21.7	21.7	0.1	-2.1	20.4	20.5	20.6	23.7	20.5	21.1	1.4	-4.7	VV
Control	22.3	23.2	21.3	22.3	21.8	22.2	0.7	0.0	22.3	23.2	21.3	22.3	21.8	22.2	0.7	0.0	WM
60	19.8	19.2	19.6	19.1	21.8	19.9	1.1	-10.4	21.8	22.3	22.9	21.8	22.4	22.2	0.5	0.2	VV
Control	21.7	20.4	21.2	22.9	22.9	21.8	1.1	0.0	21.7	20.4	21.2	22.9	22.9	21.8	1.1	0.0	WM
90	19.9	22.5	19.9	21.8	20.6	20.9	1.2	-4.1	23.6	20.5	23.1	22.4	22.6	22.4	1.2	2.9	VV
Control	22.5	21.7	23.0	23.7	23.6	22.9	0.8	0.0	22.5	21.7	23.0	23.7	23.6	22.9	0.8	0.0	WM
120	19.8	20.4	20.5	20.4	21.0	20.4	0.4	-10.8	22.4	23.1	22.3	23.0	22.4	22.6	0.4	-1.2	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000246

38

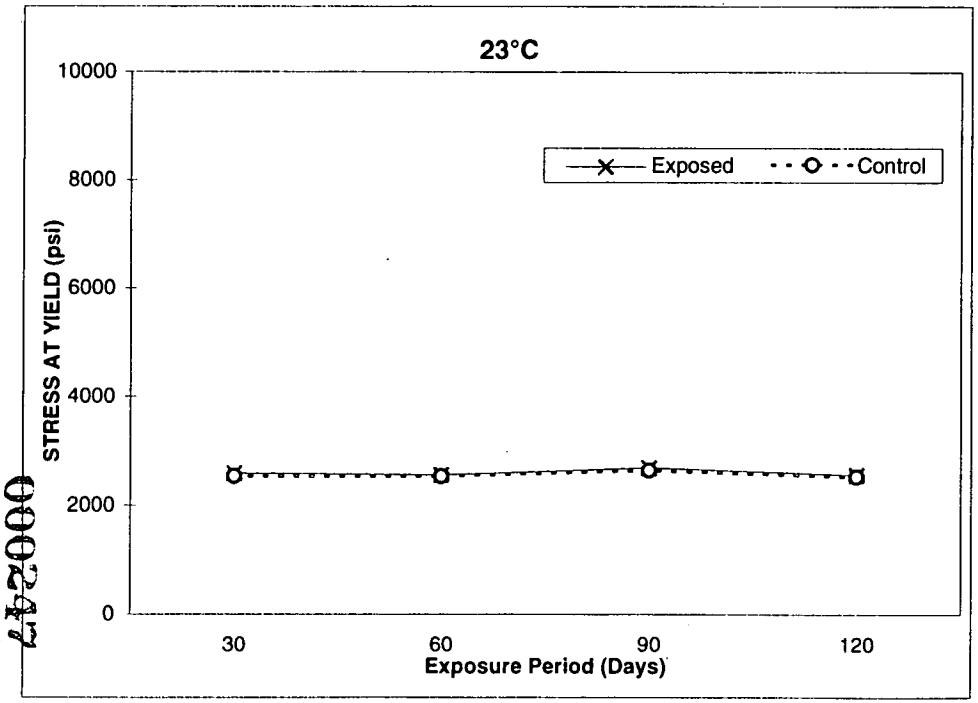
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

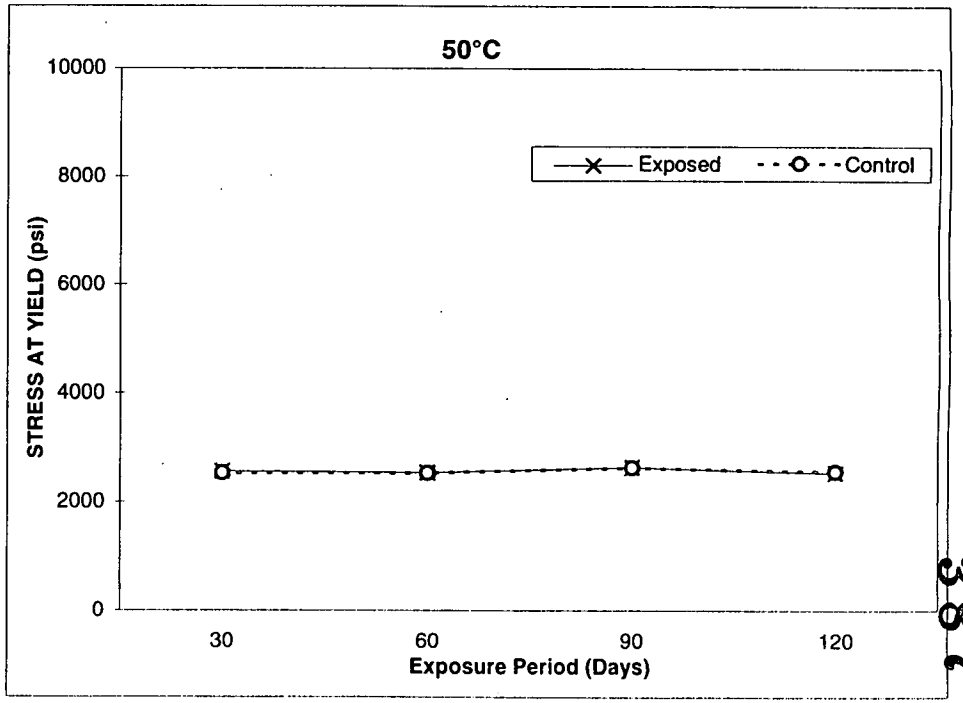
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*NSC*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRESS AT YIELD (psi)
DIRECTION: ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	2575.0	2505.0	2495.0	2505.0	2590.0	2534	45	0.000	2575.0	2505.0	2495.0	2505.0	2590.0	2534	45	0.000	VV
30	2562.5	2640.0	2640.0	2505.0	2577.5	2585	57	2.013	2587.5	2575.0	2505.0	2577.5	2572.5	2564	33	1.164	VV
Control	2575.0	2505.0	2495.0	2505.0	2590.0	2534	45	0.000	2575.0	2505.0	2495.0	2505.0	2590.0	2534	45	0.000	WM
60	2530.0	2625.0	2545.0	2497.5	2592.5	2558	51	0.947	2495.0	2575.0	2592.5	2520.0	2537.5	2544	40	0.395	VV
Control	2607.5	2642.5	2685.0	2627.5	2685.0	2650	35	0.000	2607.5	2642.5	2607.5	2642.5	2685.0	2637	32	0.000	WM
90	2695.0	2707.5	2717.5	2687.5	2667.5	2695	19	1.717	2640.0	2592.5	2692.5	2557.5	2717.5	2640	67	0.114	VV
Control	2537.5	2562.5	2568.8	2443.8	2543.8	2531	51	0.000	2537.5	2562.5	2537.5	2562.5	2568.8	2554	15	0.000	WM
120	2525.0	2547.5	2572.5	2597.5	2562.5	2561	27	1.175	2545.0	2520.0	2570.0	2537.5	2467.5	2528	38	-1.008	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

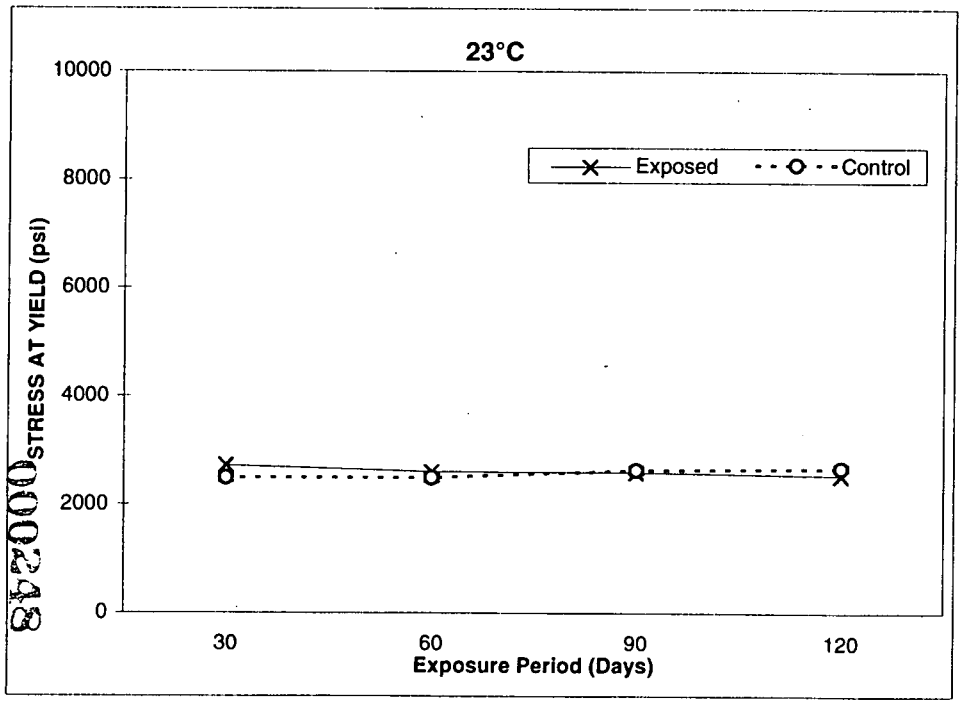
CHEMICAL COMPATIBILITY TEST RESULTS

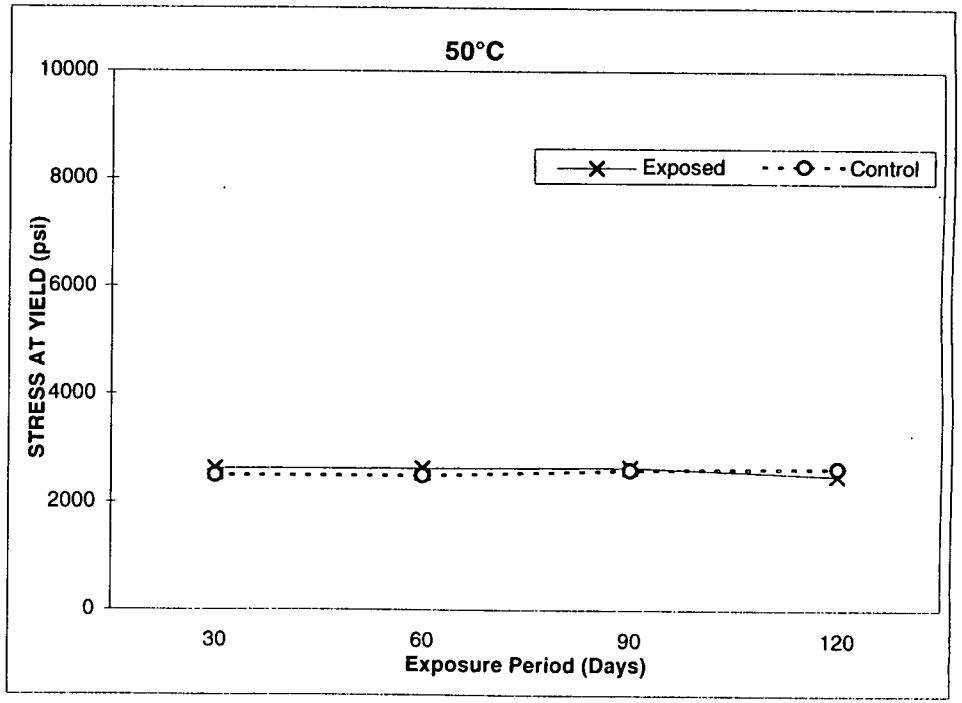
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT YIELD (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	2512.5	2475.0	2487.5	2397.5	2605.0	2496	75	0.000	2512.5	2475.0	2487.5	2397.5	2605.0	2496	75	0.000	VV
30	2605.0	2682.5	2767.5	2825.0	2717.5	2720	84	8.976	2660.0	2590.0	2617.5	2565.0	2622.5	2611	36	4.628	VV
Control	2512.5	2475.0	2487.5	2397.5	2605.0	2496	75	0.000	2512.5	2475.0	2487.5	2397.5	2605.0	2496	75	0.000	WM
60	2727.5	2667.5	2520.0	2560.0	2520.0	2599	94	4.147	2562.5	2610.0	2770.0	2595.0	2560.0	2620	87	4.969	VV
Control	2562.5	2625.0	2625.0	2627.5	2735.0	2635	62	0.000	2562.5	2625.0	2562.5	2625.0	2625.0	2600	34	0.000	WM
90	2550.0	2610.0	2572.5	2682.5	2547.5	2593	56	-1.613	2627.5	2647.5	2585.0	2730.0	2665.0	2651	53	1.962	VV
Control	2622.5	2642.5	2662.5	2697.5	2732.5	2672	44	0.000	2622.5	2642.5	2622.5	2642.5	2662.5	2639	17	0.000	WM
120	2592.5	2530.0	2550.0	2560.0	2470.0	2541	45	-4.904	2470.0	2485.0	2520.0	2520.0	2515.0	2502	23	-5.173	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000248

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

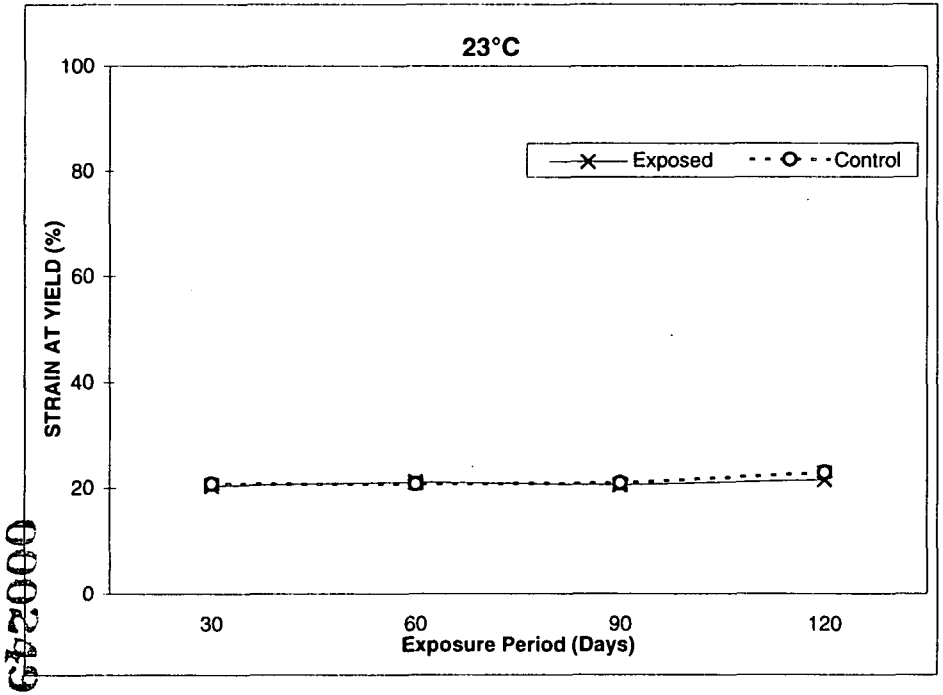
CHEMICAL COMPATIBILITY TEST RESULTS

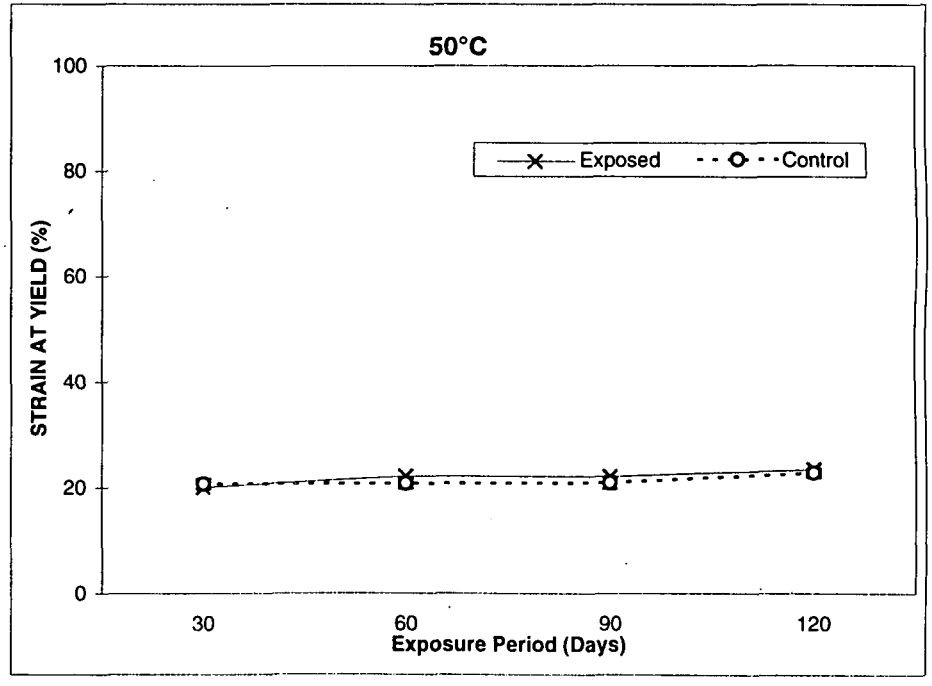
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT YIELD (%)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	21.3	21.8	21.1	19.9	19.8	20.8	0.9	0.0	21.3	21.8	21.1	19.9	19.8	20.8	0.9	0.0	VV
30	20.5	20.4	20.4	20.5	20.4	20.4	0.1	-1.6	20.4	20.5	20.5	19.2	20.0	20.1	0.5	-3.1	VV
Control	21.3	21.8	21.1	19.9	19.8	20.8	0.9	0.0	21.3	21.8	21.1	19.9	19.8	20.8	0.9	0.0	WM
60	21.8	20.5	22.3	19.9	21.1	21.1	1.0	1.7	22.9	21.2	22.4	21.0	23.0	22.1	0.9	6.4	VV
Control	19.8	20.5	21.7	22.4	20.4	20.9	1.1	0.0	19.8	20.5	21.7	22.4	20.4	20.9	1.1	0.0	WM
90	20.4	20.5	21.6	20.5	19.9	20.6	0.7	-1.8	22.3	21.2	22.4	22.3	22.4	22.1	0.5	5.6	VV
Control	21.7	23.1	22.4	23.6	23.6	22.9	0.8	0.0	21.7	23.1	22.4	23.6	23.6	22.9	0.8	0.0	WM
120	20.4	22.3	21.2	22.3	21.7	21.6	0.8	-5.7	23.1	23.1	23.7	23.6	24.2	23.5	0.5	2.8	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

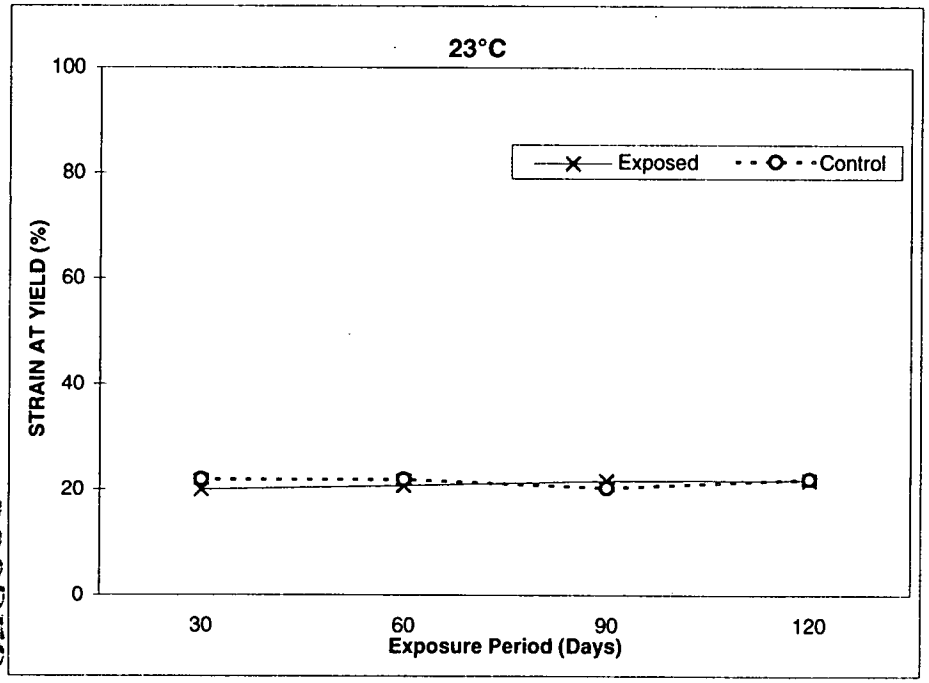
CHEMICAL COMPATIBILITY TEST RESULTS

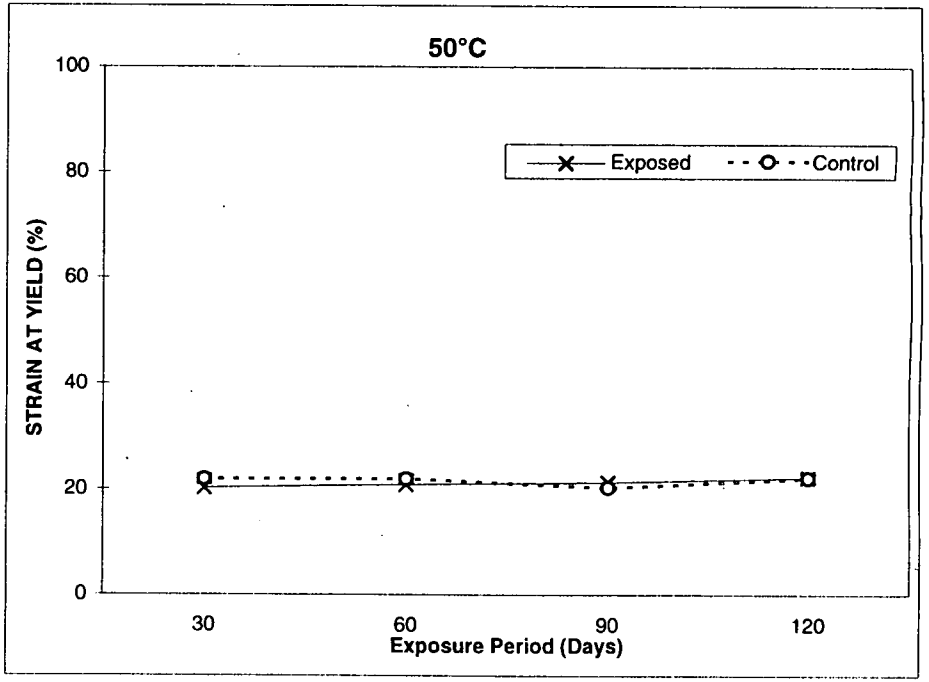
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT YIELD (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	21.8	20.5	21.8	22.4	23.0	21.9	0.9	0.0	21.8	20.5	21.8	22.4	23.0	21.9	0.9	0.0	VV
30	20.5	19.9	19.9	19.8	19.8	20.0	0.3	-8.9	20.7	20.4	19.9	20.4	19.7	20.2	0.4	-7.7	VV
Control	21.8	20.5	21.8	22.4	23.0	21.9	0.9	0.0	21.8	20.5	21.8	22.4	23.0	21.9	0.9	0.0	WM
60	20.4	19.7	20.4	21.8	21.2	20.7	0.8	-5.5	20.6	20.4	20.3	21.8	21.2	20.8	0.6	-4.9	VV
Control	20.6	19.6	20.4	20.4	20.4	20.3	0.4	0.0	20.6	19.6	20.4	20.4	20.4	20.3	0.4	0.0	WM
90	22.3	19.9	22.3	22.4	21.6	21.7	1.1	7.0	21.7	21.7	19.9	22.3	21.1	21.3	0.9	5.2	VV
Control	21.7	21.0	23.0	21.8	23.0	22.1	0.9	0.0	21.7	21.0	23.0	21.8	23.0	22.1	0.9	0.0	WM
120	21.7	22.3	21.0	21.8	22.3	21.8	0.5	-1.2	21.7	22.4	21.7	22.3	23.0	22.2	0.6	0.5	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

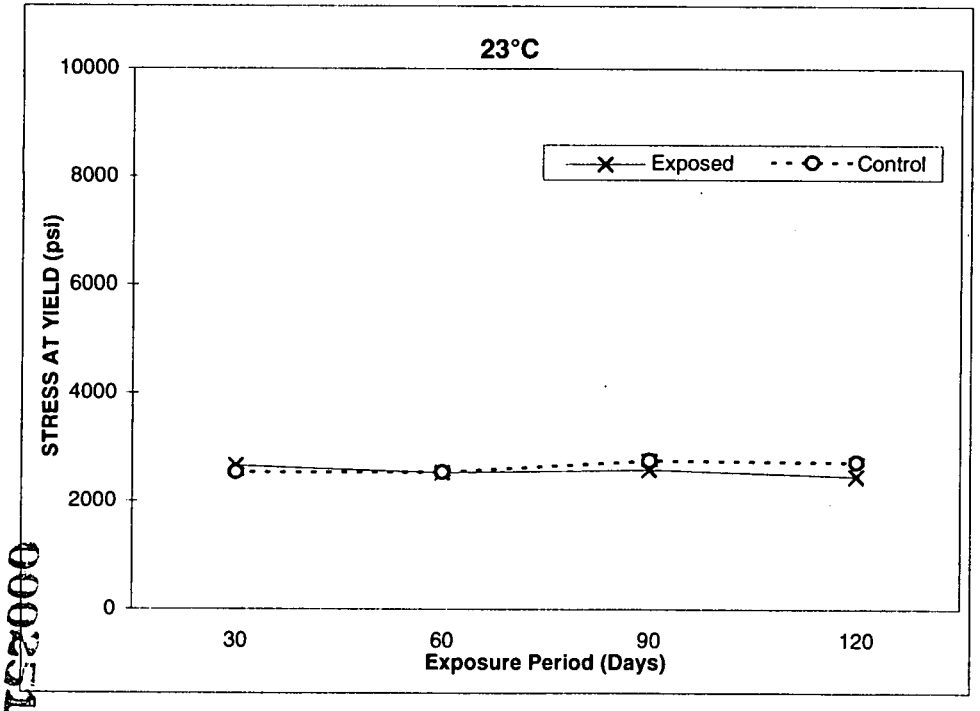
CHEMICAL COMPATIBILITY TEST RESULTS

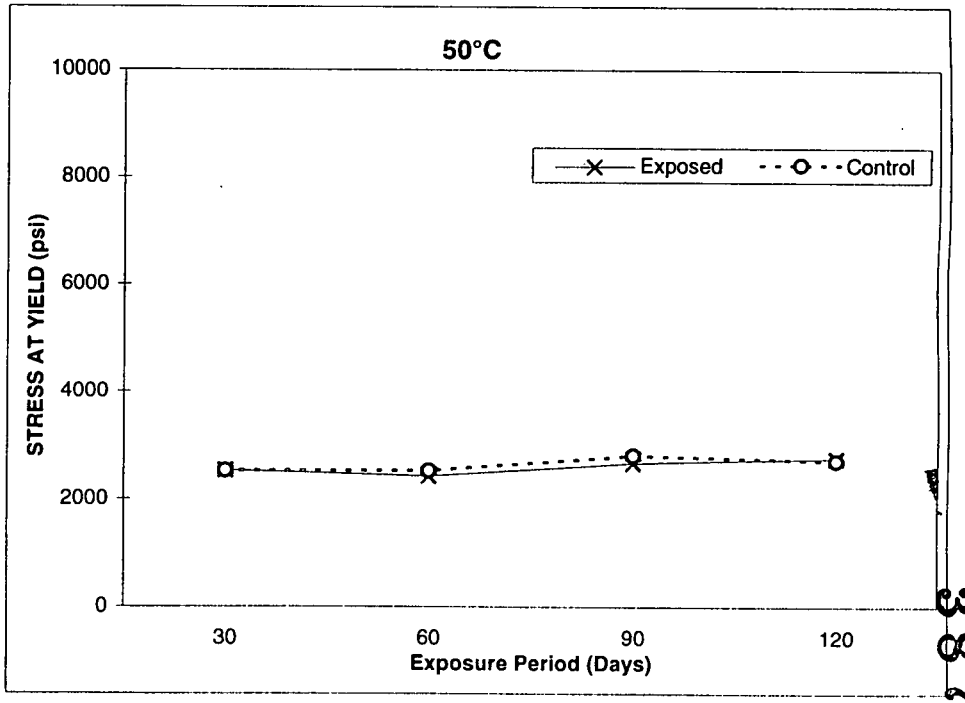
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT YIELD (psi)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	2550.0	2547.5	2617.5	2470.0	2490.0	2535	58	0.000	2550.0	2547.5	2617.5	2470.0	2490.0	2535	58	0.000	VV
30	2610.0	2675.0	2662.5	2615.0	2705.0	2654	41	4.675	2630.0	2487.5	2462.5	2510.0	2617.5	2542	77	0.256	VV
Control	2550.0	2547.5	2617.5	2470.0	2490.0	2535	58	0.000	2550.0	2547.5	2617.5	2470.0	2490.0	2535	58	0.000	WM
60	2562.5	2481.3	2462.5	2612.5	2493.8	2523	63	-0.493	2525.0	2556.3	2531.3	2000.0	2537.5	2430	241	-4.142	VV
Control	2770.0	2885.0	2750.0	2690.0	2682.5	2756	82	0.000	2770.0	2885.0	2770.0	2885.0	2750.0	2812	67	0.000	WM
90	2417.5	2527.5	2670.0	2622.5	2670.0	2582	109	-6.315	2695.0	2612.5	2607.5	2715.0	2730.0	2672	58	-4.979	VV
Control	2700.0	2690.0	2780.0	2715.0	2725.0	2722	35	0.000	2700.0	2690.0	2700.0	2690.0	2780.0	2712	38	0.000	WM
120	2442.5	2440.0	2462.5	2470.0	2480.0	2459	17	-9.662	2787.5	2780.0	2850.0	2680.0	2717.5	2763	66	1.881	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

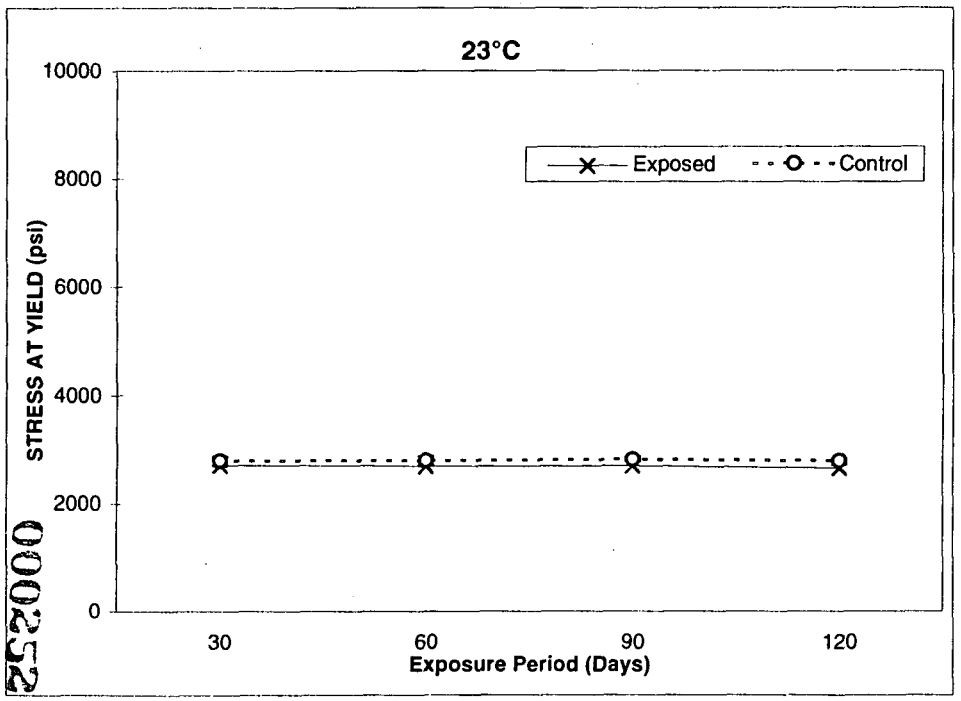
CHEMICAL COMPATIBILITY TEST RESULTS

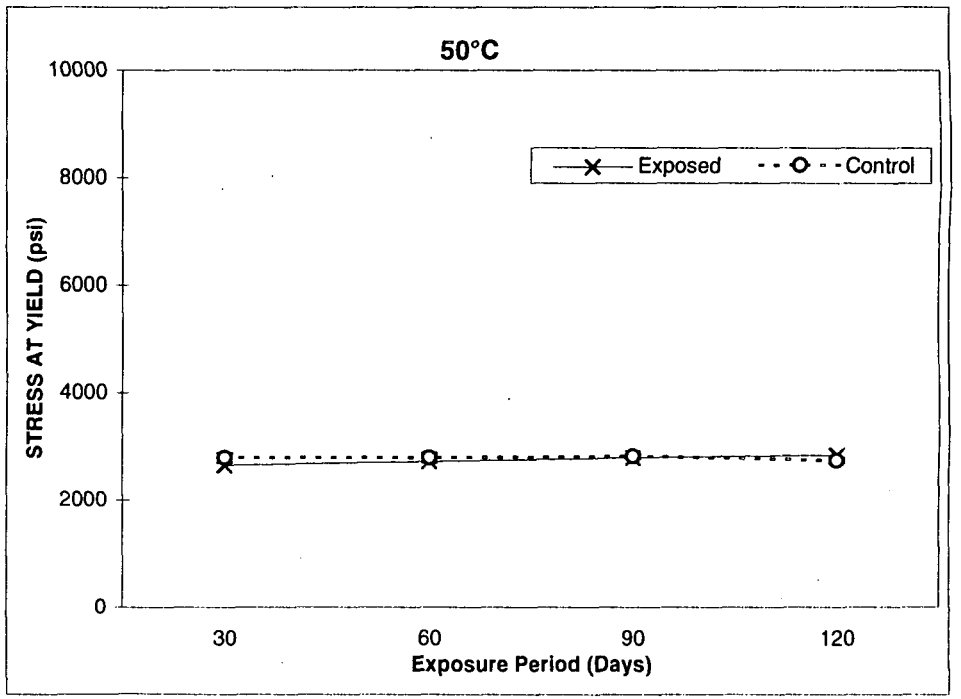
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT YIELD (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	2797.0	2870.8	2650.8	2773.1	2853.1	2789	87	0.000	2797.0	2870.8	2650.8	2773.1	2853.1	2789	87	0.000	VV
30	2685.0	2682.5	2735.0	2690.0	2715.0	2702	23	-3.136	2560.0	2595.0	2692.5	2667.5	2722.5	2648	68	-5.072	VV
Control	2797.0	2870.8	2650.8	2773.1	2853.1	2789	87	0.000	2797.0	2870.8	2650.8	2773.1	2853.1	2789	87	0.000	WM
60	2643.8	2687.5	2668.8	2762.5	2650.0	2683	48	-3.817	2656.3	2687.5	2756.3	2750.0	2731.3	2716	43	-2.607	VV
Control	2785.0	2862.5	2785.0	2850.0	2795.0	2816	38	0.000	2785.0	2862.5	2785.0	2862.5	2785.0	2816	42	0.000	WM
90	2770.0	2667.5	2637.5	2672.5	2697.5	2689	50	-4.493	2725.0	2845.0	2650.0	2855.0	2837.5	2783	91	-1.190	WM
Control	2707.5	2710.0	2810.0	2877.5	2815.0	2784	74	0.000	2707.5	2710.0	2707.5	2710.0	2810.0	2729	45	0.000	WM
120	2520.0	2527.5	2705.0	2700.0	2782.5	2647	117	-4.921	2730.0	2862.5	2845.0	2845.0	2842.5	2825	54	3.518	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

002532

F-382

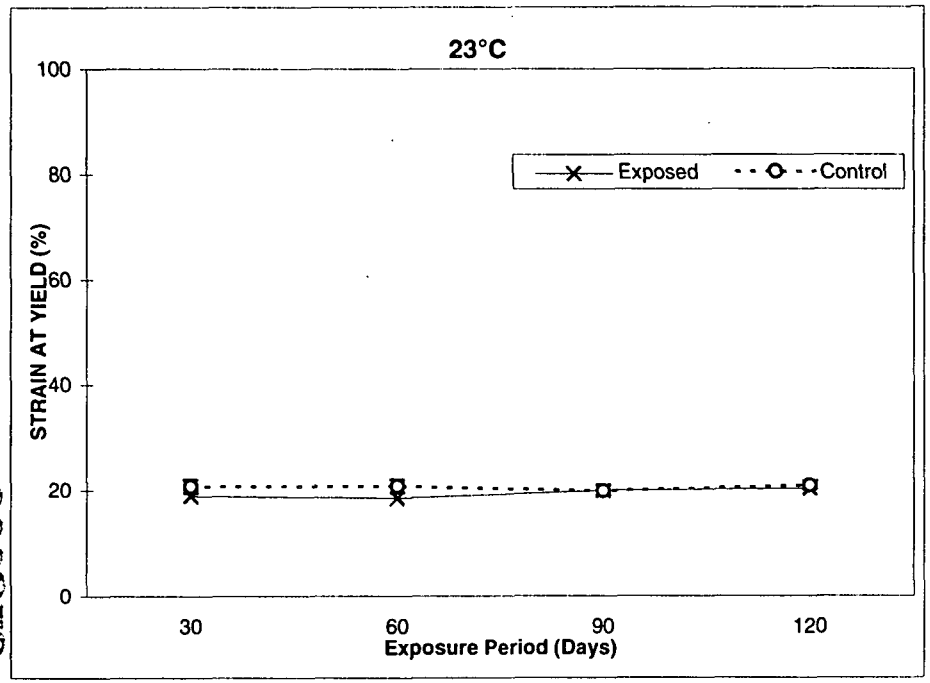
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

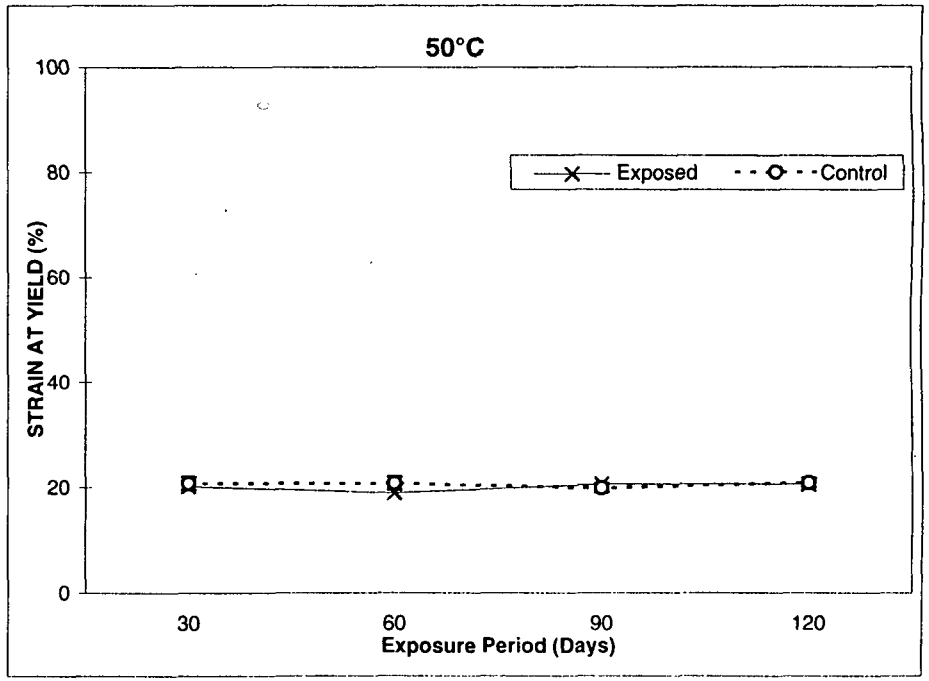
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*GSE Gundle*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRAIN AT YIELD (%)
DIRECTION: ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	21.7	19.8	19.1	21.8	21.7	20.8	1.3	0.0	21.7	19.8	19.1	21.8	21.7	20.8	1.3	0.0	VV
30	18.6	19.1	19.9	18.5	18.5	18.9	0.6	-9.2	19.3	20.4	20.5	21.7	19.2	20.2	1.0	-2.9	VV
Control	21.7	19.8	19.1	21.8	21.7	20.8	1.3	0.0	21.7	19.8	19.1	21.8	21.7	20.8	1.3	0.0	WM
60	20.0	19.1	18.0	18.5	16.7	18.5	1.2	-11.3	19.8	18.6	19.1	18.0	19.3	18.9	0.7	-9.0	VV
Control	20.4	18.5	20.4	20.4	19.7	19.9	0.8	0.0	20.4	18.5	20.4	20.4	19.7	19.9	0.8	0.0	WM
90	21.8	19.2	19.9	19.4	19.4	19.9	1.1	0.2	20.4	21.7	21.7	19.1	20.4	20.6	1.1	3.7	VV
Control	21.0	19.9	21.8	20.4	21.7	20.9	0.8	0.0	21.0	19.9	21.8	20.4	21.7	20.9	0.8	0.0	WM
120	19.8	21.2	20.4	19.7	20.5	20.3	0.6	-3.1	20.4	19.9	21.8	20.4	20.4	20.6	0.7	-1.7	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

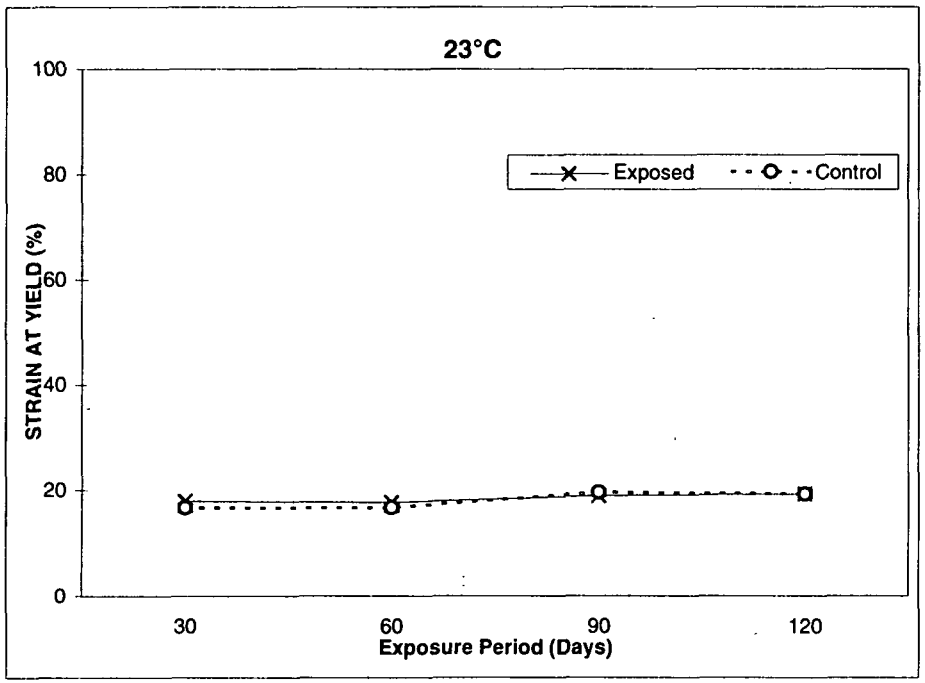
CHEMICAL COMPATIBILITY TEST RESULTS

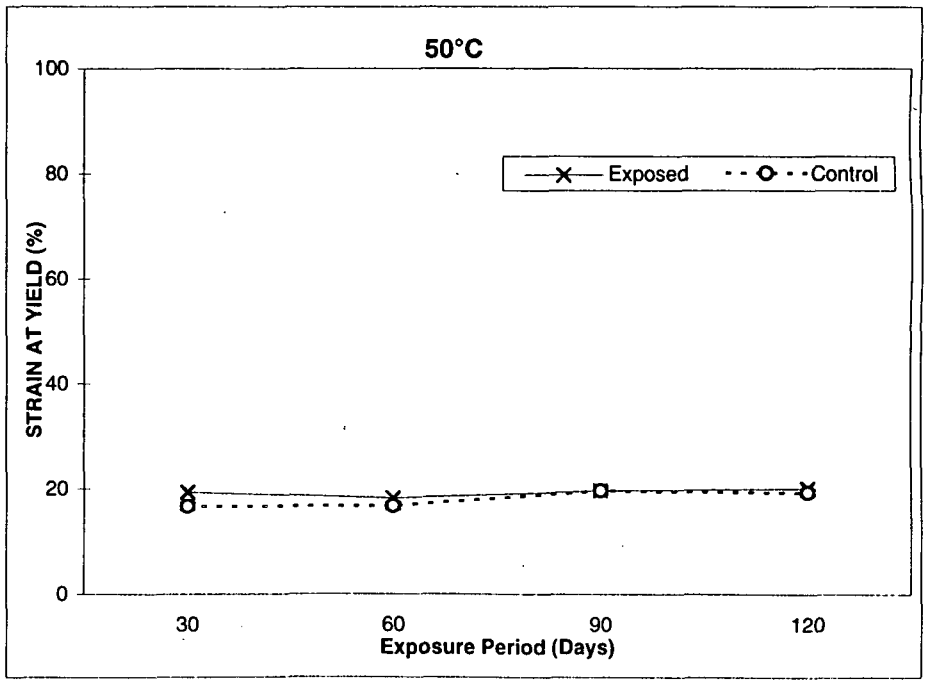
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT YIELD (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	16.0	16.5	17.9	16.5	16.5	16.7	0.7	0.0	16.0	16.5	17.9	16.5	16.5	16.7	0.7	0.0	VV
30	18.3	17.3	19.1	16.0	19.1	18.0	1.3	7.6	21.7	16.6	19.2	18.5	21.0	19.4	2.1	16.1	VV
Control	16.0	16.5	17.9	16.5	16.5	16.7	0.7	0.0	16.0	16.5	17.9	16.5	16.5	16.7	0.7	0.0	WM
60	18.6	17.8	18.6	17.3	16.1	17.7	1.0	5.8	17.9	18.0	17.3	19.9	17.7	18.2	1.0	8.7	VV
Control	20.4	19.1	19.2	19.1	20.4	19.6	0.7	0.0	20.4	19.1	19.2	19.1	20.4	19.6	0.7	0.0	WM
90	19.1	19.2	19.2	18.0	19.2	19.0	0.5	-3.5	19.1	20.5	20.0	19.2	19.3	19.6	0.6	-0.1	VV
Control	19.9	18.5	19.8	19.2	19.1	19.3	0.6	0.0	19.9	18.5	19.8	19.2	19.1	19.3	0.6	0.0	WM
120	20.4	19.1	19.3	18.5	19.1	19.3	0.7	-0.1	20.4	19.9	20.4	19.7	19.9	20.1	0.3	4.0	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000254

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

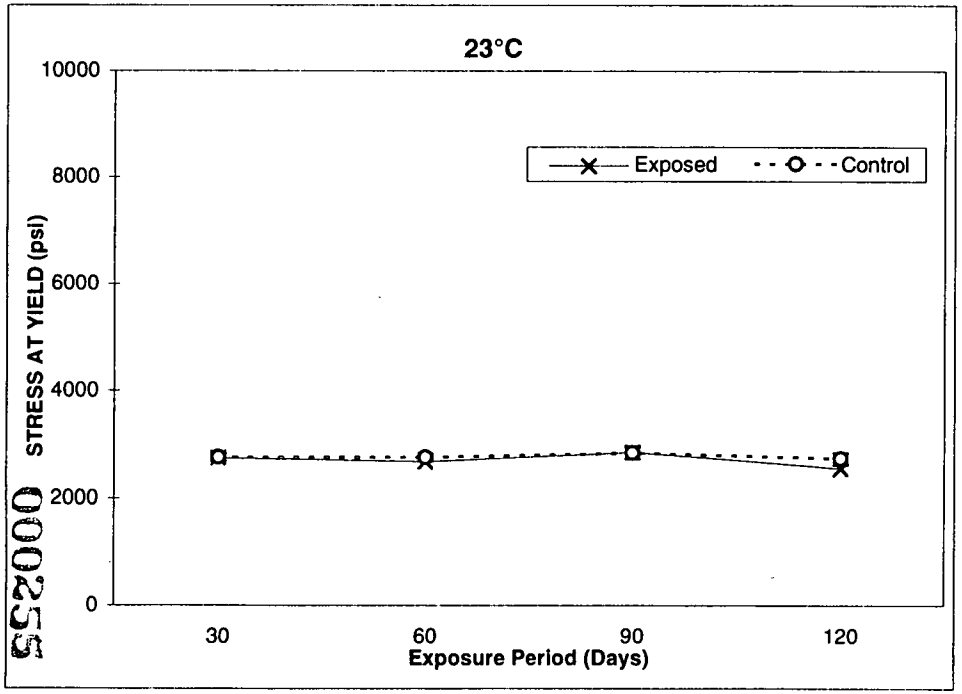
CHEMICAL COMPATIBILITY TEST RESULTS

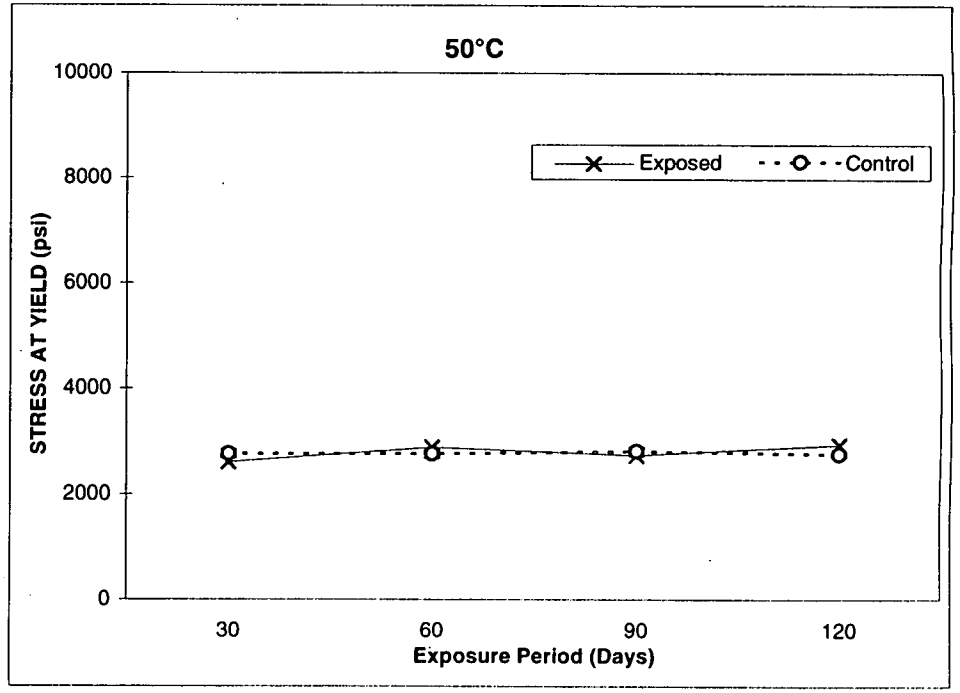
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT YIELD (psi)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	2781.3	2700.0	2675.0	2800.0	2856.3	2763	74	0.000	2781.3	2700.0	2675.0	2800.0	2856.3	2763	74	0.000	VV
30	2705.0	2787.5	2810.0	2647.5	2795.0	2749	70	-0.489	2677.5	2492.5	2637.5	2565.0	2650.0	2605	75	-5.719	VV
Control	2781.3	2700.0	2675.0	2800.0	2856.3	2763	74	0.000	2781.3	2700.0	2675.0	2800.0	2856.3	2763	74	0.000	WM
60	2615.0	2600.0	2505.0	2870.0	2805.0	2679	152	-3.023	2900.0	2915.0	2847.5	2930.0	2830.0	2885	44	4.416	VV
Control	2827.5	2855.0	2672.5	2897.5	2967.5	2844	109	0.000	2827.5	2855.0	2827.5	2855.0	2672.5	2808	77	0.000	WM
90	2692.5	2782.5	2895.0	2957.5	2955.0	2857	116	0.440	2725.0	2877.5	2717.5	2645.0	2677.5	2729	89	-2.814	WM
Control	2765.0	2762.5	2677.5	2915.0	2605.0	2745	116	0.000	2765.0	2762.5	2765.0	2762.5	2677.5	2747	39	0.000	WM
120	2572.5	2420.0	2477.5	2592.5	2735.0	2560	121	-6.758	3000.0	2970.0	2842.5	2982.5	2825.0	2924	83	6.463	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

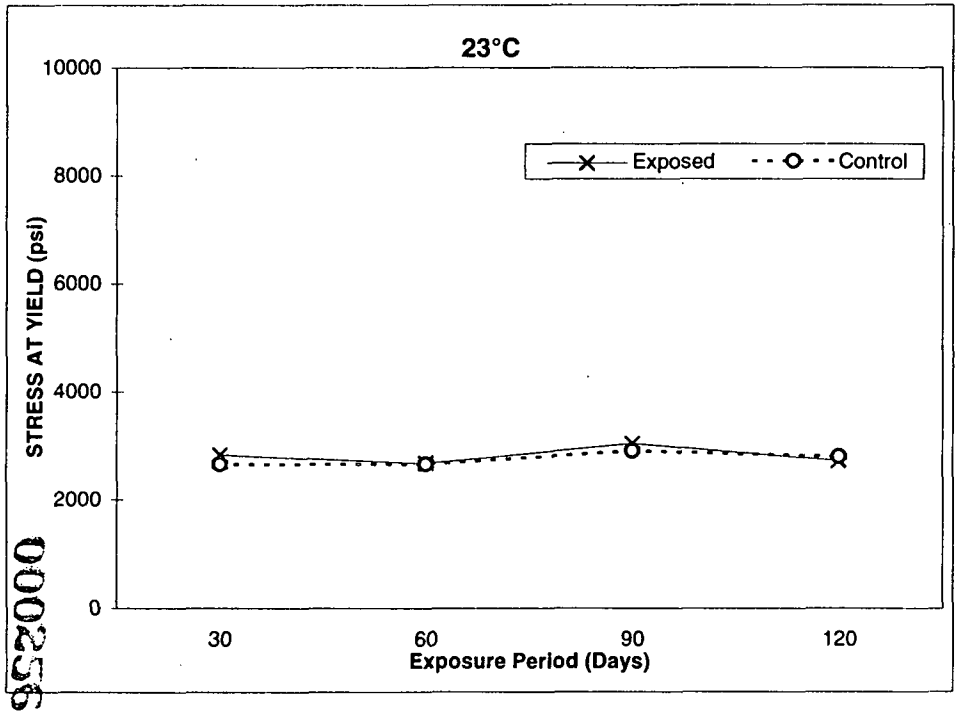
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

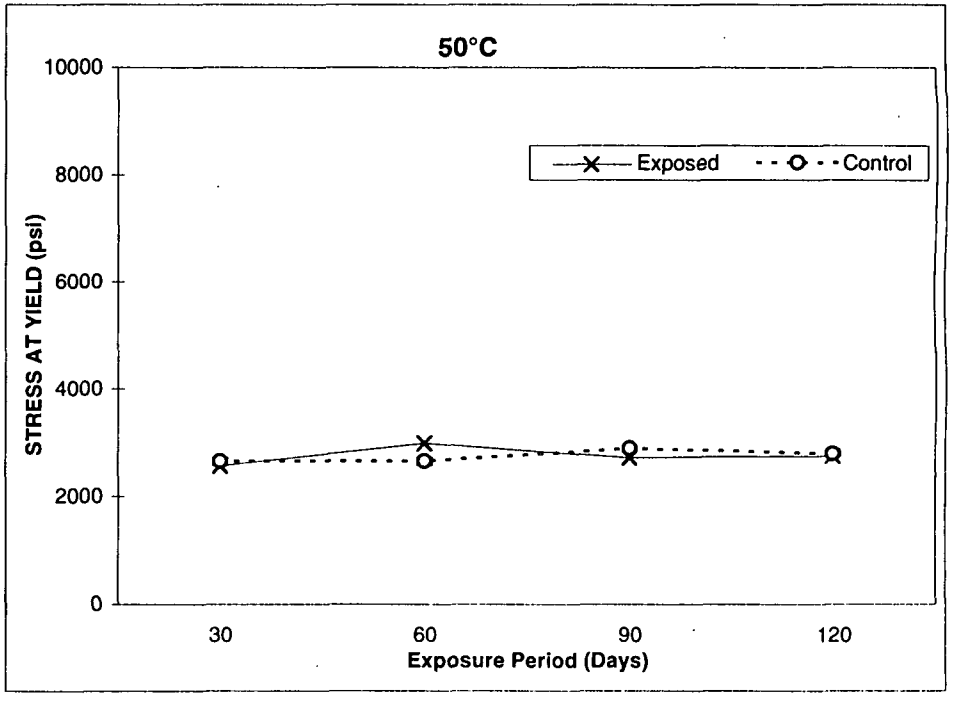
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*POLYFLEX*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRESS AT YIELD (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	2700.0	2587.5	2606.3	2650.0	2737.5	2656	63	0.000	2700.0	2587.5	2606.3	2650.0	2737.5	2656	63	0.000	VV
30	2762.5	3050.0	2807.5	2732.5	2772.5	2825	129	6.353	2472.5	2547.5	2625.0	2625.0	2562.5	2567	63	-3.379	VV
Control	2700.0	2587.5	2606.3	2650.0	2737.5	2656	63	0.000	2700.0	2587.5	2606.3	2650.0	2737.5	2656	63	0.000	WM
60	2667.5	2670.0	2675.0	2652.5	2700.0	2673	17	0.631	3045.0	2962.5	2955.0	2925.0	3062.5	2990	60	12.565	VV
Control	2867.5	2932.5	2883.8	2941.3	2905.0	2906	31	0.000	2867.5	2932.5	2867.5	2932.5	2883.8	2897	33	0.000	WM
90	3075.0	3082.5	2987.5	2965.0	3045.0	3031	53	4.301	2772.5	2720.0	2727.5	2670.0	2715.0	2721	37	-6.067	WM
Control	2772.5	2827.5	2762.5	2832.5	2810.0	2801	32	0.000	2772.5	2827.5	2772.5	2827.5	2762.5	2793	32	0.000	WM
120	2747.5	2620.0	2812.5	2645.0	2785.0	2722	85	-2.820	2722.5	2900.0	2660.0	2812.5	2630.0	2745	111	-1.701	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

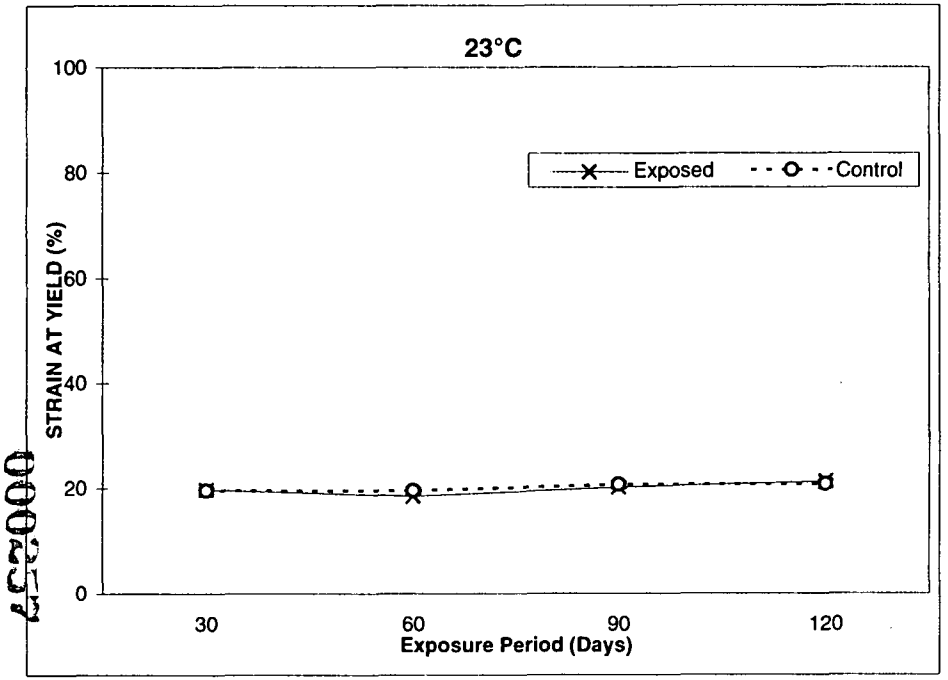
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

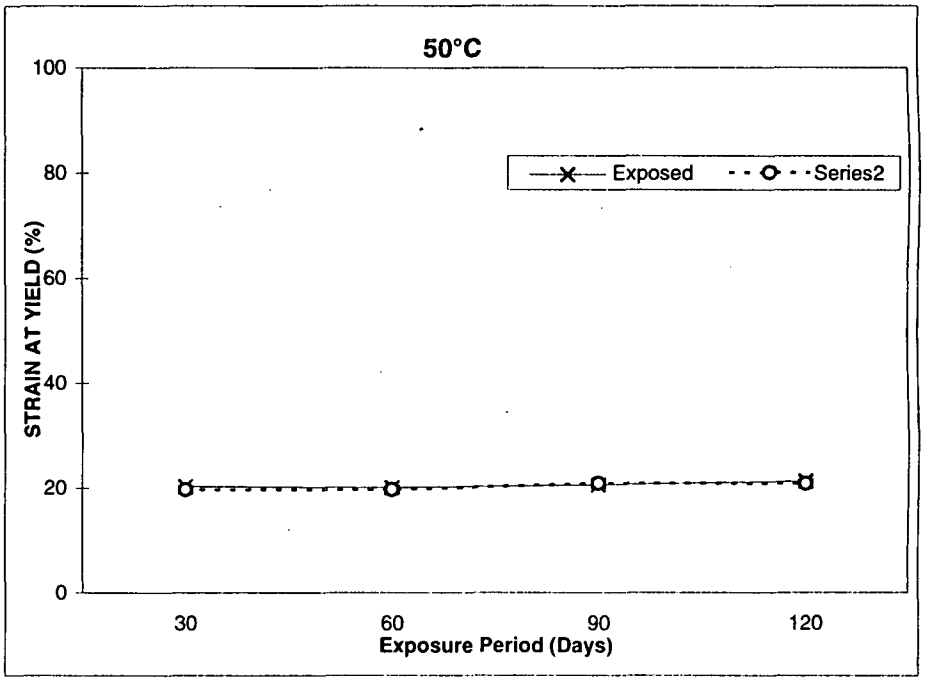
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*POLYFLEX*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRAIN AT YIELD (%)
DIRECTION: ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	19.0	19.1	19.9	20.6	19.8	19.7	0.6	0.0	19.0	19.1	19.9	20.6	19.8	19.7	0.6	0.0	VV
30	19.8	20.4	19.0	19.1	20.5	19.8	0.7	0.4	21.1	20.4	19.7	19.9	20.4	20.3	0.5	3.3	VV
Control	19.0	19.1	19.9	20.6	19.8	19.7	0.6	0.0	19.0	19.1	19.9	20.6	19.8	19.7	0.6	0.0	WM
60	18.5	18.5	19.2	18.0	18.6	18.6	0.5	-5.6	19.9	19.9	21.0	19.8	19.7	20.1	0.5	2.0	VV
Control	20.4	21.2	21.0	21.8	19.8	20.8	0.8	0.0	20.4	21.2	21.0	21.8	19.8	20.8	0.8	0.0	WM
90	20.5	20.4	20.0	19.8	20.5	20.2	0.3	-2.9	20.4	20.4	20.5	21.0	20.5	20.6	0.3	-1.3	VV
Control	21.7	21.2	21.2	20.4	19.8	20.8	0.7	0.0	21.7	21.2	21.2	20.4	19.8	20.8	0.7	0.0	WM
120	22.5	21.0	21.7	21.2	20.5	21.4	0.7	2.6	21.7	21.1	21.0	21.0	21.7	21.3	0.3	2.2	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

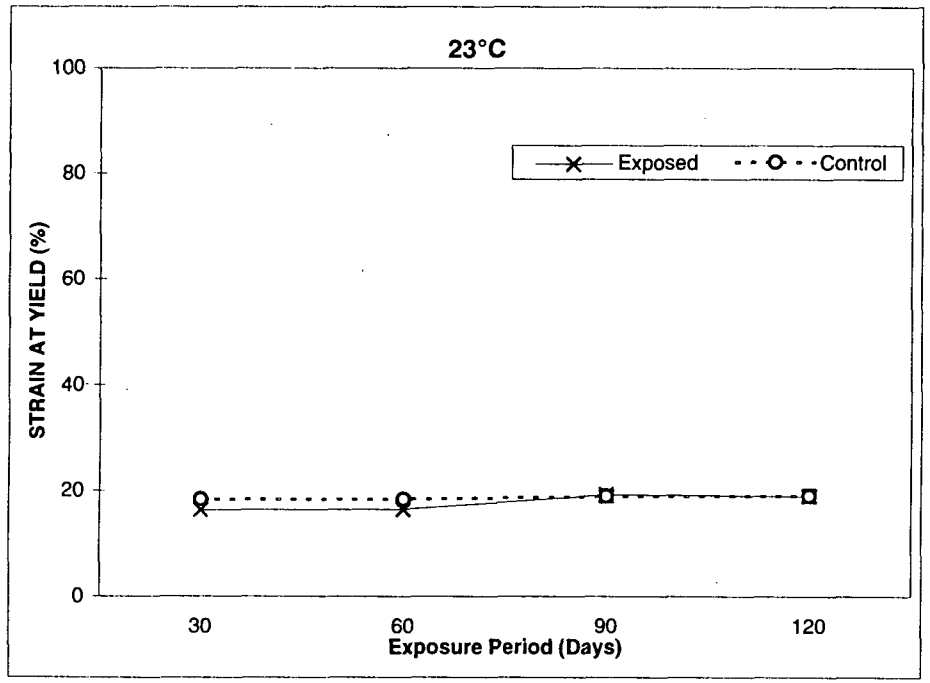
CHEMICAL COMPATIBILITY TEST RESULTS

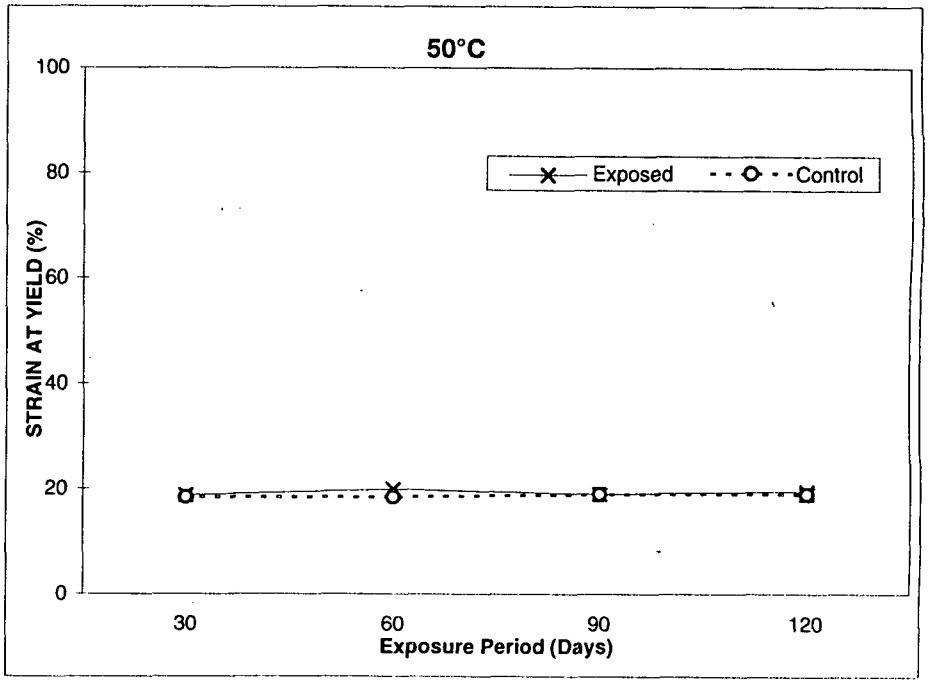
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT YIELD (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	18.5	18.5	18.5	18.6	18.0	18.4	0.2	0.0	18.5	18.5	18.5	18.6	18.0	18.4	0.2	0.0	VV
30	15.4	15.3	17.8	17.0	16.0	16.3	1.1	-11.4	19.1	19.9	19.1	17.8	17.8	18.8	0.9	1.9	VV
Control	18.5	18.5	18.5	18.6	18.0	18.4	0.2	0.0	18.5	18.5	18.5	18.6	18.0	18.4	0.2	0.0	WM
60	16.6	16.7	16.7	15.3	16.7	16.4	0.6	-11.1	21.8	19.1	19.2	20.5	19.1	19.9	1.2	8.3	VV
Control	21.0	19.1	17.8	18.6	18.6	19.0	1.2	0.0	21.0	19.1	17.8	18.6	18.6	19.0	1.2	0.0	WM
90	17.8	19.9	19.7	20.6	18.6	19.3	1.1	1.5	19.9	20.5	19.1	17.2	18.6	19.0	1.3	0.0	VV
Control	18.6	17.4	20.4	19.2	19.9	19.1	1.2	0.0	18.6	17.4	20.4	19.2	19.9	19.1	1.2	0.0	WM
120	18.6	19.8	18.5	19.9	17.9	18.9	0.9	-0.8	19.7	20.4	18.0	19.2	21.0	19.7	1.2	3.0	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

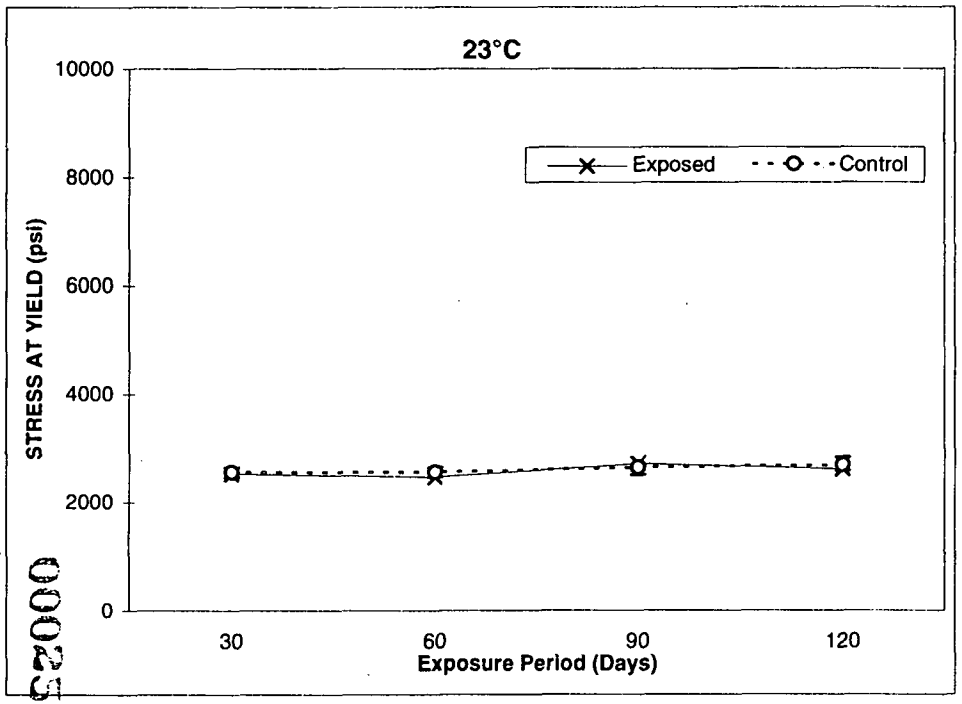
CHEMICAL COMPATIBILITY TEST RESULTS

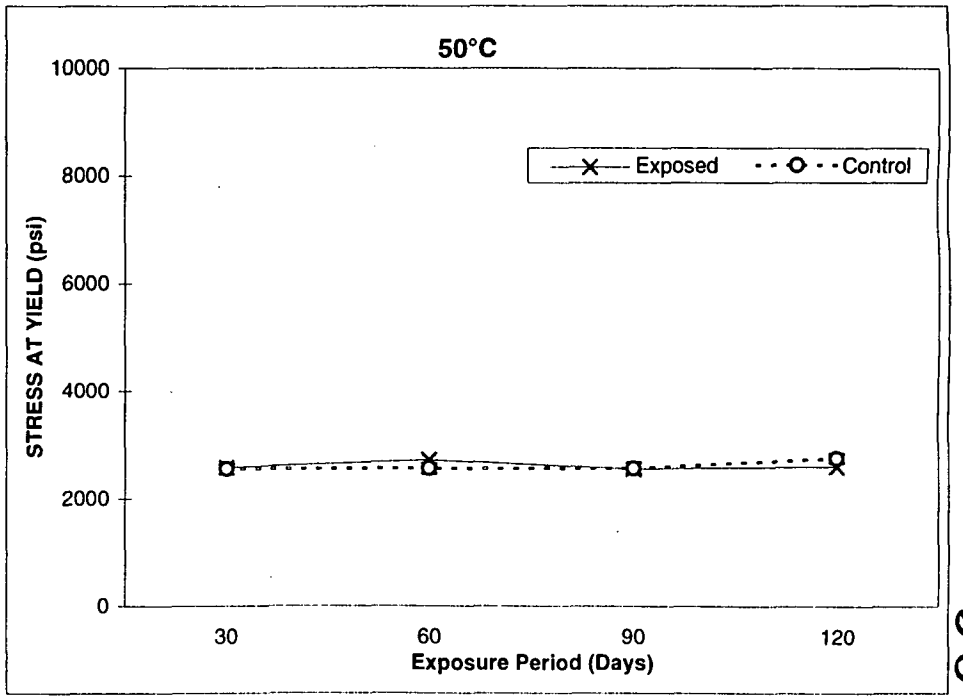
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT YIELD (psi)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	2462.5	2681.3	2512.5	2631.3	2506.3	2559	93	0.000	2462.5	2681.3	2512.5	2631.3	2506.3	2559	93	0.000	VV
30	2382.5	2782.5	2497.5	2447.5	2530.0	2528	153	-1.202	2567.5	2612.5	2590.0	2585.0	2577.5	2587	17	1.085	VV
Control	2462.5	2681.3	2512.5	2631.3	2506.3	2559	93	0.000	2462.5	2681.3	2512.5	2631.3	2506.3	2559	93	0.000	WM
60	2437.5	2525.0	2462.5	2512.5	2393.8	2466	54	-3.615	2850.0	2625.0	2818.8	2618.8	2656.3	2714	112	6.058	VV
Control	2522.5	2517.5	2755.0	2612.5	2842.5	2650	144	0.000	2522.5	2517.5	2522.5	2517.5	2755.0	2567	105	0.000	WM
90	2727.5	2702.5	2787.5	2690.0	2682.5	2718	42	2.566	2543.8	2500.0	2493.8	2543.8	2693.8	2555	81	-0.467	WM
Control	2735.0	2825.0	2620.0	2552.5	2712.5	2689	106	0.000	2735.0	2825.0	2735.0	2825.0	2620.0	2748	85	0.000	WM
120	2582.5	2642.5	2582.5	2677.5	2587.5	2615	43	-2.771	2547.5	2568.8	2610.0	2600.0	2632.5	2592	34	-5.686	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

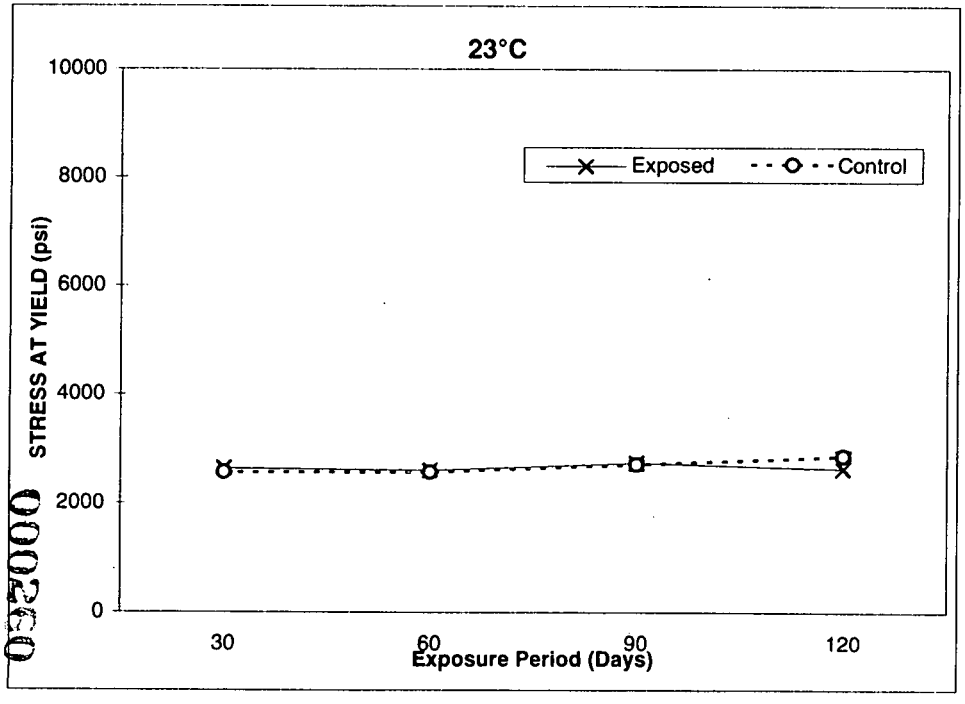
CHEMICAL COMPATIBILITY TEST RESULTS

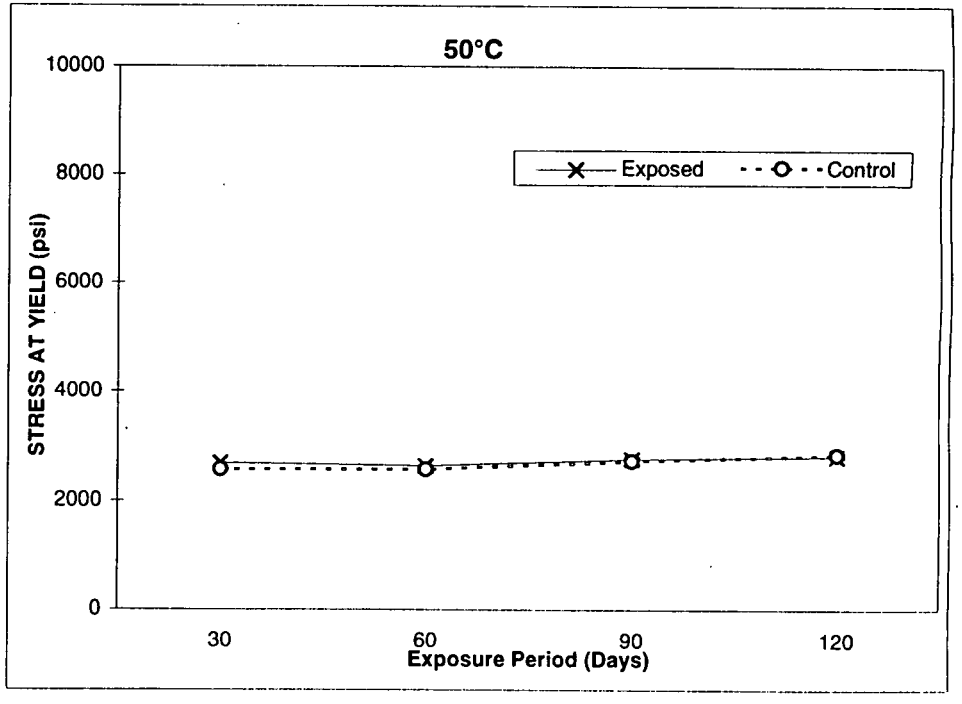
CLIENT: *FERMCO*
METHOD: *ASTM D638*
DATE TESTED: *06/14/96*

GEOSYNTEC JOB NO.: *GE 3900*
MATERIAL TYPE: *SERROT*
CHARACTERISTICS: *80 mil HDPE Geomembrane*
IMMERSION MEDIUM: *Perched Ground Water*

PROPERTY (UNIT): STRESS AT YIELD (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	2568.8	2568.8	2581.3	2587.5	2562.5	2574	10	0.000	2568.8	2568.8	2581.3	2587.5	2562.5	2574	10	0.000	VV
30	2795.0	2485.0	2670.0	2615.0	2642.5	2642	111	2.632	2617.5	2847.5	2597.5	2635.0	2752.5	2690	107	4.517	VV
Control	2568.8	2568.8	2581.3	2587.5	2562.5	2574	10	0.000	2568.8	2568.8	2581.3	2587.5	2562.5	2574	10	0.000	WM
60	2562.5	2587.5	2606.3	2575.0	2700.0	2606	55	1.263	2593.8	2643.8	2637.5	2631.3	2693.8	2640	36	2.574	VV
Control	2810.0	2678.8	2678.8	2833.8	2607.5	2722	96	0.000	2810.0	2678.8	2810.0	2678.8	2678.8	2731	72	0.000	WM
90	2657.5	2856.3	2793.8	2700.0	2737.5	2749	78	1.001	2770.0	2747.5	2732.5	2807.5	2780.0	2768	29	1.327	WM
Control	2810.0	2862.5	2900.0	2852.5	2940.0	2873	49	0.000	2810.0	2862.5	2810.0	2862.5	2900.0	2849	39	0.000	WM
120	2595.0	2647.5	2665.0	2605.0	2690.0	2641	40	-8.093	2693.8	2862.5	2868.8	2825.0	2862.5	2823	74	-0.930	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

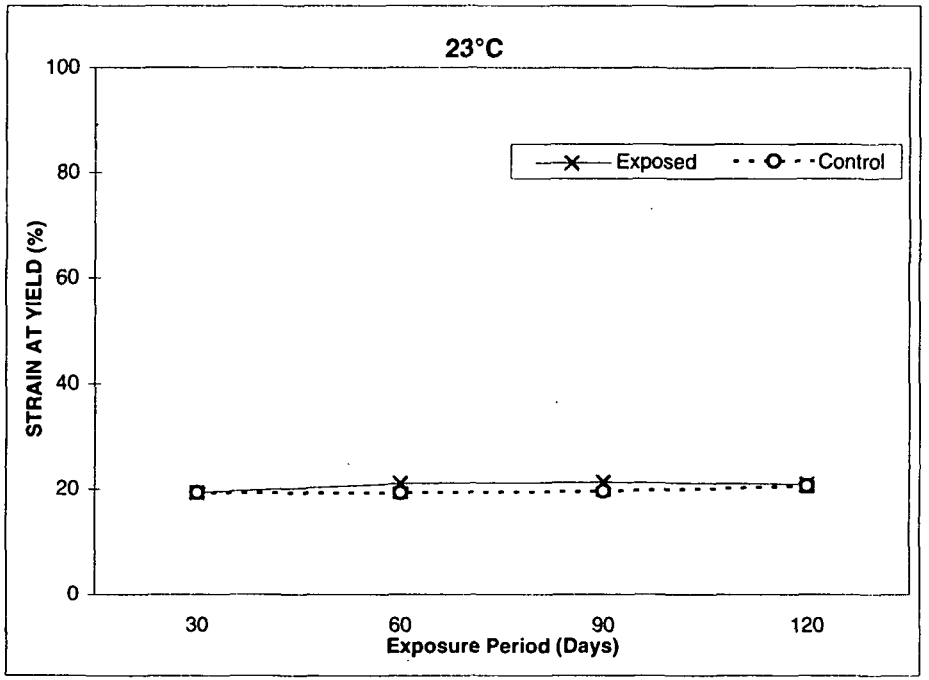
CHEMICAL COMPATIBILITY TEST RESULTS

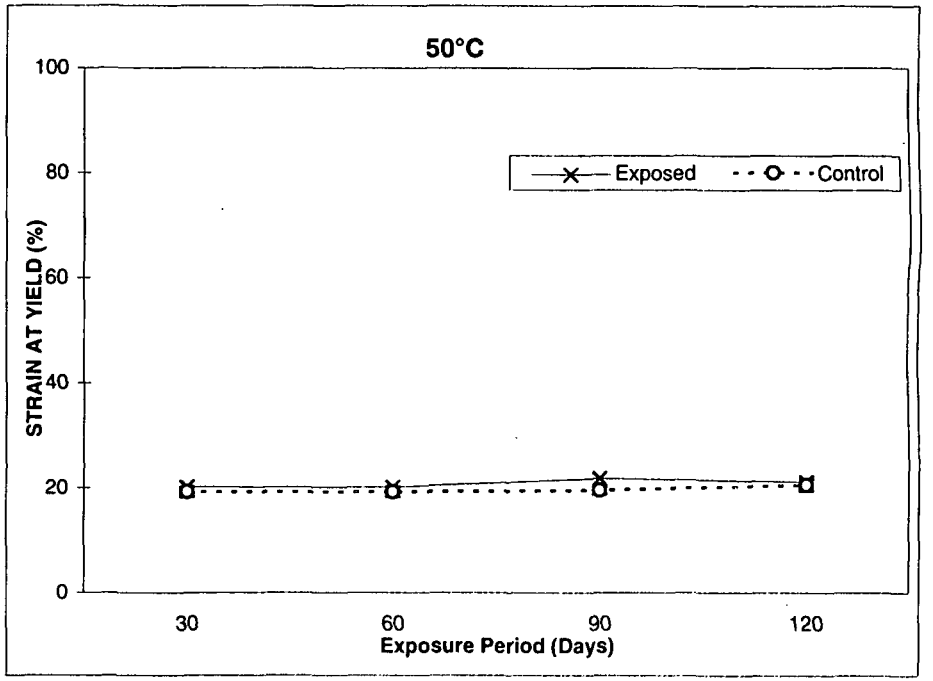
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT YIELD (%)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	19.8	18.0	19.8	18.6	20.3	19.3	1.0	0.0	19.8	18.0	19.8	18.6	20.3	19.3	1.0	0.0	VV
30	18.4	20.3	19.1	19.2	19.7	19.3	0.7	0.3	20.5	20.4	19.9	20.3	19.8	20.2	0.3	4.6	VV
Control	19.8	18.0	19.8	18.6	20.3	19.3	1.0	0.0	19.8	18.0	19.8	18.6	20.3	19.3	1.0	0.0	WM
60	21.7	20.4	22.3	20.4	20.6	21.1	0.9	9.3	19.9	20.6	19.1	20.5	20.4	20.1	0.6	4.2	VV
Control	20.0	18.5	20.4	19.3	19.9	19.6	0.8	0.0	20.0	18.5	20.4	19.3	19.9	19.6	0.8	0.0	WM
90	20.4	21.7	21.8	21.0	21.7	21.3	0.6	8.8	23.6	21.7	20.4	21.7	21.8	21.9	1.1	11.5	VV
Control	19.9	21.8	21.8	20.4	19.2	20.6	1.2	0.0	19.9	21.8	21.8	20.4	19.2	20.6	1.2	0.0	WM
120	21.2	21.7	20.5	20.4	21.2	21.0	0.5	1.7	21.7	21.8	19.7	20.6	21.8	21.1	0.9	2.4	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000261

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

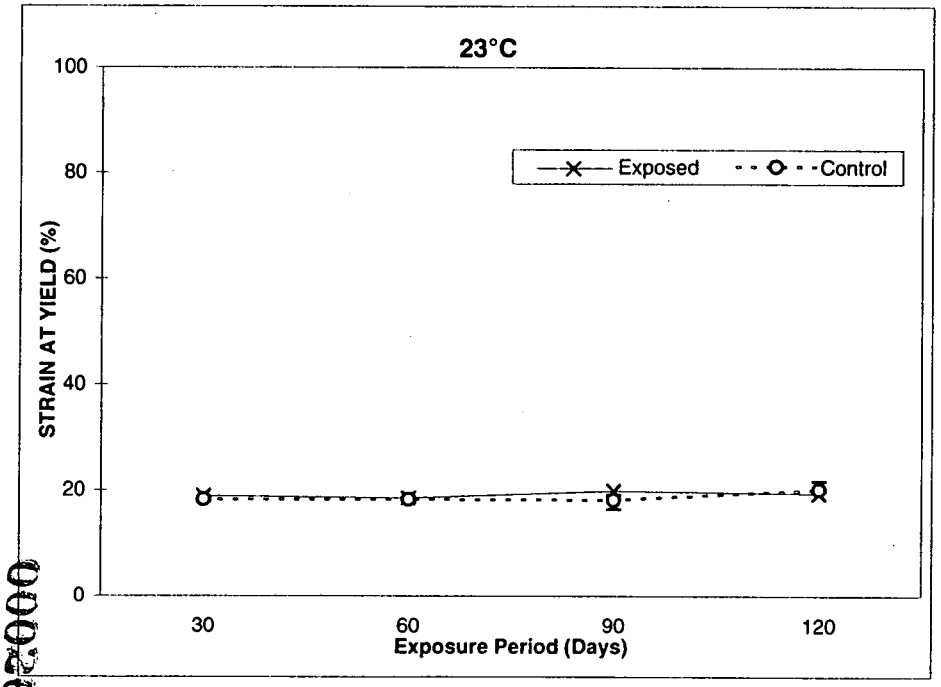
CHEMICAL COMPATIBILITY TEST RESULTS

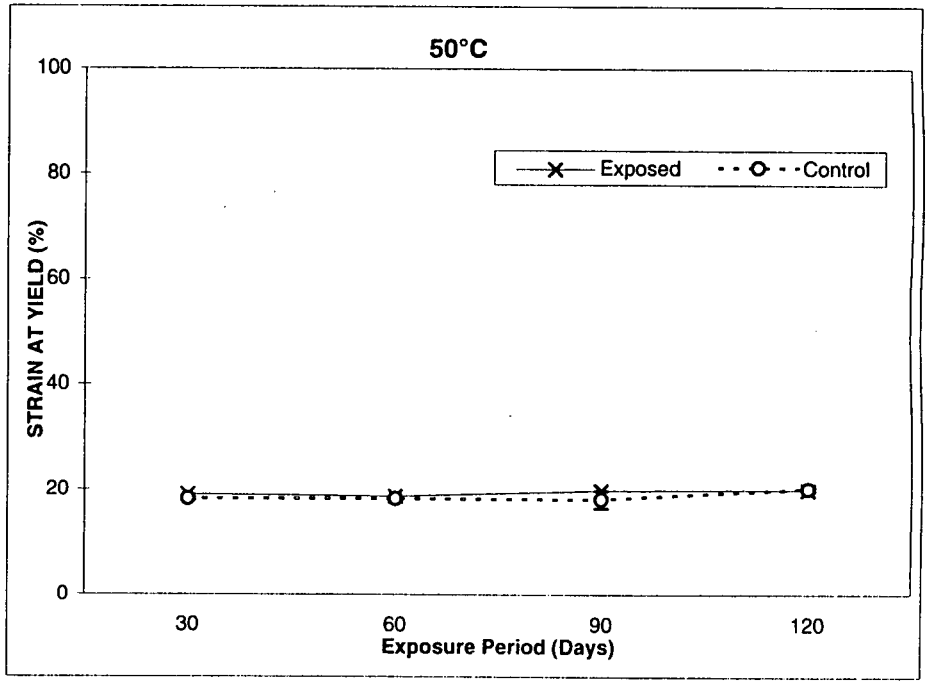
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT YIELD (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	18.5	18.6	18.0	18.5	18.0	18.3	0.3	0.0	18.5	18.6	18.0	18.5	18.0	18.3	0.3	0.0	VV
30	18.0	20.6	19.1	18.4	18.6	18.9	1.0	3.5	20.4	18.4	18.5	19.1	19.1	19.1	0.8	4.3	VV
Control	18.5	18.6	18.0	18.5	18.0	18.3	0.3	0.0	18.5	18.6	18.0	18.5	18.0	18.3	0.3	0.0	WM
60	18.5	19.7	18.5	18.6	17.5	18.5	0.8	1.3	19.1	18.5	17.8	20.4	18.0	18.7	1.1	2.4	VV
Control	17.8	21.0	16.8	17.8	17.3	18.2	1.7	0.0	17.8	21.0	16.8	17.8	17.3	18.2	1.7	0.0	WM
90	21.1	19.1	18.6	20.4	20.4	19.9	1.0	9.8	18.6	21.1	19.9	20.4	19.3	19.8	0.9	9.3	VV
Control	19.9	19.9	20.4	20.4	20.6	20.2	0.3	0.0	19.9	19.9	20.4	20.4	20.6	20.2	0.3	0.0	WM
120	20.4	18.6	18.6	20.4	19.1	19.4	0.9	-4.0	19.9	19.1	19.9	20.6	20.5	20.0	0.6	-1.2	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

2.8 Stress and Strain at Break

Rationale of Test

Stress at break is the stress required to cause the rupture of the test specimen. On the molecular level, this is the point at which the molecules of the material either break or disentangle and part from each other. In contrast, strain at break is the lineal increase in the length of a material as it deforms (e.g., elongates) to the point of rupture. Both stress at break and strain at break are sensitive to surface imperfections, which concentrate stress. Because of this sensitivity, specimens may fail prematurely.

Results and Discussion

The following observations were made regarding stress and strain at break of the geomembranes:

GSE-SLT Geomembrane. Both 23°C (73°F) and 50°C (122°F) roll-direction samples exhibited trends of slightly decreasing values during the 120 days of exposure to the leachate. The cross-roll direction sample results were more varied than the roll-direction sample results. For samples of both direction types, approximately 50 percent of all the exposed sample mean values were within one standard deviation of the control value means. Finally, there were no significant differences between the 23°C (73°F) and 50°C (122°F) samples.

Strain at break for both the roll and cross-roll samples were usually constant, with the exception of the 90-day values, which increased significantly. Most of the exposed sample mean values were slightly more than one standard deviation from the control value means. In addition, there was no significant difference between the 23°C (73°F) and 50°C (122°F) samples. There was no evidence of the inverse relationship between stress and strain.

NSC Geomembrane. Stress at break values for both the roll and cross-roll direction samples were nearly constant, except for: (i) the 90-day roll direction sample value, which increased approximately 10 percent; and (ii) the 120-day

Draft

cross-roll sample values, which decreased approximately 6 percent and 12 percent for the 23°C (73°F) and 50°C (122°F) exposure temperatures, respectively. In general, most of the mean values for the exposed samples were within one standard deviation of the control value means. In addition, there were no significant differences in the results of 23°C (73°F) and 50°C (122°F) samples.

As with stress at break, strain at break for both the roll and cross-roll direction samples were generally constant during the geomembrane's exposure to the leachate. Only the 90-day roll direction (both 23°C (73°F) and 50°C (122°F)) values changed significantly (by approximately 10 percent). The mean values of the exposed samples were within one standard deviation of the control value means. There was no measurable difference between the results of the 23°C (73°F) and 50°C (122°F) samples. Finally, the inverse relationship between stress and strain was not evident in these data.

GSE-Gundle Geomembrane. Stress at break of the roll direction sample showed some variability during the 120-day exposure period; however, the mean values of the exposed samples were generally within one standard deviation of the control value means. The cross-roll direction values were consistently below the control values, but did not show a decreasing trend. There were no appreciable differences between the 23°C (73°F) and 50°C (122°F) results.

Strain at break for both roll and cross-roll direction samples were generally constant for the 120 days of leachate exposure. In addition, the mean values of the exposed samples were within one standard deviation of the control value means. Finally, the inverse relationship of stress and strain was not evident in these test results.

Polyflex Geomembrane. Stress at break values for the roll and cross-roll direction samples were variable, except for the 23°C (73°F) roll direction samples, which were nearly constant. Most of the mean values of the exposed samples were outside of one standard deviation of the control value means. The 23°C (73°F) and 50°C (122°F) cross-roll direction sample results were particularly at variance from their respective control sample values at 90 and 120 days. The overall

percent changes in stress at break for 23°C (73°F) and 50°C (122°F) samples were not appreciable different.

The strain at break values for the roll and cross-roll direction samples exhibited changes that were parallel to those of stress at break, with variability similar to that of stress at break, i.e., cross-roll direction samples were more variable that the roll direction samples.

Serrot Geomembrane. Stress at break values of roll direction samples were higher than the control values except for the 23°C (73°F) samples which were approximately 12 percent and 8 percent below the control samples at 30 days and 120 days, respectively. Stress at break values for the cross-roll direction samples were generally constant. Stress at break values for the exposed roll direction samples were generally 20 percent above the control values. Most of the exposed samples were outside of one standard deviation of the control value means. The percent change in stress of break values for the 23°C (73°F) and 50°C (122°F) samples were not appreciably different.

Strain at break values of the roll and cross-roll direction samples were generally parallel to those of stress at break, with variability similar to that of stress at break.

The stress at break and strain at break values for the five geomembranes were variable (i.e., no trends were observed). However, the results of the NSC and GSE-Gundle geomembranes were more uniform than the GSE-SLT, Serrot, and Polyflex geomembranes. The percent change values of the 23°C (73°F) and 50°C (122°F) samples were generally equivalent. In addition, the inverse relationship of stress and strain was not evident in these results because stress and strain generally experienced variable changes. Changes occurring in strain at break and stress at break in these samples are not likely due to interaction with the leachate because: (i) the data were variable; (ii) no significant differences in the percent change values were observed between the 23°C (73°F) and 50°C (122°F) samples; and (iii) the inverse relationship of stress and strain was not evident. In addition, because the measured physical properties and stress and strain at yield values were generally constant, stress and strain

at break were not expected to exhibit evidence of leachate interaction. Therefore, it is likely that the observed changes in stress and strain at break of the five geomembranes are attributable to experimental variability and material variability.

Conclusion

The test leachate did not measurably impact the stress and strain at break of the geomembranes during the 120 day exposure period.

draft

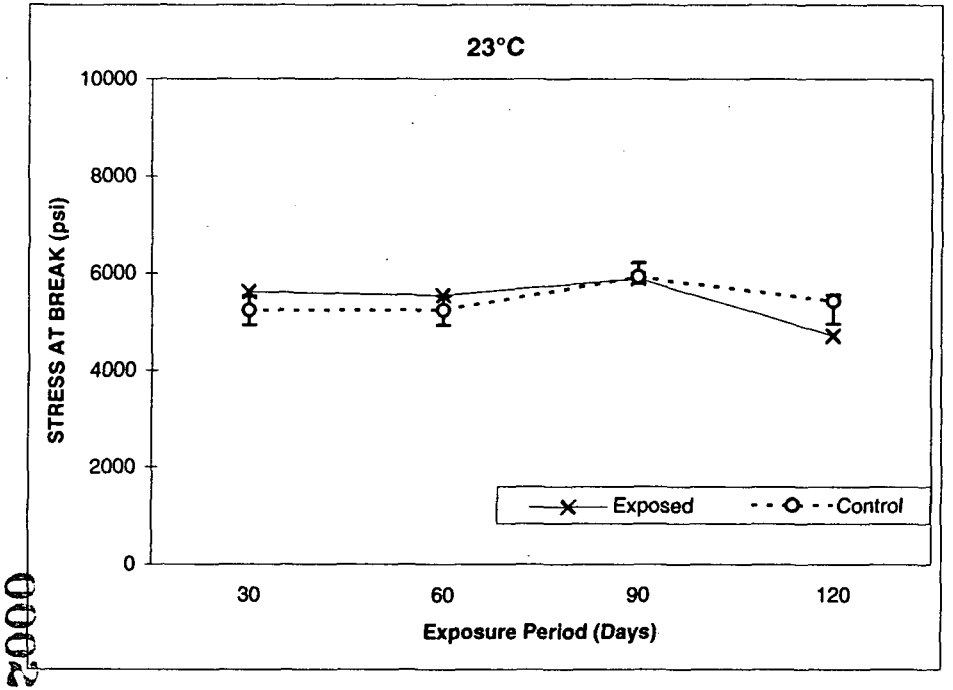
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

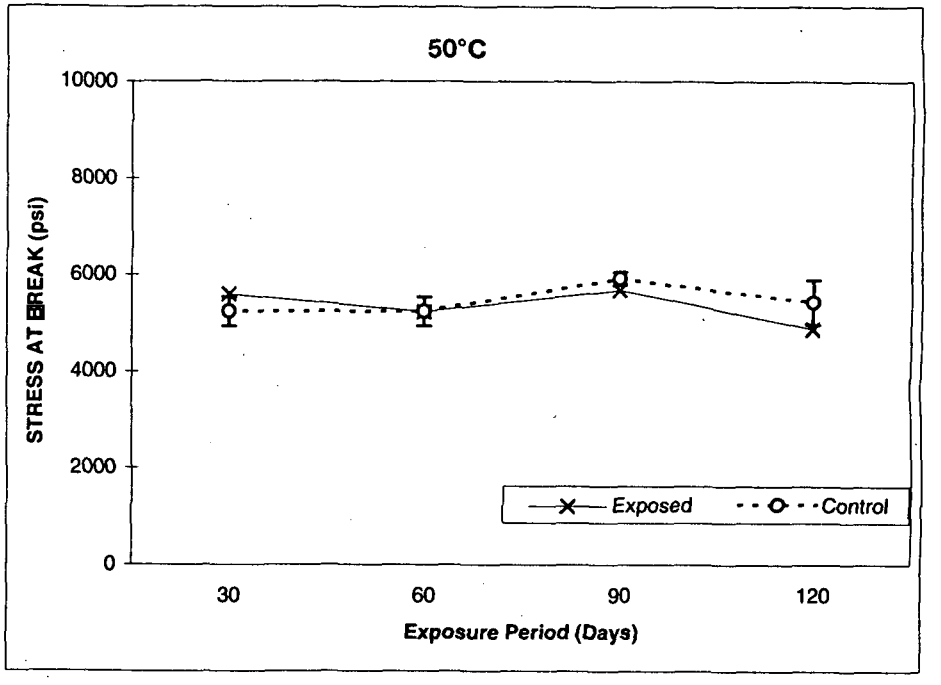
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*GSE - SLT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRESS AT BREAK (psi)
DIRECTION: ROLL

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	5010.0	5520.0	5380.0	5470.0	4830.0	5242	305	0.000	5010.0	5520.0	5380.0	5470.0	4830.0	5242	305	0.000	VV
30	5835.0	5780.0	5490.0	5845.0	5170.0	5624	292	7.287	5620.0	5100.0	5940.0	5665.0	5695.0	5604	308	6.906	VV
Control	5010.0	5520.0	5380.0	5470.0	4830.0	5242	305	0.000	5010.0	5520.0	5380.0	5470.0	4830.0	5242	305	0.000	WM
60	5855.0	5350.0	5390.0	5570.0	5600.0	5553	201	5.933	5280.0	5255.0	5150.0	5280.0	5175.0	5228	61	-0.267	VV
Control	5695.0	5950.0	6030.0	6010.0	5995.0	5936	138	0.000	5695.0	5950.0	6030.0	6010.0	5995.0	5936	138	0.000	WM
90	6015.0	5925.0	5395.0	6065.0	6075.0	5895	286	-0.691	6085.0	5840.0	5520.0	5980.0	5055.0	5696	417	-4.043	VV
Control	5625.0	4937.5	5912.5	5780.0	4918.8	5435	474	0.000	5625.0	4937.5	5912.5	5780.0	4918.8	5435	474	0.000	WM
120	4887.5	3912.5	4837.5	4837.5	5100.0	4715	462	-13.243	4150.0	5362.5	4662.5	4750.0	5437.5	4873	534	-10.345	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

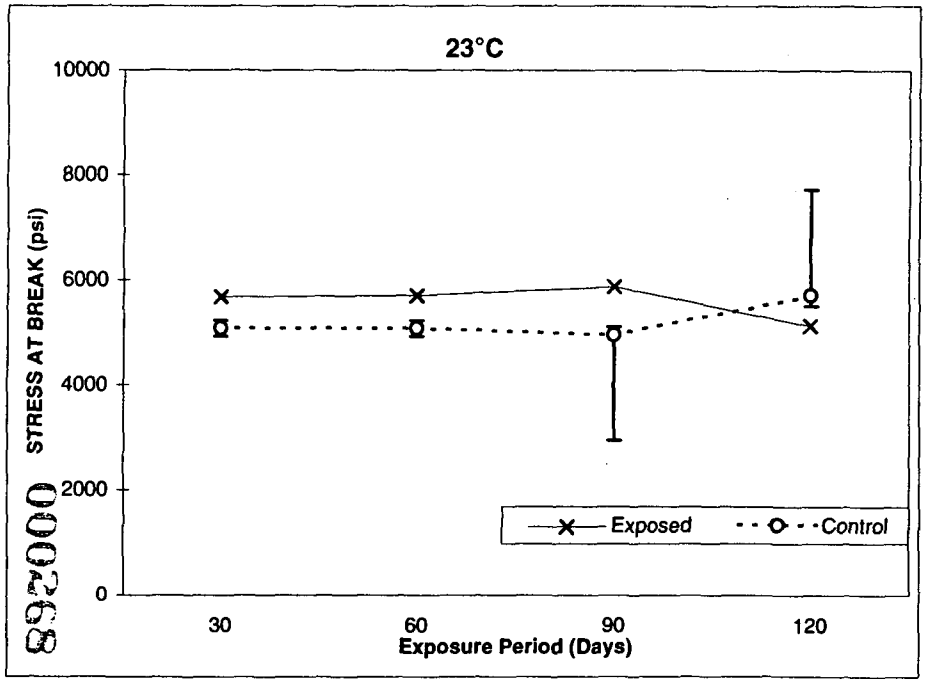
CHEMICAL COMPATIBILITY TEST RESULTS

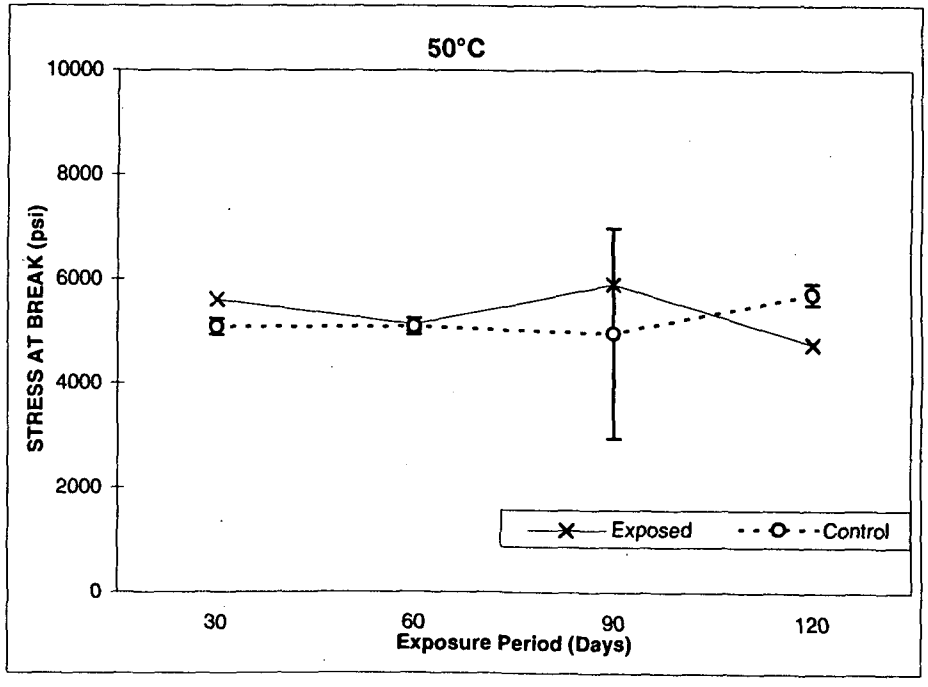
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	5320.0	5025.0	5020.0	5125.0	4915.0	5081	153	0.000	5320.0	5025.0	5020.0	5125.0	4915.0	5081	153	0.000	VV
30	5745.0	5470.0	5765.0	5712.5	5705.0	5680	120	11.779	5900.0	5660.0	5645.0	5675.0	5145.0	5605	278	10.313	VV
Control	5320.0	5025.0	5020.0	5125.0	4915.0	5081	153	0.000	5320.0	5025.0	5020.0	5125.0	4915.0	5081	153	0.000	WM
60	5700.0	5565.0	5700.0	5760.0	5790.0	5703	86	12.242	5110.0	5045.0	5000.0	5375.0	5060.0	5118	149	0.728	VV
Control	5180.0	6410.0	6045.0	1452.5	5685.0	4955	2010	0.000	5180.0	6410.0	6045.0	1452.5	5685.0	4955	2010	0.000	WM
90	6090.0	5937.5	5790.0	5670.0	5895.0	5877	158	18.609	6280.0	5860.0	5895.0	5725.0	5745.0	5901	224	19.104	VV
Control	5668.8	5943.8	5843.8	5718.8	5406.3	5716	204	0.000	5668.8	5943.8	5843.8	5718.8	5406.3	5716	204	0.000	WM
120	5262.5	4875.0	5000.0	5112.5	5400.0	5130	208	-10.256	5150.0	4925.0	5375.0	5200.0	3112.5	4753	931	-16.860	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

892000

3872

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

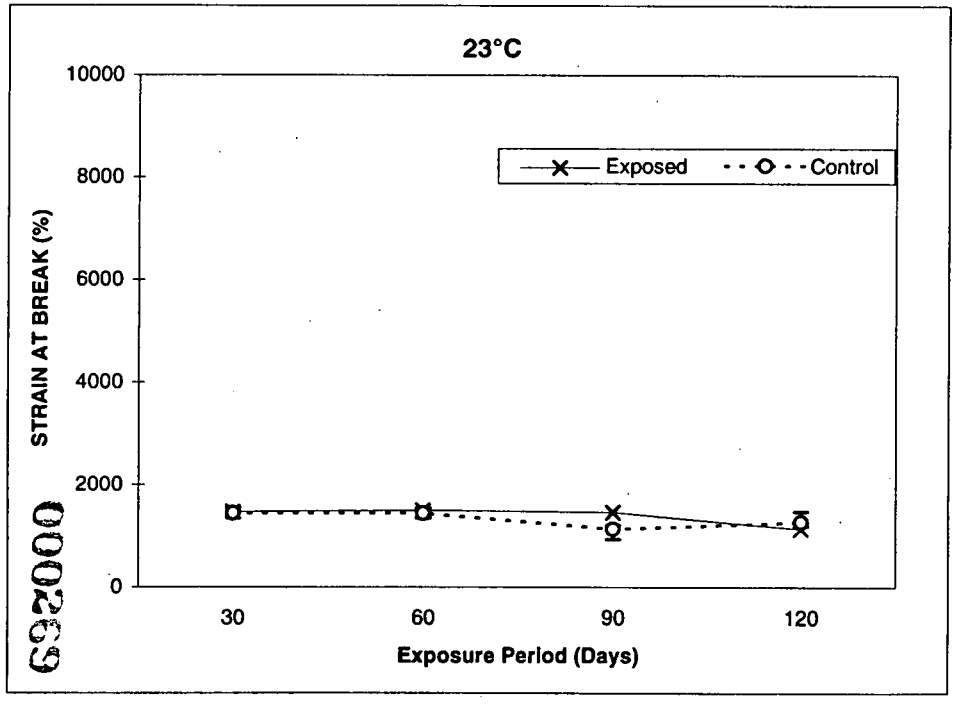
CHEMICAL COMPATIBILITY TEST RESULTS

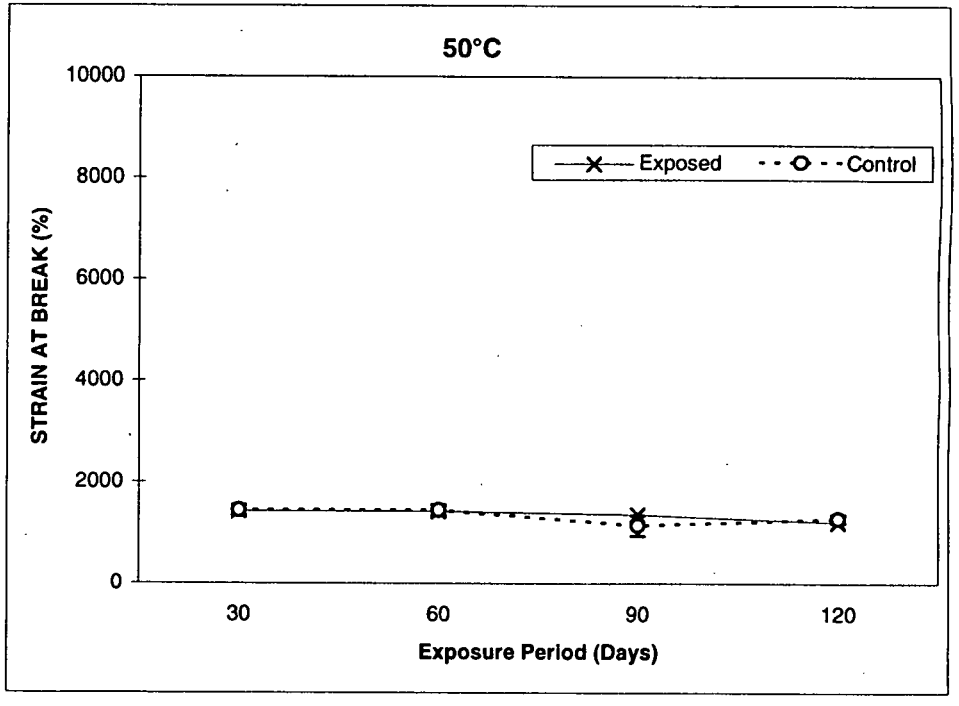
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1360	1545	1488	1533	1322	1450	102	0.0	1360	1545	1488	1533	1322	1450	102	0.0	VV
30	1557	1507	1436	1528	1338	1473	88	1.6	1415	1282	1515	1433	1457	1420	86	-2.0	VV
Control	1360	1545	1488	1533	1322	1450	102	0.0	1360	1545	1488	1533	1322	1450	102	0.0	WM
60	1568	1458	1480	1486	1515	1501	42	3.6	1438	1435	1385	1435	1408	1420	23	-2.0	VV
Control	1257	1274	1225	1163	785	1141	203	0.0	1257	1274	1225	1163	785	1141	203	0.0	WM
90	1530	1482	1330	1492	1499	1467	78	28.5	1536	1367	1293	1418	1191	1361	130	19.3	VV
Control	1287	1328	1344	1304	1132	1279	85	0.0	1287	1328	1344	1304	1132	1279	85	0.0	WM
120	1154	1335	1271	845	1092	1139	190	-10.9	1267	1269	1100	1231	1119	1197	82	-6.4	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

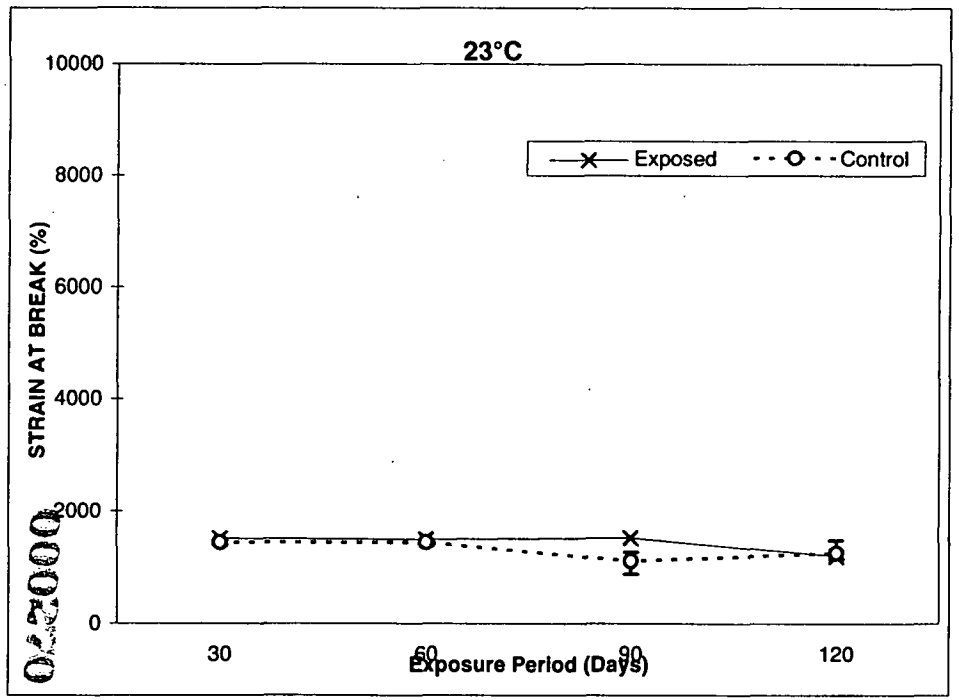
CHEMICAL COMPATIBILITY TEST RESULTS

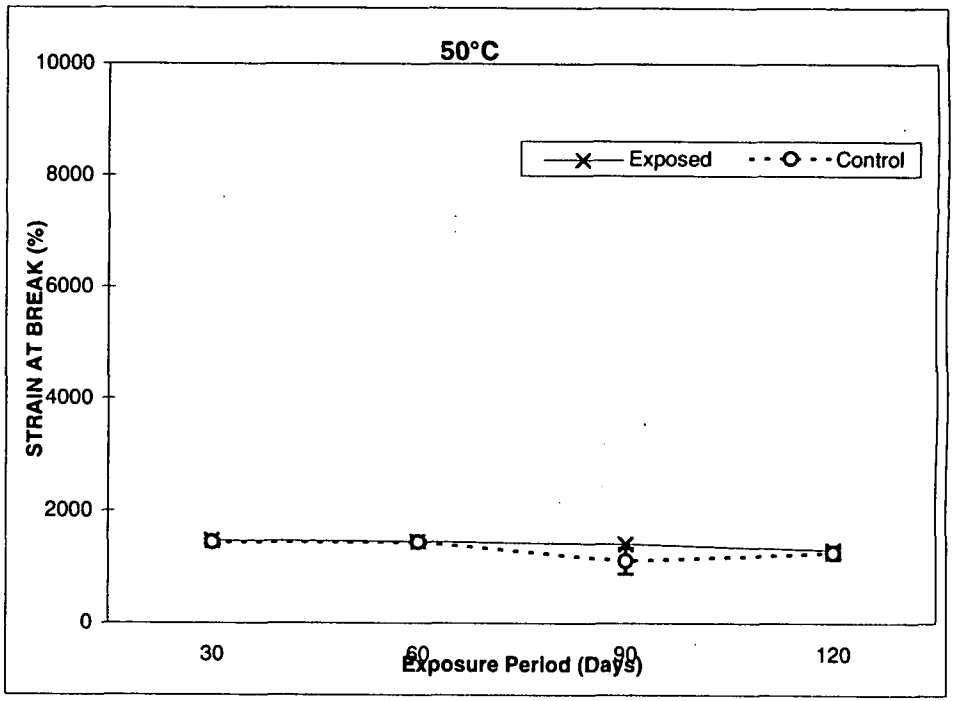
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1512	1426	1428	1458	1397	1444	44	0.000	1512	1426	1428	1458	1397	1444	44	0.000	VV
30	1534	1449	1528	1522	1528	1512	36	4.708	1523	1492	1482	1498	1358	1471	65	1.828	VV
Control	1512	1426	1428	1458	1397	1444	44	0.000	1512	1426	1428	1458	1397	1444	44	0.000	WM
60	1480	1442	1505	1525	1532	1497	37	3.642	1449	1428	1415	1537	1432	1452	49	0.554	VV
Control	1310	1135	1071	742	1295	1111	230	0.000	1310	1135	1071	742	1295	1111	230	0.000	WM
90	1494	1805	1465	1411	1453	1526	159	37.360	1494	1391	1401	1362	1387	1407	51	26.681	VV
Control	1359	1185	1366	1204	1143	1251	104	0.000	1359	1185	1366	1204	1143	1251	104	0.000	WM
120	1389	1297	1212	812	1269	1196	224	-4.451	1412	1423	1223	1256	1175	1298	113	3.708	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

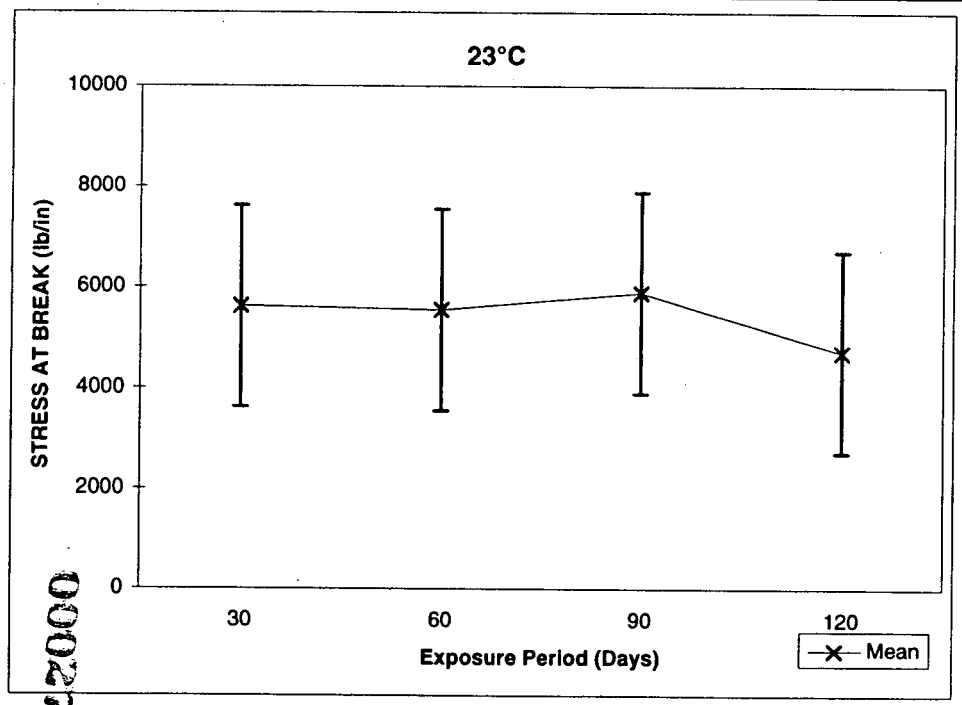
CHEMICAL COMPATIBILITY TEST RESULTS

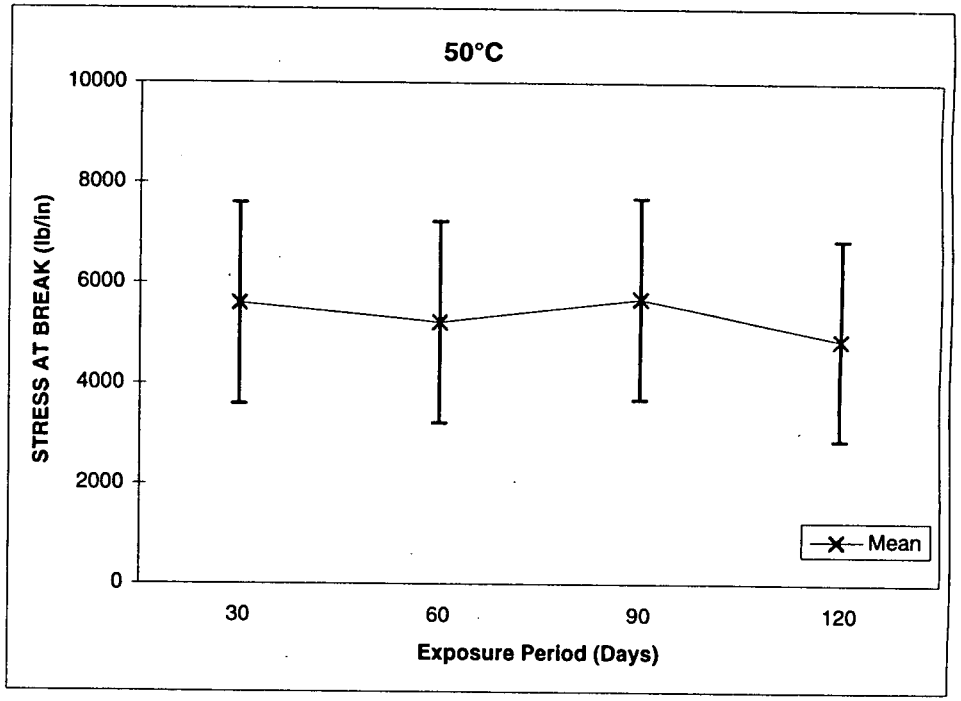
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (lbs/in)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	5010.0	5520.0	5380.0	5470.0	4830.0	5242	305	0.0	5010.0	5520.0	5380.0	5470.0	4830.0	5242	305	0.0	VV
30	5835.0	5780.0	5490.0	5845.0	5170.0	5624	292	7.3	5620.0	5100.0	5940.0	5665.0	5695.0	5604	308	6.9	VV
60	5855.0	5350.0	5390.0	5570.0	5600.0	5553	201	5.9	5280.0	5255.0	5150.0	5280.0	5175.0	5228	61	-0.3	VV
90	6015.0	5925.0	5395.0	6065.0	6075.0	5895	286	12.5	6085.0	5840.0	5520.0	5980.0	5055.0	5696	417	8.7	VV
120	4887.5	3912.5	4837.5	4837.5	5100.0	4715	462	-10.1	4150.0	5362.5	4662.5	4750.0	5437.5	4873	534	-7.0	WM





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

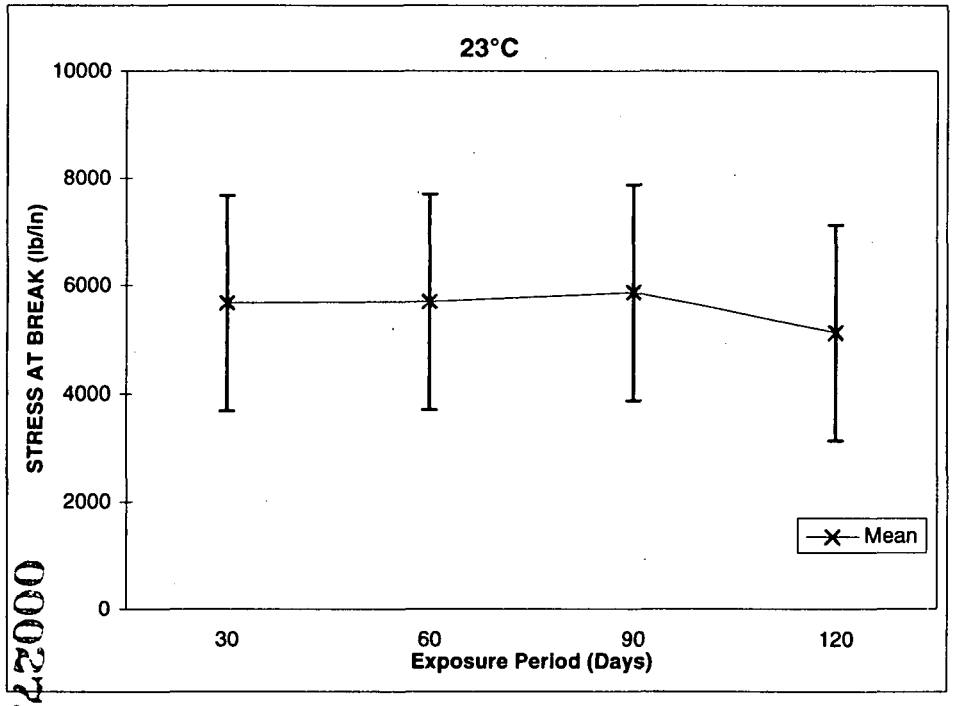
CHEMICAL COMPATIBILITY TEST RESULTS

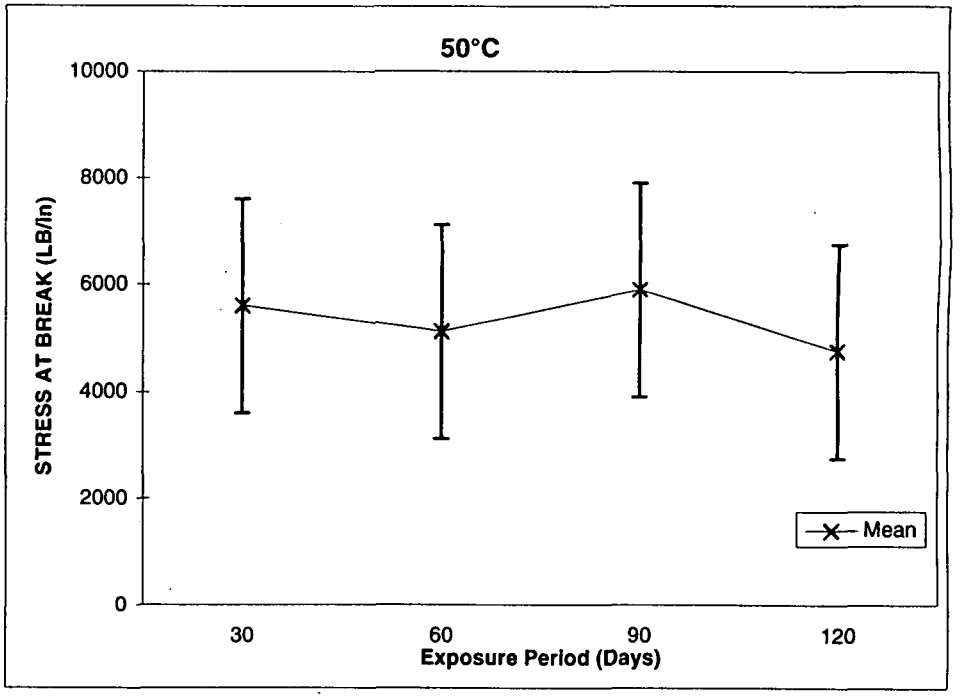
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (lbs/in)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	5320.0	5025.0	5020.0	5125.0	4915.0	5081	153	0.0	5320.0	5025.0	5020.0	5125.0	4915.0	5081	153	0.0	VV
30	5745.0	5470.0	5765.0	5712.5	5705.0	5680	120	11.8	5900.0	5660.0	5645.0	5675.0	5145.0	5605	278	10.3	VV
60	5700.0	5565.0	5700.0	5760.0	5790.0	5703	86	12.2	5110.0	5045.0	5000.0	5375.0	5060.0	5118	149	0.7	VV
90	6090.0	5937.5	5790.0	5670.0	5895.0	5877	158	15.7	6280.0	5860.0	5895.0	5725.0	5745.0	5901	224	16.1	VV
120	5262.5	4875.0	5000.0	5112.5	5400.0	5130	208	1.0	5150.0	4925.0	5375.0	5200.0	3112.5	4753	931	-6.5	WM





© 1996 GEOSYNTEC CONSULTANTS

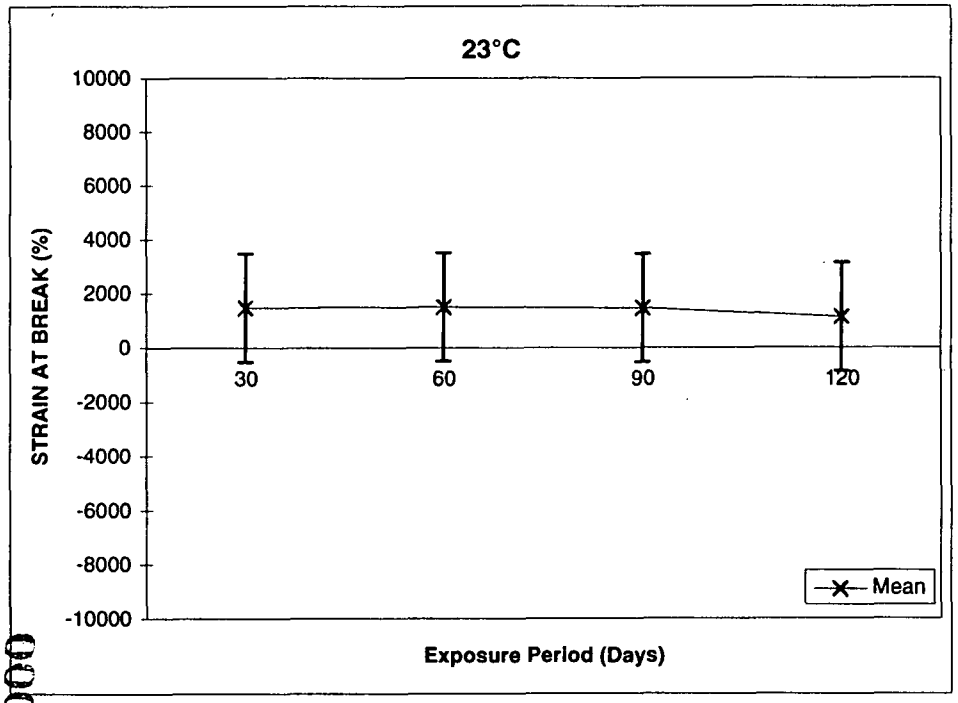
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

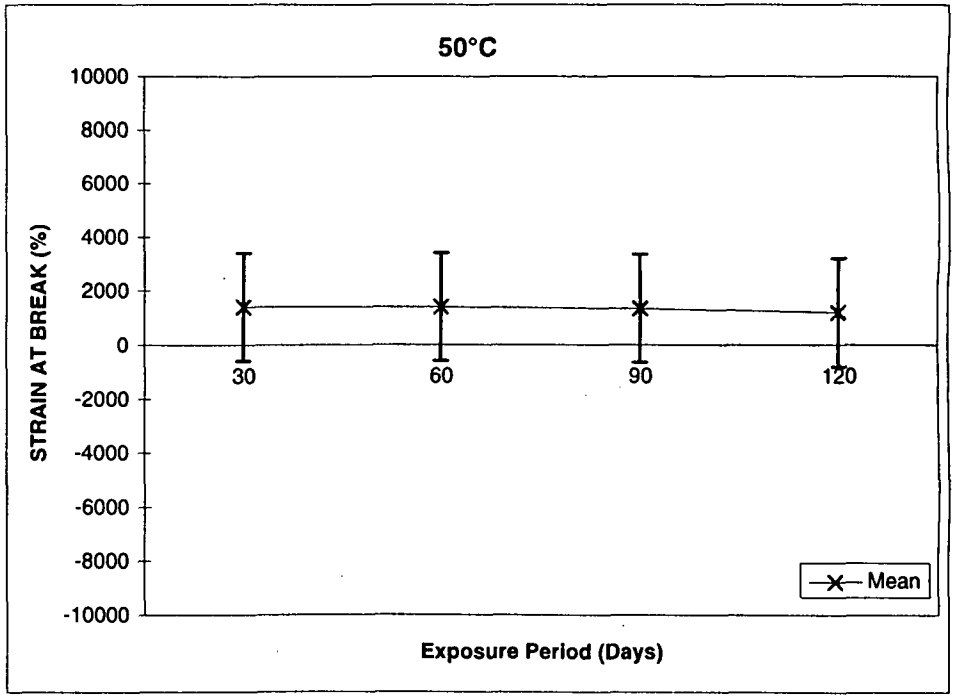
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*GSE - SLT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: ROLL

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	1360	1545	1488	1533	1322	1450	102	0.0	1360	1545	1488	1533	1322	1450	102	0.0	VV
30	1557	1507	1436	1528	1338	1473	88	1.6	1415	1282	1515	1433	1457	1420	86	-2.0	VV
60	1568	1458	1480	1486	1515	1501	42	3.6	1438	1435	1385	1435	1408	1420	23	-2.0	VV
90	1530	1482	1330	1492	1499	1467	78	1.2	1536	1367	1293	1418	1191	1361	130	-6.1	VV
120	1154	1335	1271	845	1092	1139	190	-21.4	1267	1269	1100	1231	1119	1197	82	-17.4	WM





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

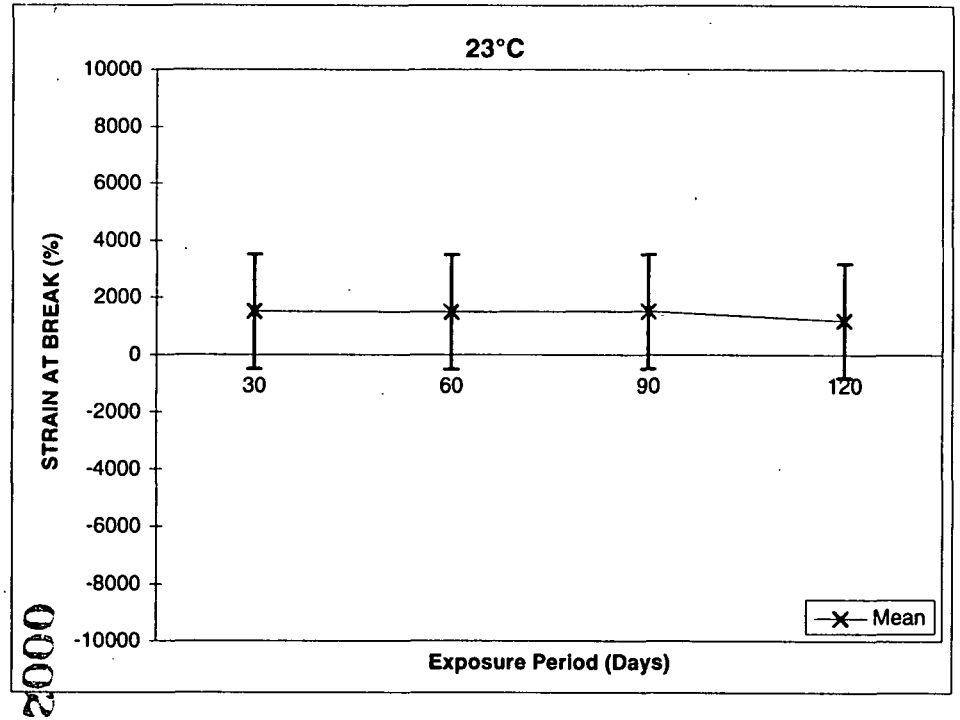
CHEMICAL COMPATIBILITY TEST RESULTS

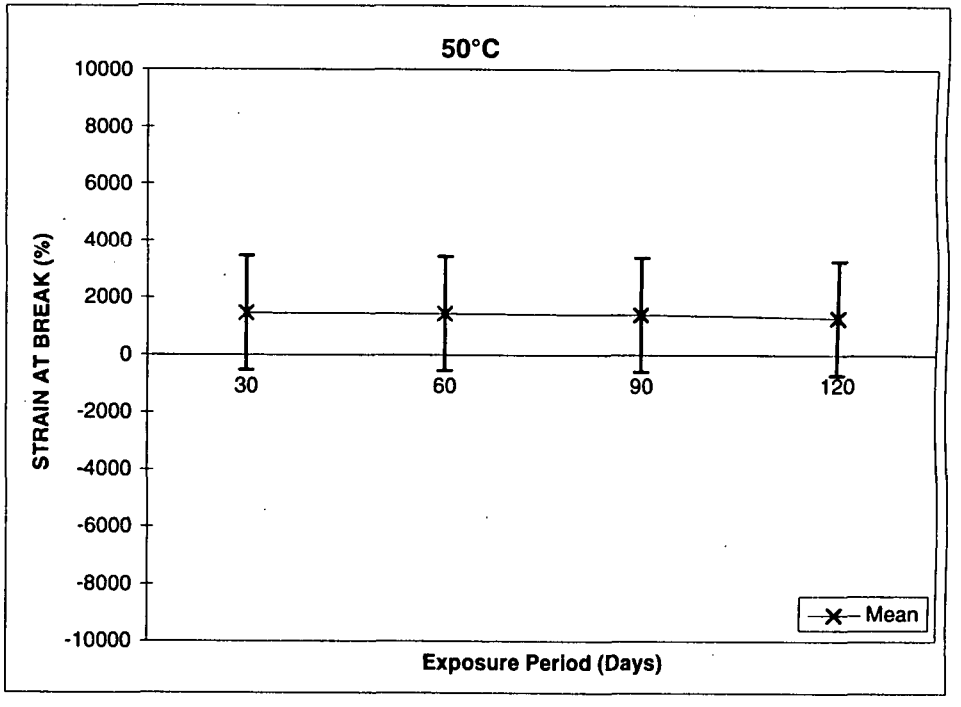
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1512	1426	1428	1458	1397	1444	44	0.0	1512	1426	1428	1458	1397	1444	44	0.0	VV
30	1534	1449	1528	1522	1528	1512	36	4.7	1523	1492	1482	1498	1358	1471	65	1.8	VV
60	1480	1442	1505	1525	1532	1497	37	3.6	1449	1428	1415	1537	1432	1452	49	0.6	VV
90	1494	1805	1465	1411	1453	1526	159	5.6	1494	1391	1401	1362	1387	1407	51	-2.6	VV
120	1389	1297	1212	812	1269	1196	224	-17.2	1412	1423	1223	1256	1175	1298	113	-10.1	WM





© 1996 GEOSYNTEC CONSULTANTS

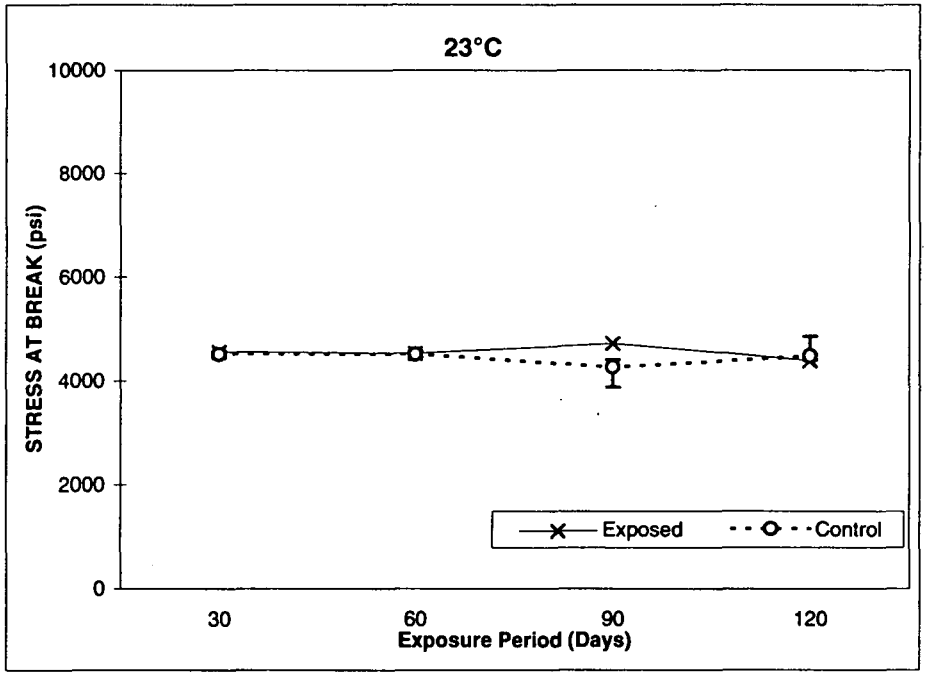
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

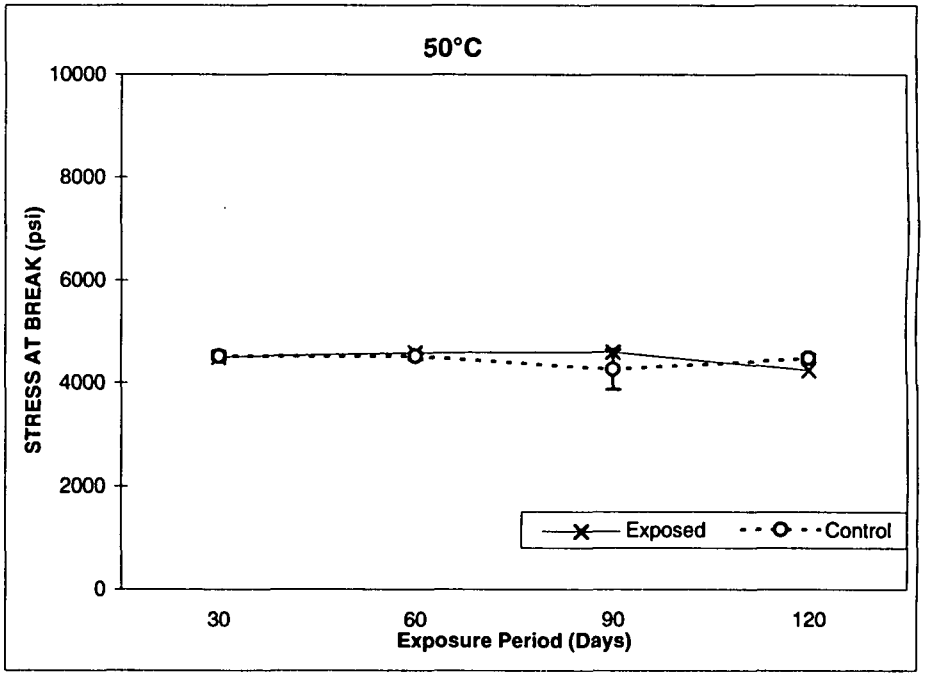
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*NSC*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRESS AT BREAK (psi)
DIRECTION: ROLL

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	4492.5	4600.0	4455.0	4565.0	4487.5	4520	60	0.000	4492.5	4600.0	4455.0	4565.0	4487.5	4520	60	0.000	VV
30	4535.0	4582.5	4450.0	4775.0	4480.0	4565	128	0.985	4482.5	4517.5	4532.5	4510.0	4460.0	4501	29	-0.431	VV
Control	4492.5	4600.0	4455.0	4565.0	4487.5	4520	60	0.000	4492.5	4600.0	4455.0	4565.0	4487.5	4520	60	0.000	WM
60	4552.5	4365.0	4625.0	4585.0	4537.5	4533	100	0.288	4340.0	4567.5	4687.5	4727.5	4587.5	4582	151	1.372	VV
Control	3767.5	4422.5	4627.5	3955.0	4572.5	4269	385	0.000	3767.5	4422.5	4627.5	3955.0	4572.5	4269	385	0.000	WM
90	4942.5	4727.5	4642.5	4555.0	4757.5	4725	145	10.682	4740.0	4630.0	4352.5	4647.5	4635.0	4601	146	7.777	VV
Control	4606.3	4493.8	4431.3	4412.5	4468.8	4483	76	0.000	4606.3	4493.8	4431.3	4412.5	4468.8	4483	76	0.000	WM
120	4650.0	4322.5	4395.0	4510.0	4085.0	4393	212	-2.008	3925.0	4325.0	4375.0	4302.5	4302.5	4246	182	-5.276	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000275

2 8 3

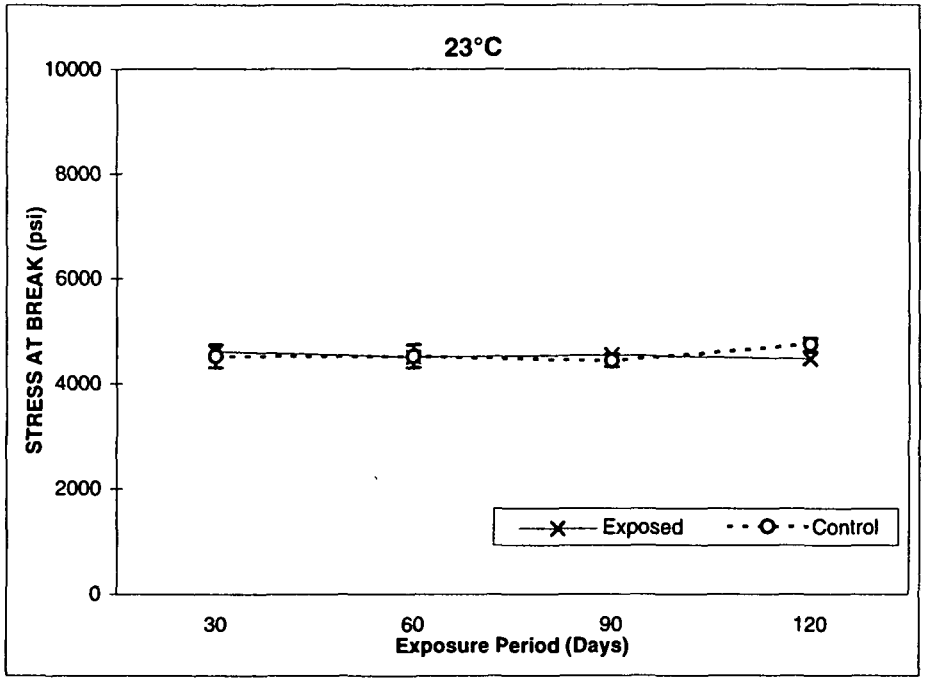
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

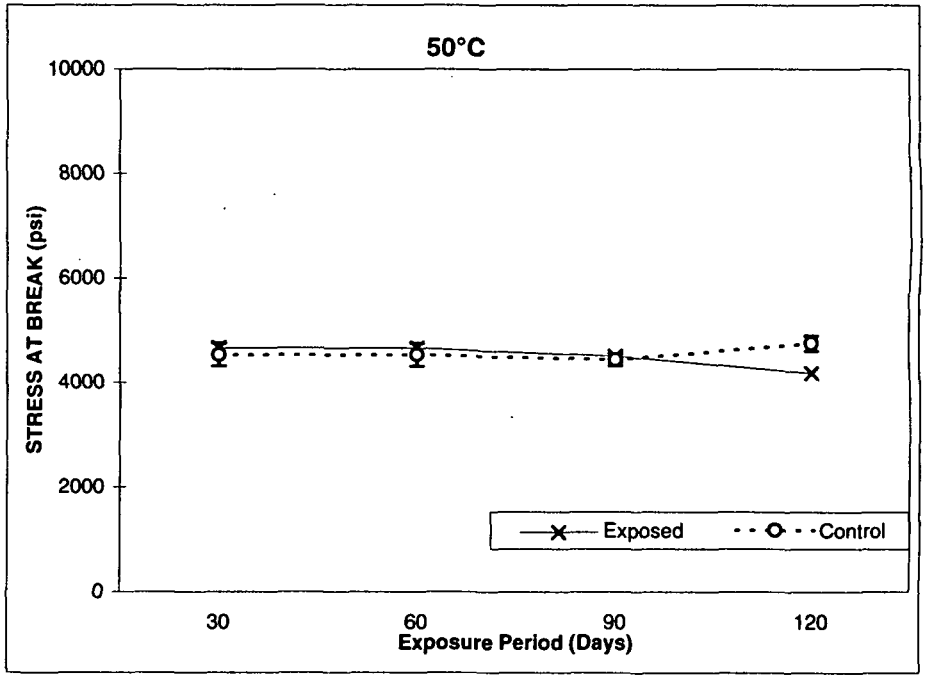
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*NSC*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRESS AT BREAK (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	4157.5	4722.5	4610.0	4645.0	4547.5	4537	221	0.000	4157.5	4722.5	4610.0	4645.0	4547.5	4537	221	0.000	VV
30	4425.0	4622.5	4767.5	4762.5	4520.0	4620	150	1.830	4510.0	4620.0	4777.5	4725.0	4692.5	4665	104	2.833	VV
Control	4157.5	4722.5	4610.0	4645.0	4547.5	4537	221	0.000	4157.5	4722.5	4610.0	4645.0	4547.5	4537	221	0.000	WM
60	4920.0	4607.5	4310.0	4465.0	4320.0	4525	252	-0.265	4747.5	4635.0	4942.5	4360.0	4645.0	4666	211	2.855	VV
Control	4435.0	4247.5	4522.5	4480.0	4555.0	4448	121	0.000	4435.0	4247.5	4522.5	4480.0	4555.0	4448	121	0.000	WM
90	4657.5	4630.0	4407.5	4670.0	4432.5	4560	128	2.507	4770.0	4675.0	4892.5	3762.5	4455.0	4511	448	1.416	VV
Control	4937.5	4565.0	4667.5	4832.5	4790.0	4759	145	0.000	4937.5	4565.0	4667.5	4832.5	4790.0	4759	145	0.000	WM
120	4567.5	4430.0	4527.5	4542.5	4342.5	4482	94	-5.811	4282.5	3927.5	4302.5	3877.5	4535.0	4185	277	-12.052	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000276

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

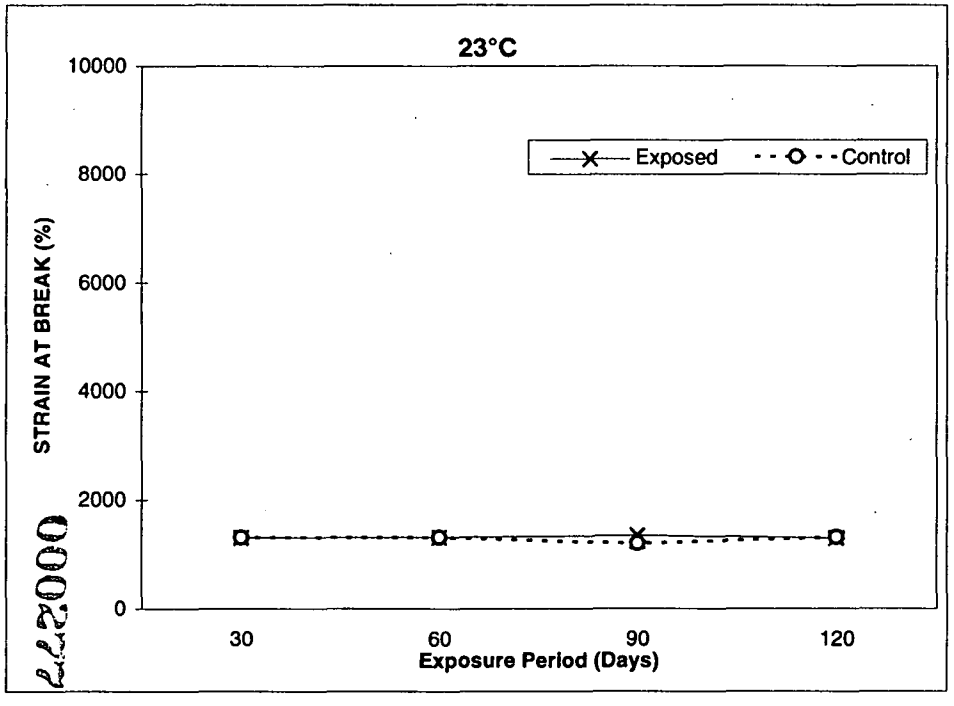
CHEMICAL COMPATIBILITY TEST RESULTS

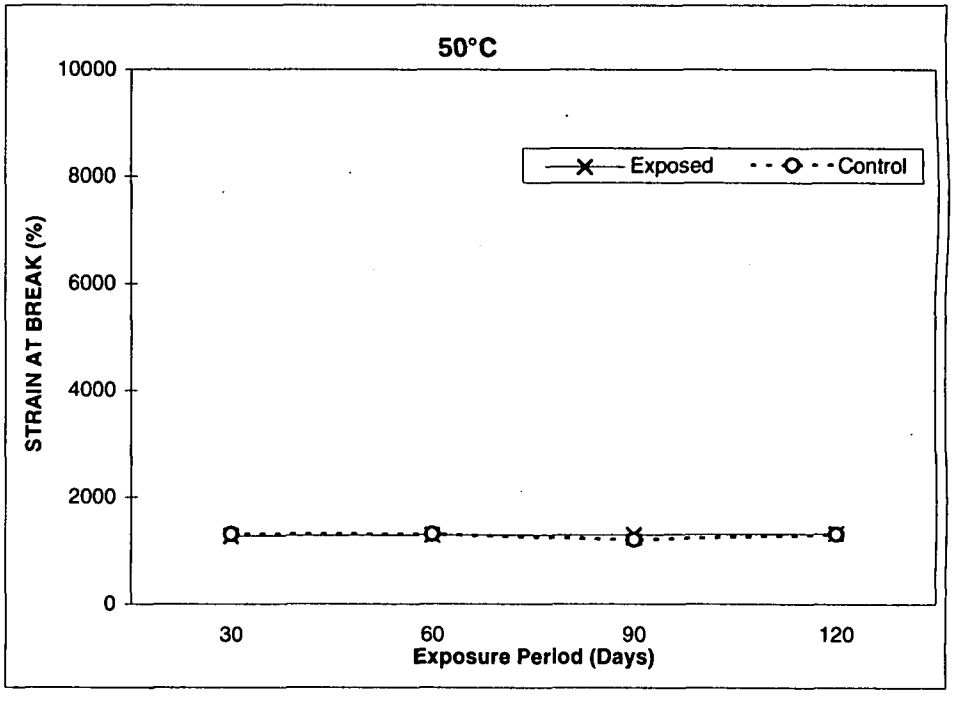
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1287	1338	1294	1322	1308	1310	21	0.000	1287	1338	1294	1322	1308	1310	21	0.000	VV
30	1295	1303	1278	1352	1285	1303	29	-0.550	1271	1277	1278	1277	1264	1273	6	-2.779	VV
Control	1287	1338	1294	1322	1308	1310	21	0.000	1287	1338	1294	1322	1308	1310	21	0.000	WM
60	1318	1265	1334	1319	1307	1309	26	-0.092	1242	1295	1318	1326	1293	1295	33	-1.145	VV
Control	1088	1233	1278	1142	1278	1204	85	0.000	1088	1233	1278	1142	1278	1204	85	0.000	WM
90	1400	1352	1325	1292	1349	1344	40	11.613	1322	1296	1228	1309	1303	1292	37	7.294	VV
Control	1358	1318	1300	1293	1296	1313	27	0.000	1358	1318	1300	1293	1296	1313	27	0.000	WM
120	1361	1296	1291	1315	1220	1297	51	-1.249	1342	1320	1309	1330	1324	1325	12	0.914	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

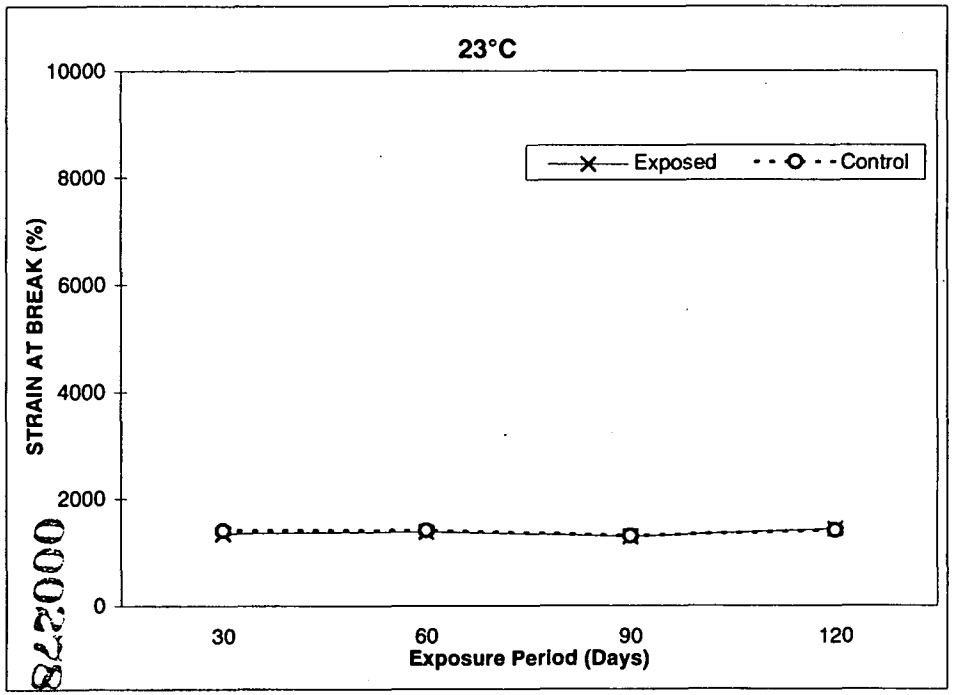
CHEMICAL COMPATIBILITY TEST RESULTS

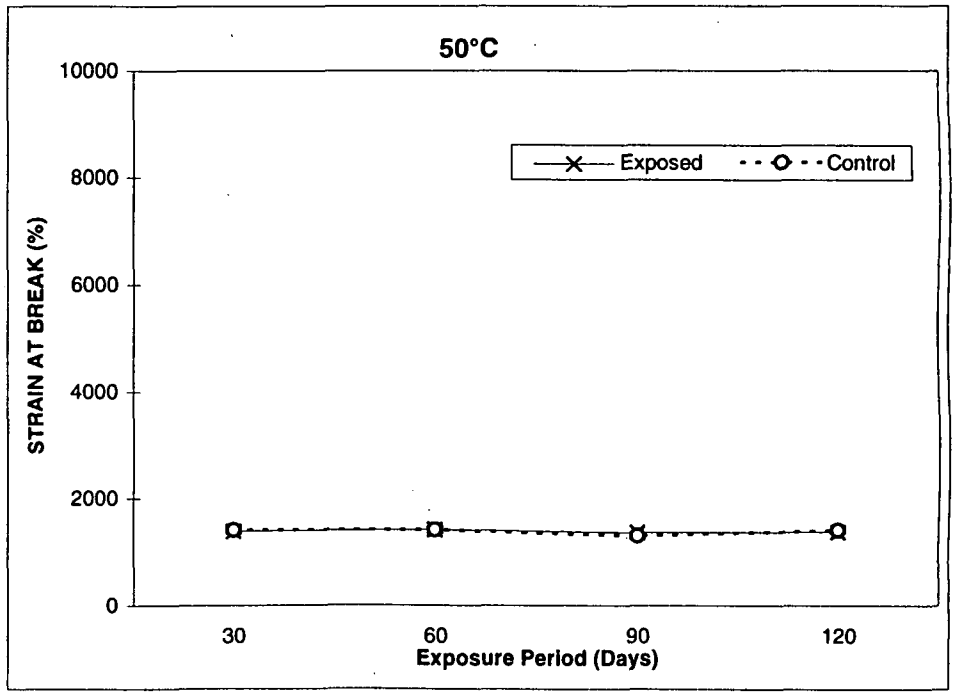
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1304	1455	1428	1438	1409	1407	60	0.000	1304	1455	1428	1438	1409	1407	60	0.000	VV
30	1307	1357	1384	1385	1321	1351	36	-3.981	1348	1368	1407	1401	1392	1383	25	-1.678	VV
Control	1304	1455	1428	1438	1409	1407	60	0.000	1304	1455	1428	1438	1409	1407	60	0.000	WM
60	1487	1398	1315	1364	1325	1378	69	-2.061	1430	1402	1473	1329	1398	1406	53	-0.028	VV
Control	1297	1249	1321	1310	1325	1300	31	0.000	1297	1249	1321	1310	1325	1300	31	0.000	WM
90	1307	1302	1259	1312	1272	1290	23	-0.769	1422	1407	1467	1172	1349	1363	115	4.845	VV
Control	1458	1344	1375	1425	1400	1400	44	0.000	1458	1344	1375	1425	1400	1400	44	0.000	WM
120	1436	1467	1424	1436	1380	1429	31	2.014	1443	1280	1391	1264	1460	1368	91	-2.342	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

842000

F-382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

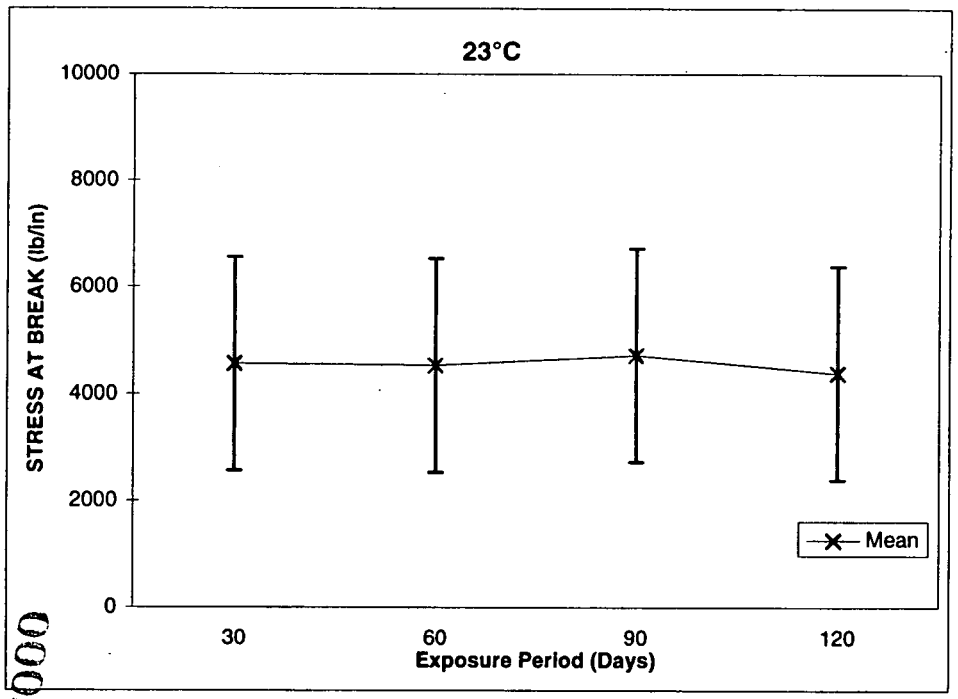
CHEMICAL COMPATIBILITY TEST RESULTS

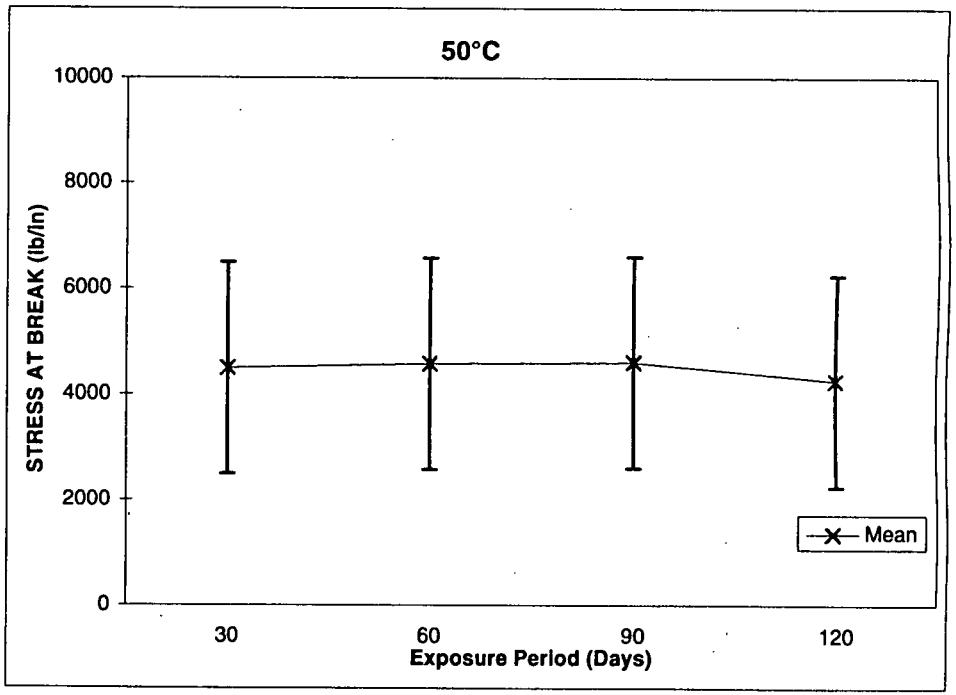
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (lbs/in)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	4492.5	4600.0	4455.0	4565.0	4487.5	4520	60	0.0	4492.5	4600.0	4455.0	4565.0	4487.5	4520	60	0.0	VV
30	4535.0	4582.5	4450.0	4775.0	4480.0	4565	128	1.0	4482.5	4517.5	4532.5	4510.0	4460.0	4501	29	-0.4	VV
60	4552.5	4365.0	4625.0	4585.0	4537.5	4533	100	0.3	4340.0	4567.5	4687.5	4727.5	4587.5	4582	151	1.4	VV
90	4942.5	4727.5	4642.5	4555.0	4757.5	4725	145	4.5	4740.0	4630.0	4352.5	4647.5	4635.0	4601	146	1.8	VV
120	4650.0	4322.5	4395.0	4510.0	4085.0	4393	212	-2.8	3925.0	4325.0	4375.0	4302.5	4302.5	4246	182	-6.1	WM





© 1996 GEOSYNTEC CONSULTANTS

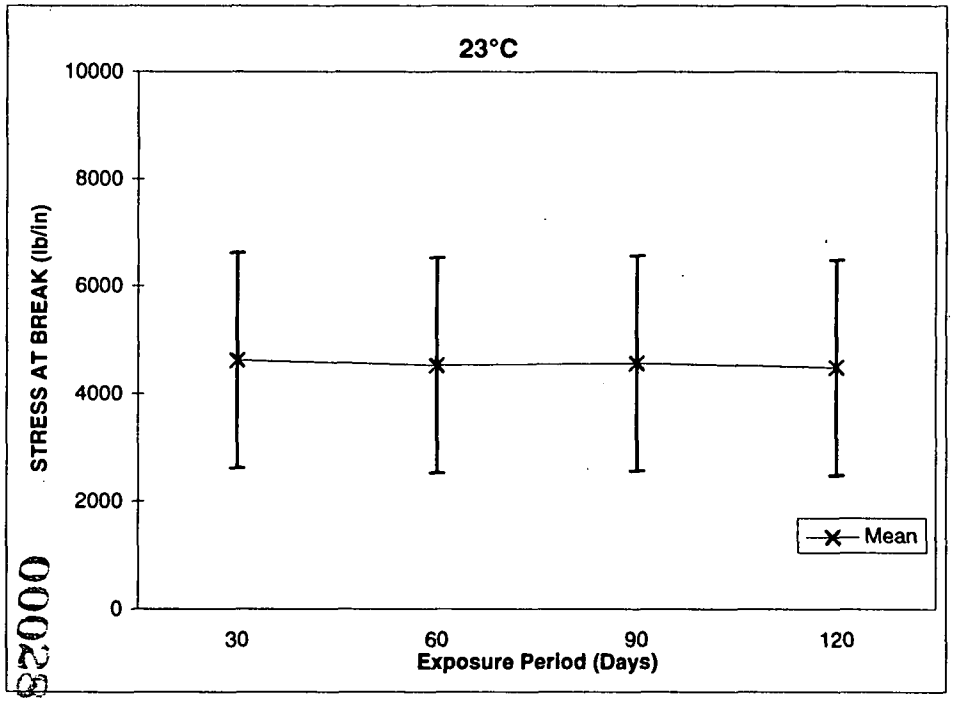
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

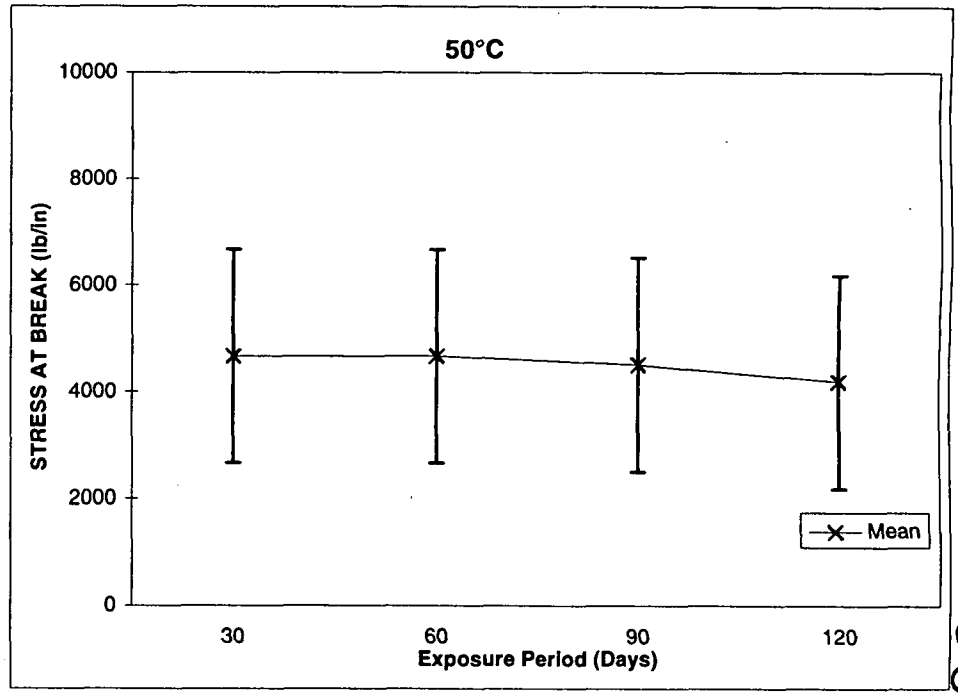
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*NSC*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRESS AT BREAK (lbs/in)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	4157.5	4722.5	4610.0	4645.0	4547.5	4537	221	0.0	4157.5	4722.5	4610.0	4645.0	4547.5	4537	221	0.0	VV
30	4425.0	4622.5	4767.5	4762.5	4520.0	4620	150	1.8	4510.0	4620.0	4777.5	4725.0	4692.5	4665	104	2.8	VV
60	4920.0	4607.5	4310.0	4465.0	4320.0	4525	252	-0.3	4747.5	4635.0	4942.5	4360.0	4645.0	4666	211	2.9	VV
90	4657.5	4630.0	4407.5	4670.0	4432.5	4560	128	0.5	4770.0	4675.0	4892.5	3762.5	4455.0	4511	448	-0.6	VV
120	4567.5	4430.0	4527.5	4542.5	4342.5	4482	94	-1.2	4282.5	3927.5	4302.5	3877.5	4535.0	4185	277	-7.7	WM





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

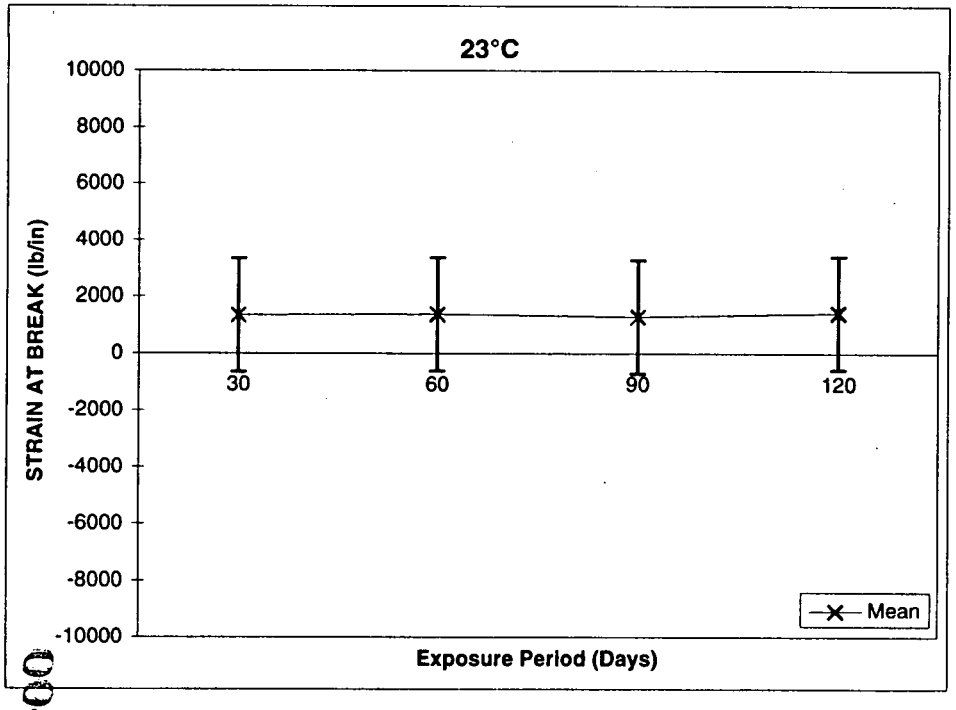
CHEMICAL COMPATIBILITY TEST RESULTS

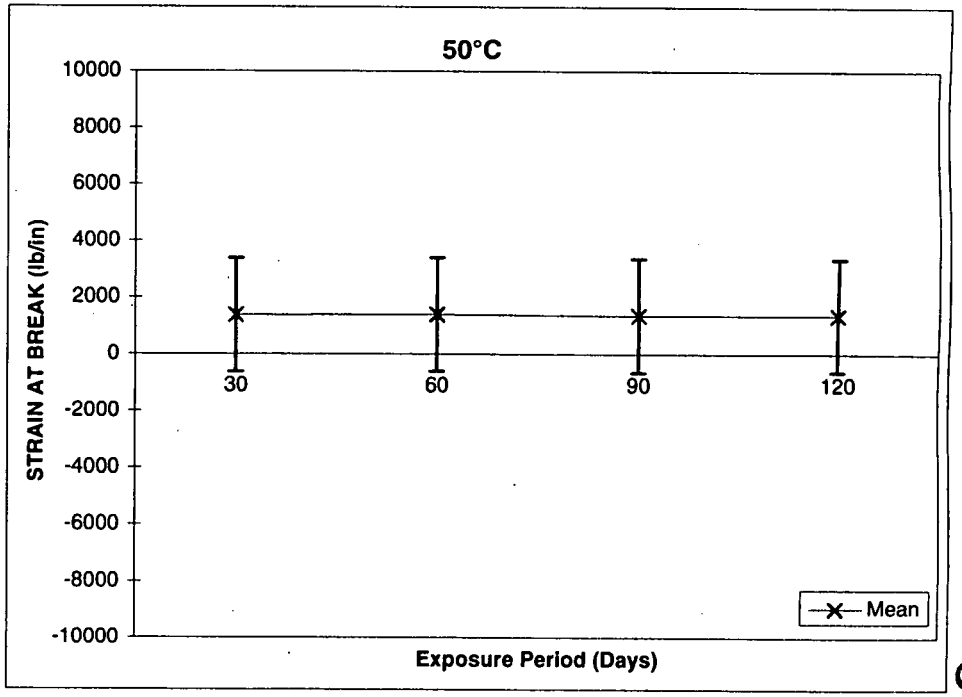
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1304	1455	1428	1438	1409	1407	60	0.0	1304	1455	1428	1438	1409	1407	60	0.0	VV
30	1307	1357	1384	1385	1321	1351	36	-4.0	1348	1368	1407	1401	1392	1383	25	-1.7	VV
60	1487	1398	1315	1364	1325	1378	69	-2.1	1430	1402	1473	1329	1398	1406	53	0.0	VV
90	1307	1302	1259	1312	1272	1290	23	-8.3	1422	1407	1467	1172	1349	1363	115	-3.1	VV
120	1436	1467	1424	1436	1380	1429	31	1.5	1443	1280	1391	1264	1460	1368	91	-2.8	WM





© 1996 GEOSYNTEC CONSULTANTS

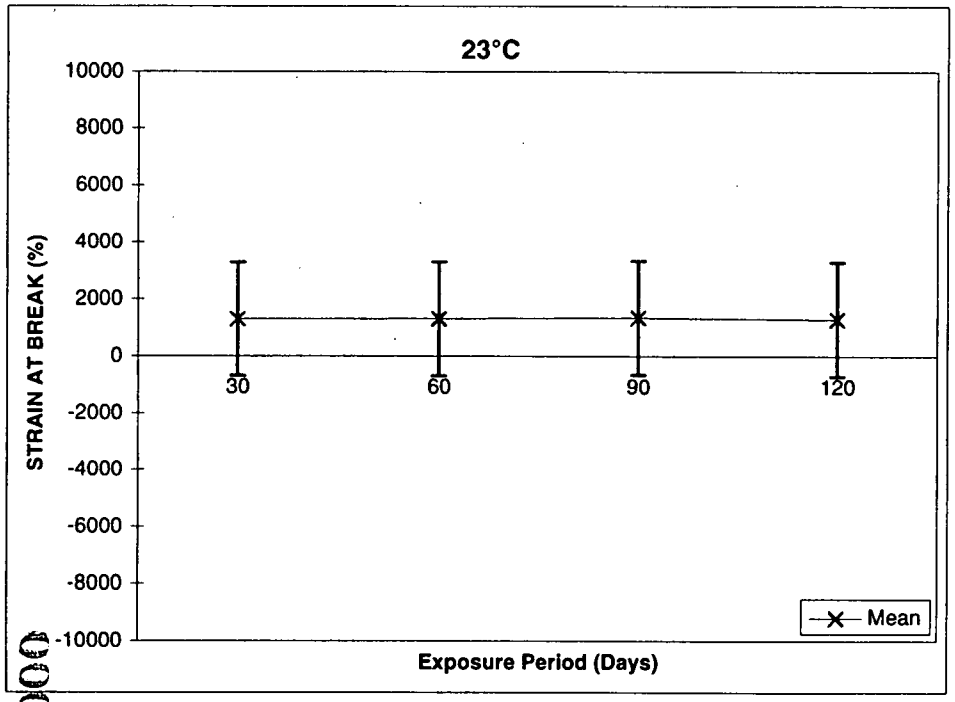
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

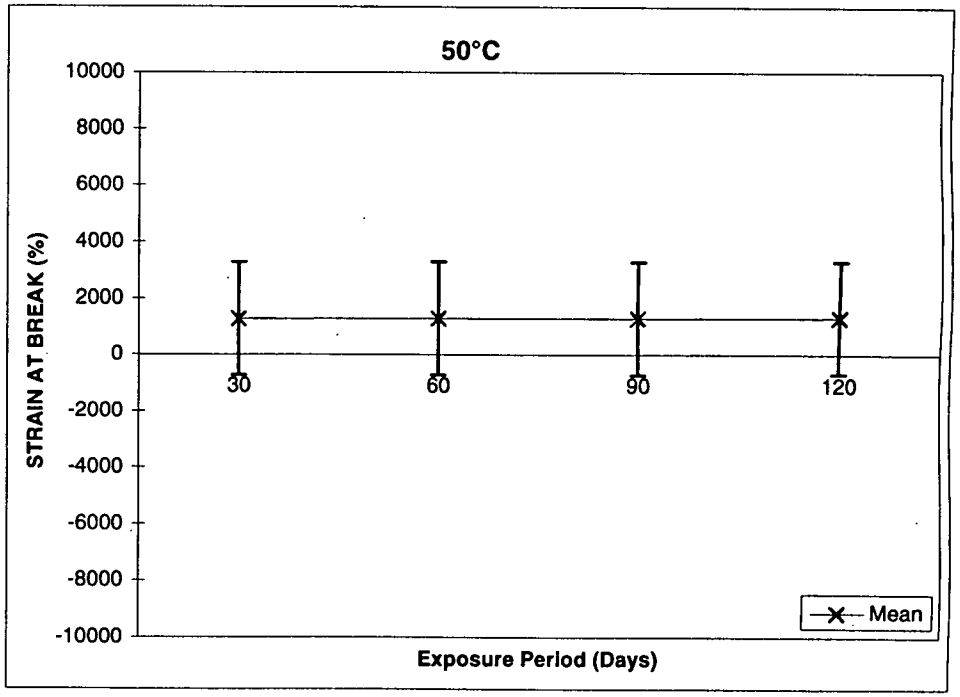
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*NSC*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	1287	1338	1294	1322	1308	1310	21	0.0	1287	1338	1294	1322	1308	1310	21	0.0	VV
30	1295	1303	1278	1352	1285	1303	29	-0.5	1271	1277	1278	1277	1264	1273	6	-2.8	VV
60	1318	1265	1334	1319	1307	1309	26	-0.1	1242	1295	1318	1326	1293	1295	33	-1.1	VV
90	1400	1352	1325	1292	1349	1344	40	2.6	1322	1296	1228	1309	1303	1292	37	-1.4	VV
120	1361	1296	1291	1315	1220	1297	51	-1.0	1342	1320	1309	1330	1324	1325	12	1.2	WM





© 1996 GEOSYNTEC CONSULTANTS

0002282

387

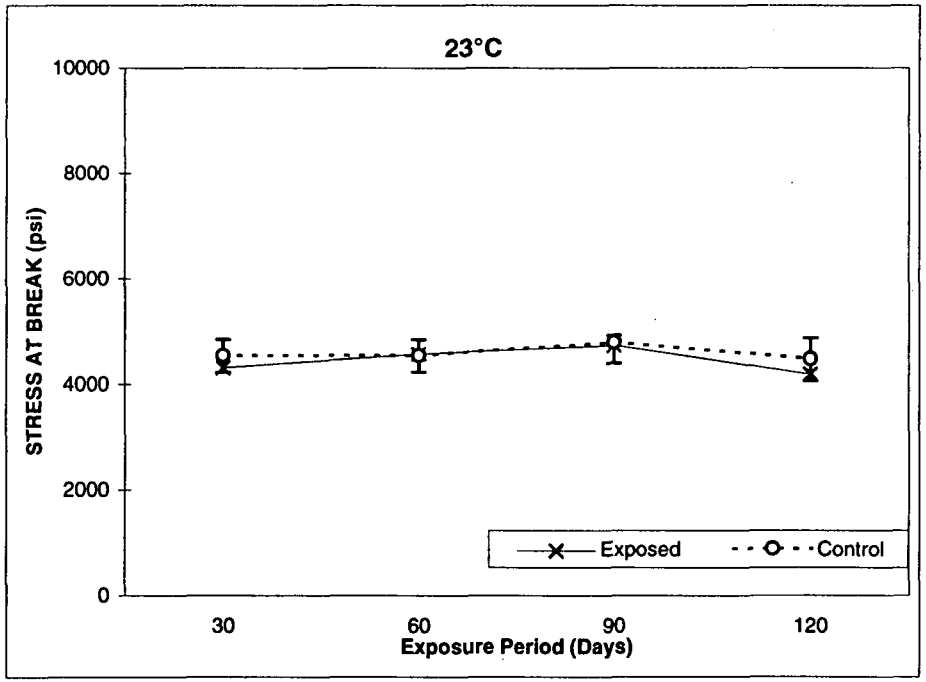
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

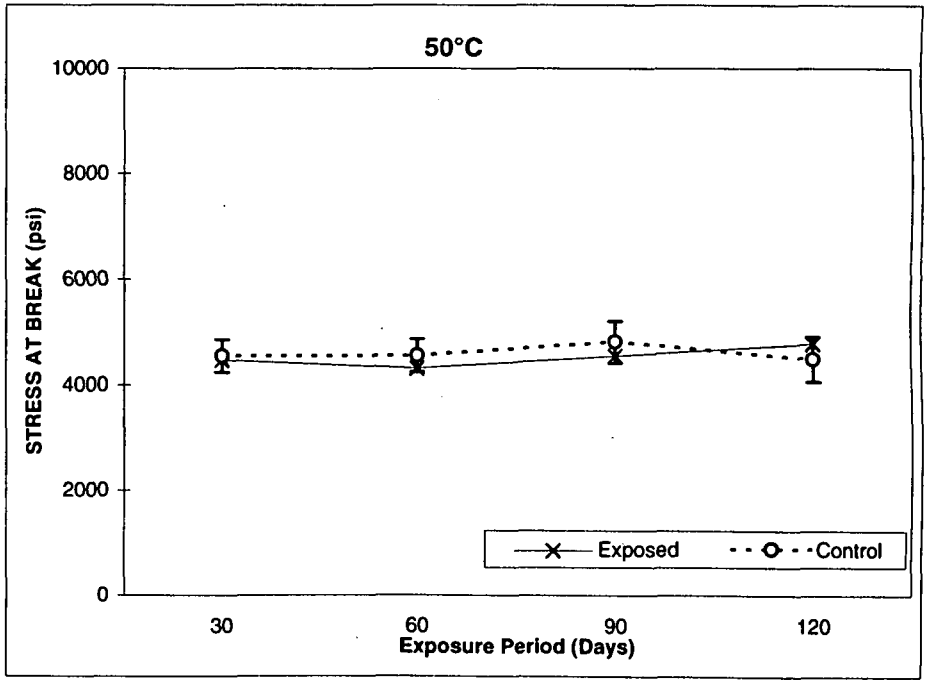
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*GSE Gundle*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRESS AT BREAK (psi)
DIRECTION: ROLL

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	4630.0	4775.0	4002.5	4672.5	4657.5	4548	310	0.000	4630.0	4775.0	4002.5	4672.5	4657.5	4548	310	0.000	VV
30	4837.5	4565.0	3235.0	4880.0	4072.5	4318	686	-5.047	4647.5	4300.0	4740.0	4025.0	4627.5	4468	298	-1.748	VV
Control	4630.0	4775.0	4002.5	4672.5	4657.5	4548	310	0.000	4630.0	4775.0	4002.5	4672.5	4657.5	4548	310	0.000	WM
60	3906.3	4475.0	4731.3	4775.0	4975.0	4573	413	0.550	4687.5	4393.8	4700.0	3162.5	4568.8	4303	649	-5.388	VV
Control	5280.0	4805.0	4895.0	4177.5	4880.0	4808	398	0.000	5280.0	4805.0	4895.0	4177.5	4880.0	4808	398	0.000	WM
90	4670.0	4740.0	4557.5	4882.5	4862.5	4743	136	-1.352	4177.5	4942.5	5070.0	3977.5	4555.0	4545	472	-5.471	VV
Control	4192.5	4190.0	4997.5	4895.0	4172.5	4490	419	0.000	4192.5	4190.0	4997.5	4895.0	4172.5	4490	419	0.000	WM
120	4272.5	4185.0	3862.5	4135.0	4510.0	4193	234	-6.604	4757.5	5030.0	4550.0	4597.5	4947.5	4777	210	6.393	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000283

! 382

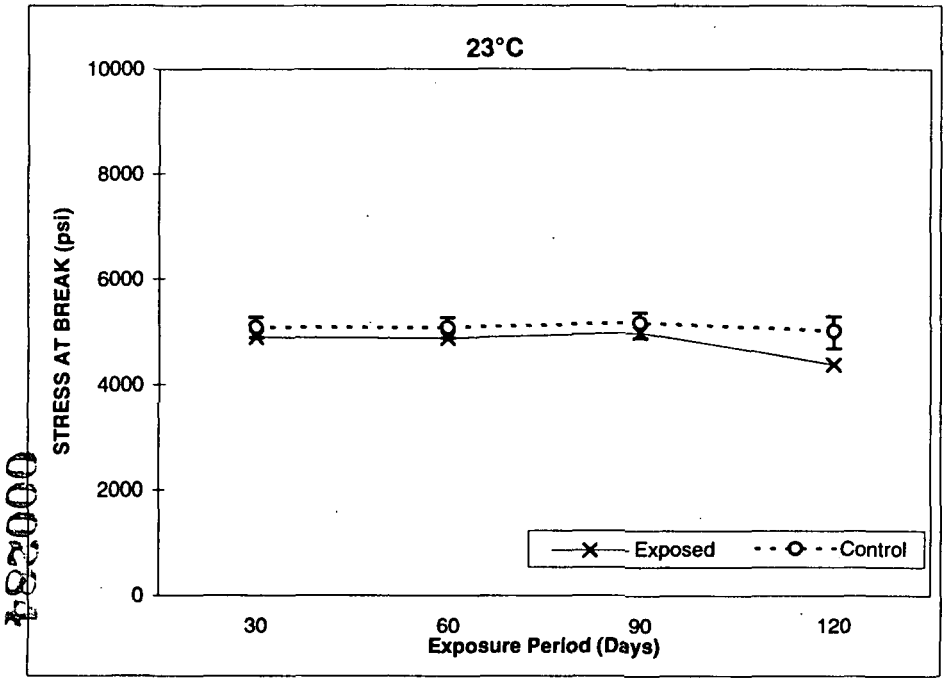
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

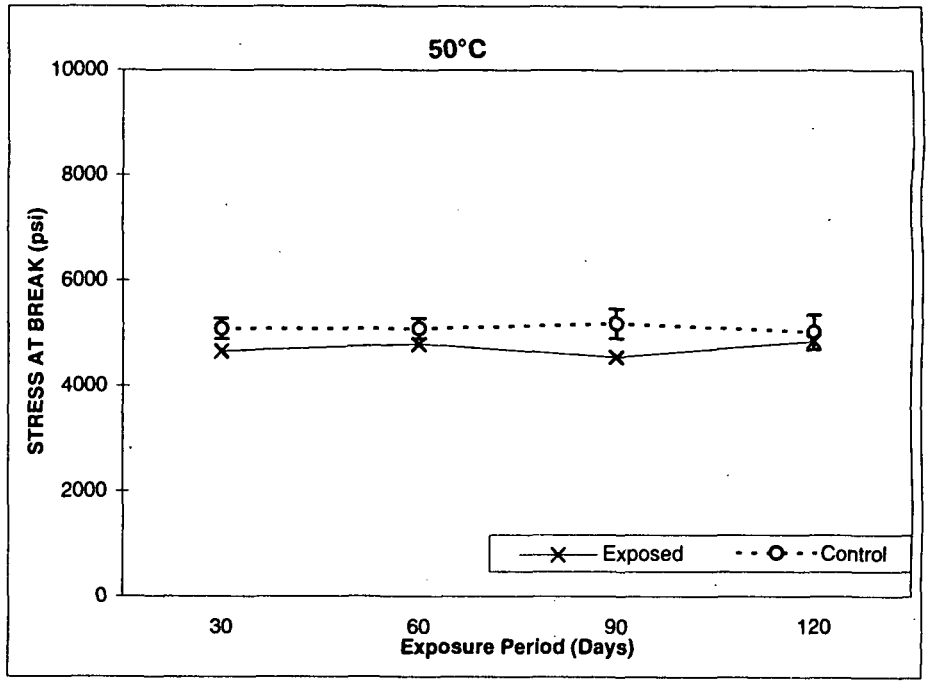
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*GSE Gundle*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRESS AT BREAK (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	5004.9	5211.3	4807.5	5306.8	5097.1	5086	193	0.000	5004.9	5211.3	4807.5	5306.8	5097.1	5086	193	0.000	VV
30	4762.5	4512.5	5175.0	5065.0	4972.5	4898	263	-3.697	4967.5	4420.0	4692.5	4395.0	4775.0	4650	243	-8.564	VV
Control	5004.9	5211.3	4807.5	5306.8	5097.1	5086	193	0.000	5004.9	5211.3	4807.5	5306.8	5097.1	5086	193	0.000	WM
60	4581.3	5000.0	4862.5	4975.0	5015.0	4887	181	-3.908	4275.0	4950.0	5185.0	4687.5	4843.8	4788	339	-5.845	VV
Control	4737.5	5250.0	5410.0	5085.0	5430.0	5183	285	0.000	4737.5	5250.0	5410.0	5085.0	5430.0	5183	285	0.000	WM
90	5015.0	4952.5	5315.0	4757.5	4937.5	4996	203	-3.608	4177.5	4942.5	5070.0	3977.5	4555.0	4545	472	-12.311	VV
Control	5117.5	5500.0	4587.5	4962.5	4940.0	5022	330	0.000	5117.5	5500.0	4587.5	4962.5	4940.0	5022	330	0.000	WM
120	4880.0	3647.5	5007.5	4220.0	4147.5	4381	561	-12.765	4880.0	4947.5	4670.0	4795.0	4927.5	4844	114	-3.535	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

002084

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

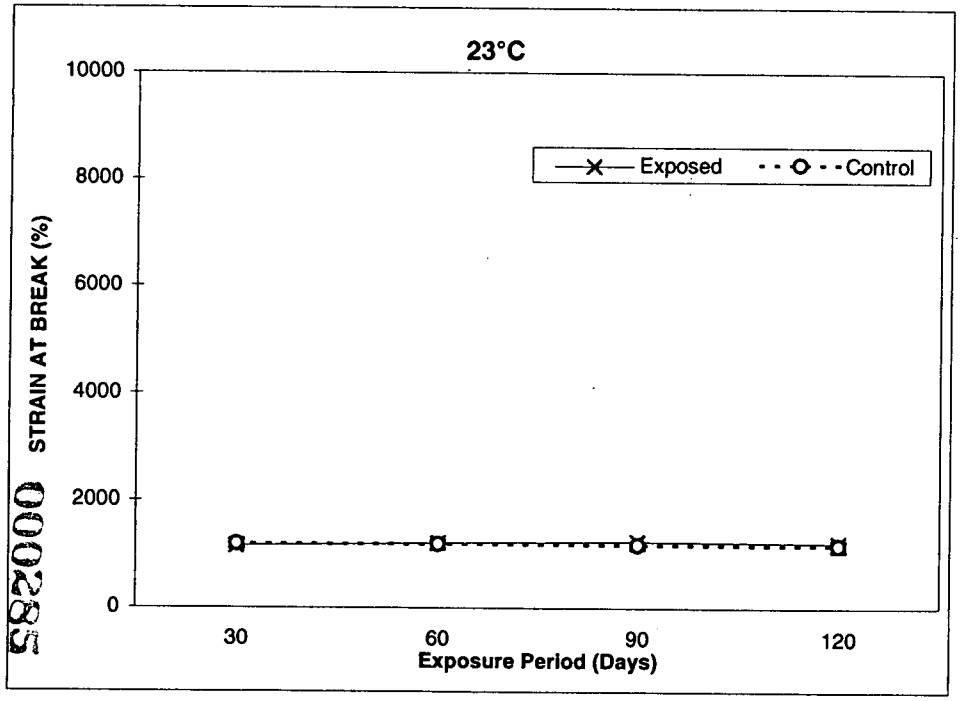
CHEMICAL COMPATIBILITY TEST RESULTS

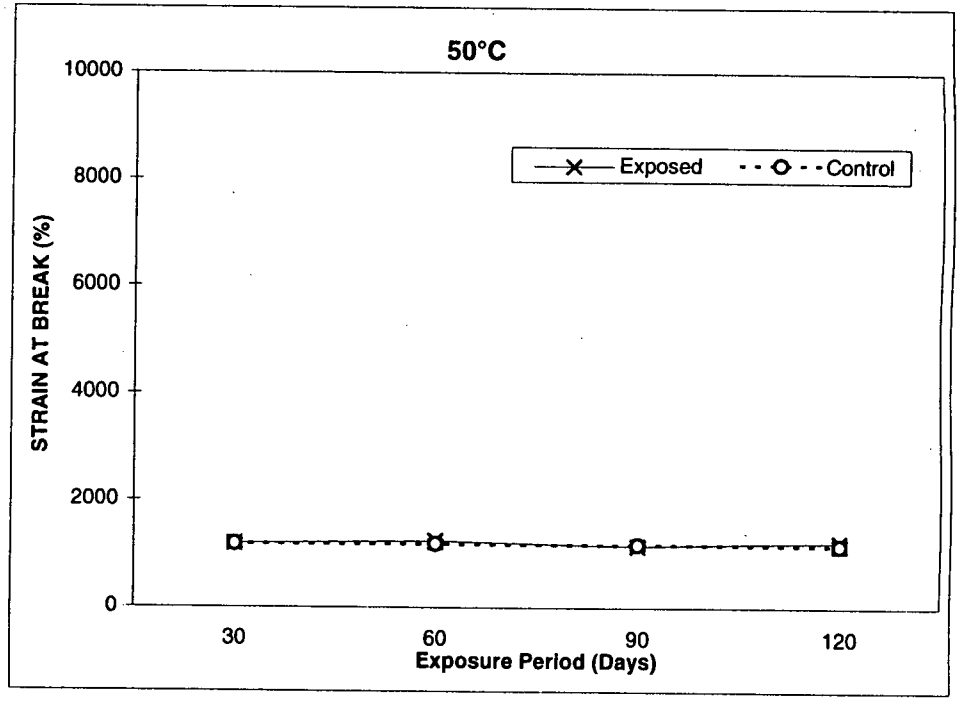
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1187	1222	1043	1246	1223	1184	82	0.000	1187	1222	1043	1246	1223	1184	82	0.000	VV
30	1228	1167	1063	1241	1044	1149	91	-3.006	1227	1157	1285	1069	1220	1192	82	0.625	VV
Control	1187	1222	1043	1246	1223	1184	82	0.000	1187	1222	1043	1246	1223	1184	82	0.000	WM
60	1036	1193	1256	1236	1302	1205	102	1.723	1266	1174	1247	1303	1215	1241	49	4.796	VV
Control	1275	1177	1194	1043	1196	1177	84	0.000	1275	1177	1194	1043	1196	1177	84	0.000	WM
90	1270	1287	1154	1241	1213	1233	52	4.758	1072	1231	1271	1024	1151	1150	104	-2.311	VV
Control	1047	1047	1241	1223	1287	1169	114	0.000	1047	1047	1241	1223	1287	1169	114	0.000	WM
120	1218	1251	1085	1247	1252	1211	72	3.559	1204	1289	1159	1195	1292	1228	60	5.030	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

002085

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

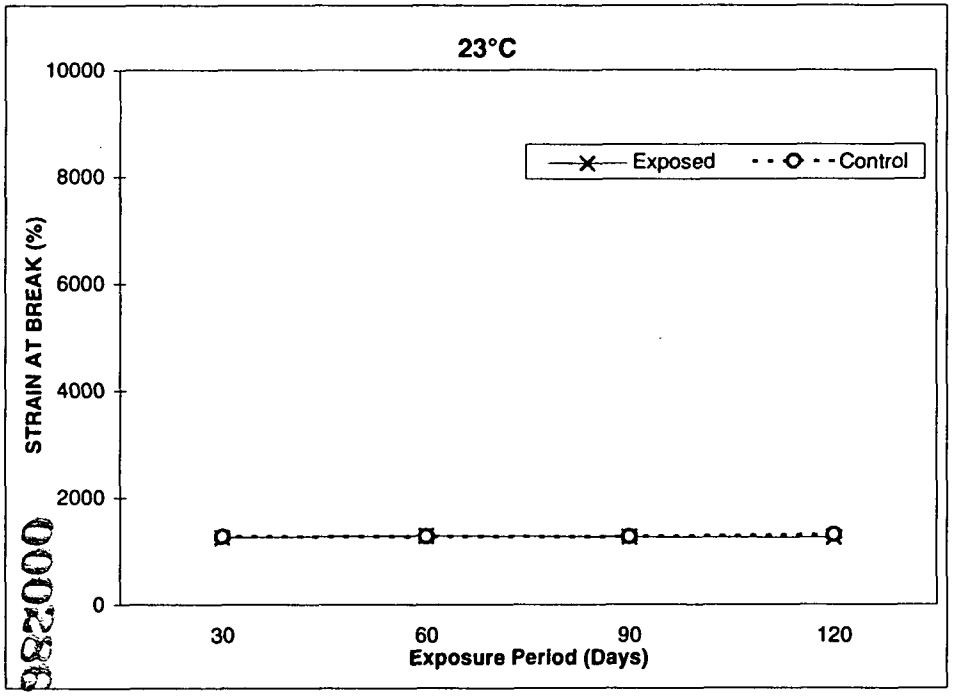
CHEMICAL COMPATIBILITY TEST RESULTS

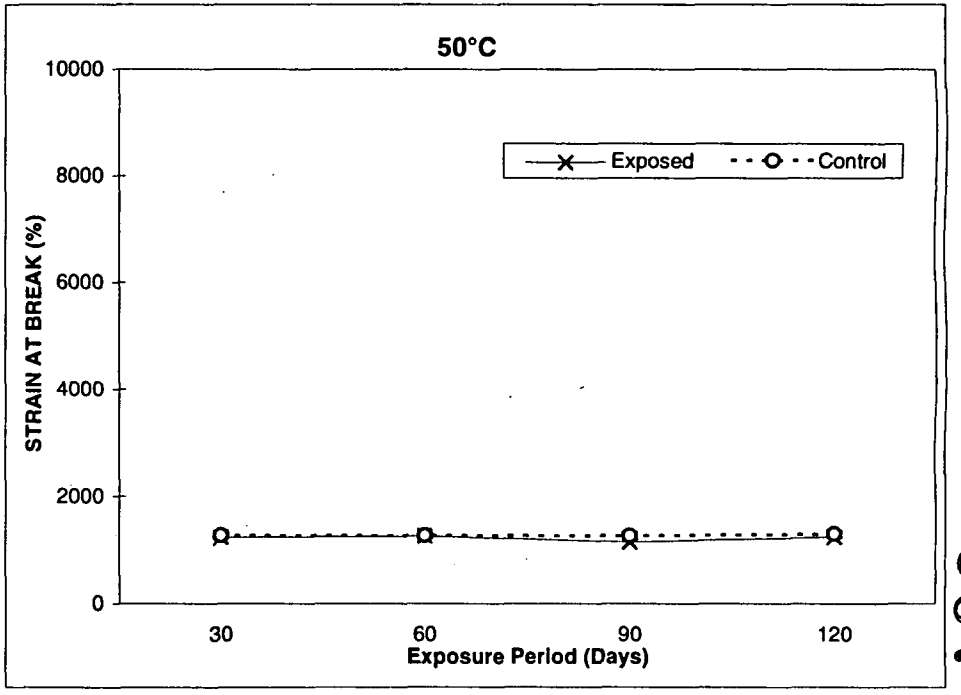
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1254	1315	1208	1320	1272	1274	46	0.000	1254	1315	1208	1320	1272	1274	46	0.000	VV
30	1215	1175	1322	1291	1278	1256	60	-1.382	1298	1197	1252	1175	1280	1240	53	-2.622	VV
Control	1254	1315	1208	1320	1272	1274	46	0.000	1254	1315	1208	1320	1272	1274	46	0.000	WM
60	1218	1318	1282	1308	1325	1290	44	1.287	1139	1295	1368	1232	1279	1263	85	-0.879	VV
Control	1173	1285	1328	1242	1325	1271	65	0.000	1173	1285	1328	1242	1325	1271	65	0.000	WM
90	1273	1257	1345	1212	1248	1267	49	-0.283	1072	1231	1271	1024	1151	1150	104	-9.507	VV
Control	1292	1380	1352	1251	1256	1306	58	0.000	1292	1380	1352	1251	1256	1306	58	0.000	WM
120	1368	1370	1303	1119	1112	1254	130	-3.966	1262	1276	1205	1235	1267	1249	29	-4.379	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

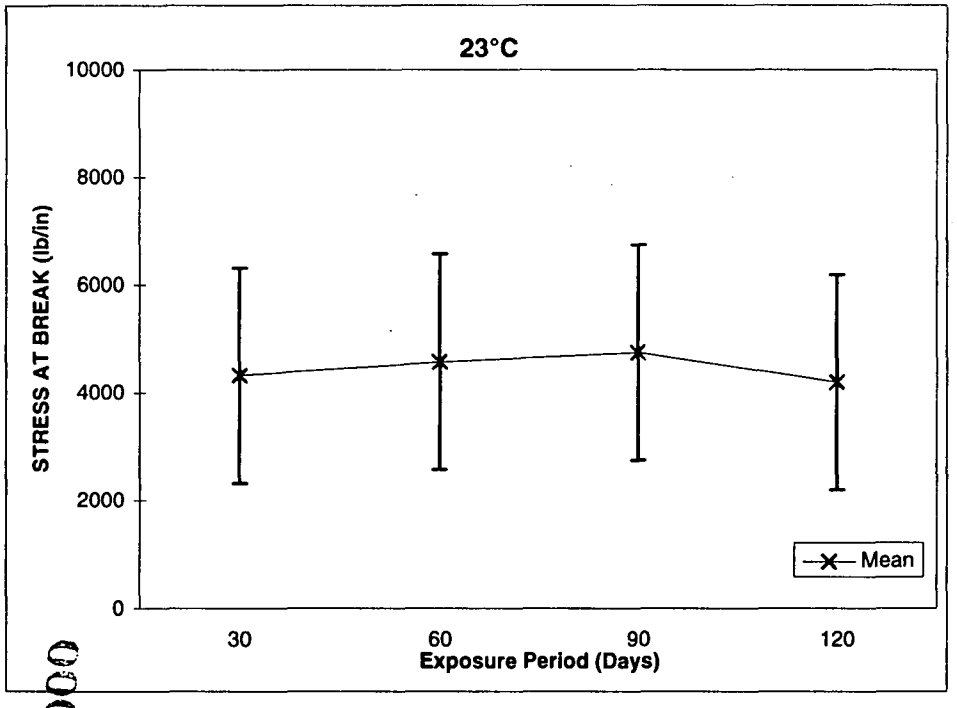
CHEMICAL COMPATIBILITY TEST RESULTS

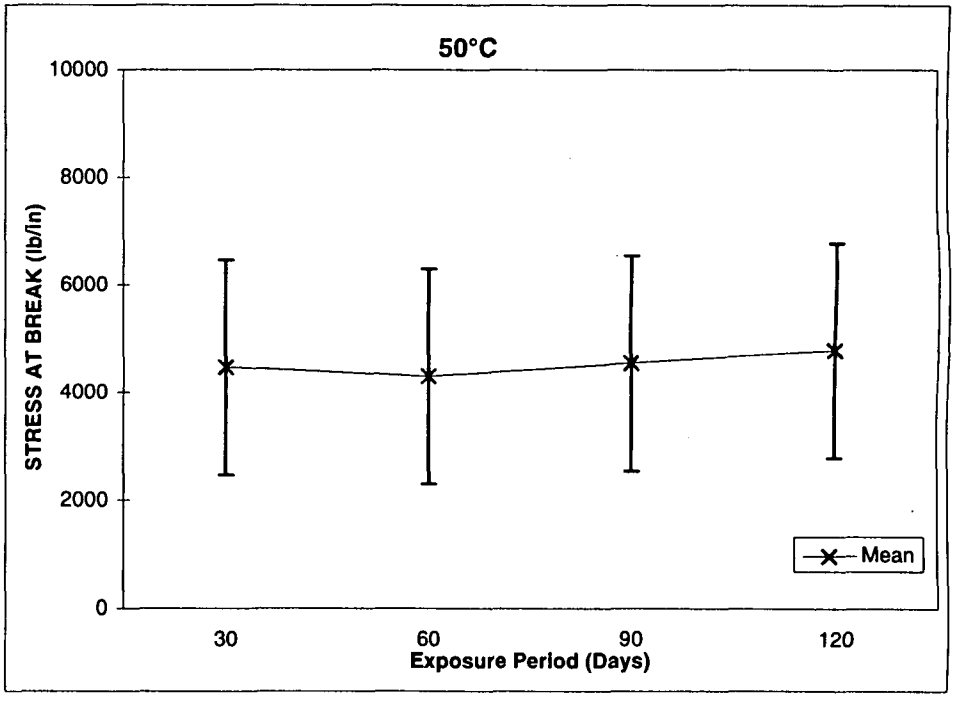
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (lbs/in)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	4630.0	4775.0	4002.5	4672.5	4657.5	4548	310	0.0	4630.0	4775.0	4002.5	4672.5	4657.5	4548	310	0.0	VV
30	4837.5	4565.0	3235.0	4880.0	4072.5	4318	686	-5.0	4647.5	4300.0	4740.0	4025.0	4627.5	4468	298	-1.7	VV
60	3906.3	4475.0	4731.3	4775.0	4975.0	4573	413	0.5	4687.5	4393.8	4700.0	3162.5	4568.8	4303	649	-5.4	VV
90	4670.0	4740.0	4557.5	4882.5	4862.5	4743	136	4.3	4177.5	4942.5	5070.0	3977.5	4555.0	4545	472	-0.1	VV
120	4272.5	4185.0	3862.5	4135.0	4510.0	4193	234	-7.8	4757.5	5030.0	4550.0	4597.5	4947.5	4777	210	5.0	WM





© 1996 GEOSYNTEC CONSULTANTS

000287

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

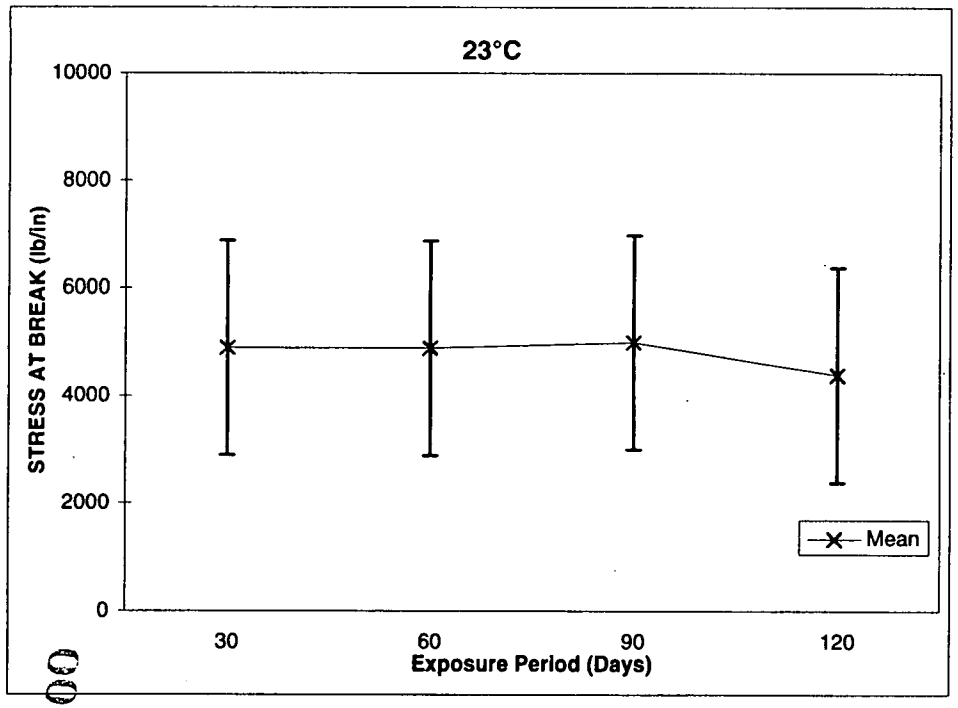
CHEMICAL COMPATIBILITY TEST RESULTS

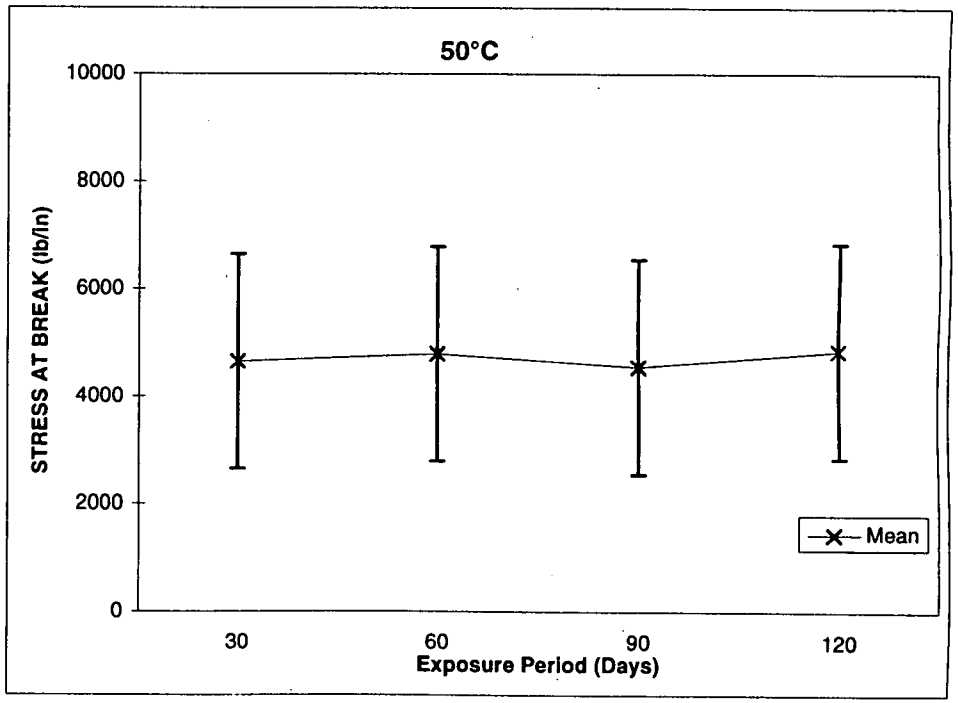
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (lbs/in)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	5004.9	5211.3	4807.5	5306.8	5097.1	5086	193	0.0	5004.9	5211.3	4807.5	5306.8	5097.1	5086	193	0.0	VV
30	4762.5	4512.5	5175.0	5065.0	4972.5	4898	263	-3.7	4967.5	4420.0	4692.5	4395.0	4775.0	4650	243	-8.6	VV
60	4581.3	5000.0	4862.5	4975.0	5015.0	4887	181	-3.9	4275.0	4950.0	5185.0	4687.5	4843.8	4788	339	-5.8	VV
90	5015.0	4952.5	5315.0	4757.5	4937.5	4996	203	-1.8	4177.5	4942.5	5070.0	3977.5	4555.0	4545	472	-10.6	VV
120	4880.0	3647.5	5007.5	4220.0	4147.5	4381	561	-13.9	4880.0	4947.5	4670.0	4795.0	4927.5	4844	114	-4.7	WM





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

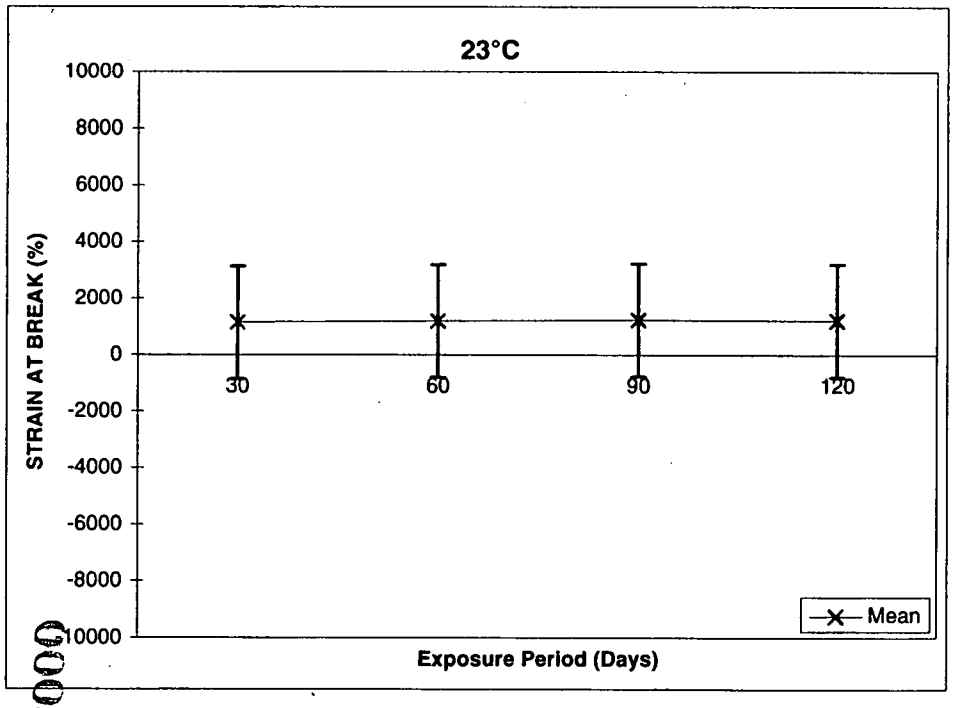
CHEMICAL COMPATIBILITY TEST RESULTS

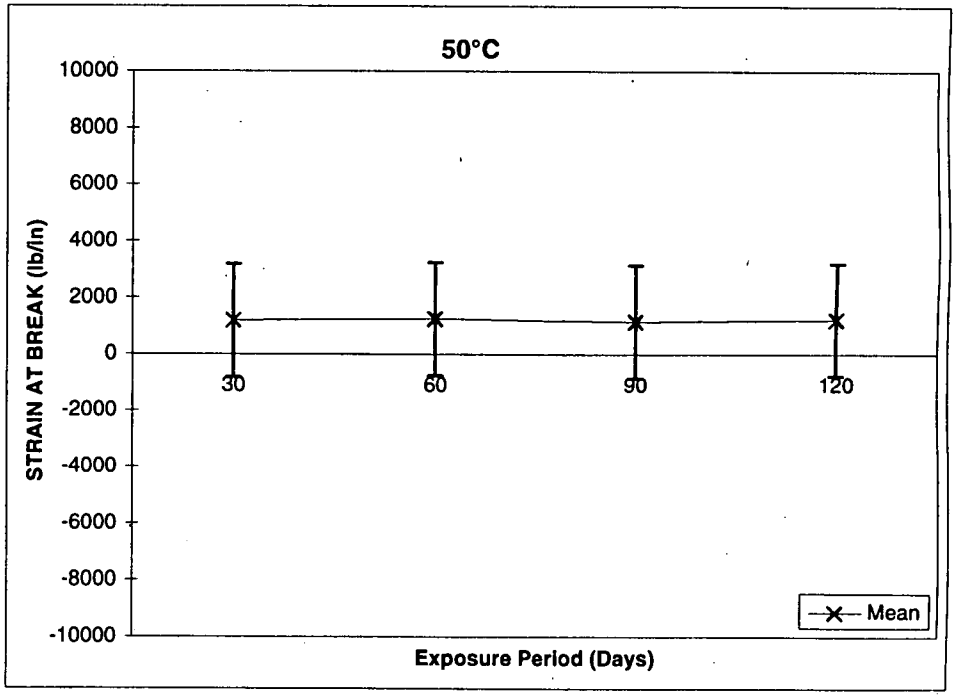
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1187	1222	1043	1246	1223	1184	82	0.0	1187	1222	1043	1246	1223	1184	82	0.0	VV
30	1228	1167	1063	1241	1044	1149	91	-3.0	1227	1157	1285	1069	1220	1192	82	0.6	VV
60	1036	1193	1256	1236	1302	1205	102	1.7	1266	1174	1247	1303	1215	1241	49	4.8	VV
90	1270	1287	1154	1241	1213	1233	52	4.1	1072	1231	1271	1024	1151	1150	104	-2.9	VV
120	1218	1251	1085	1247	1252	1211	72	2.2	1204	1289	1159	1195	1292	1228	60	3.7	WM





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

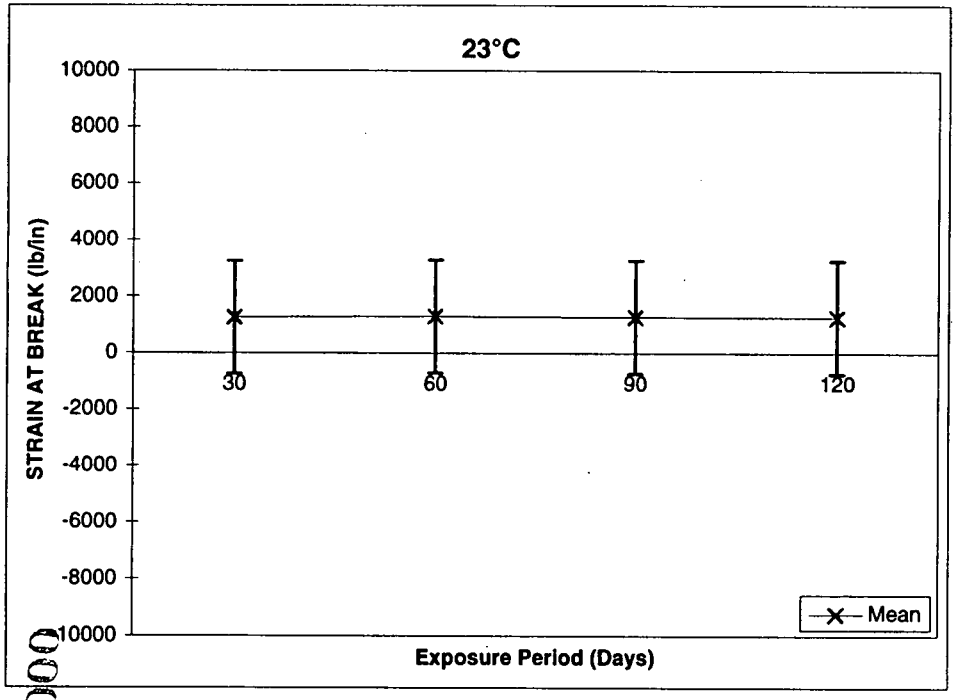
CHEMICAL COMPATIBILITY TEST RESULTS

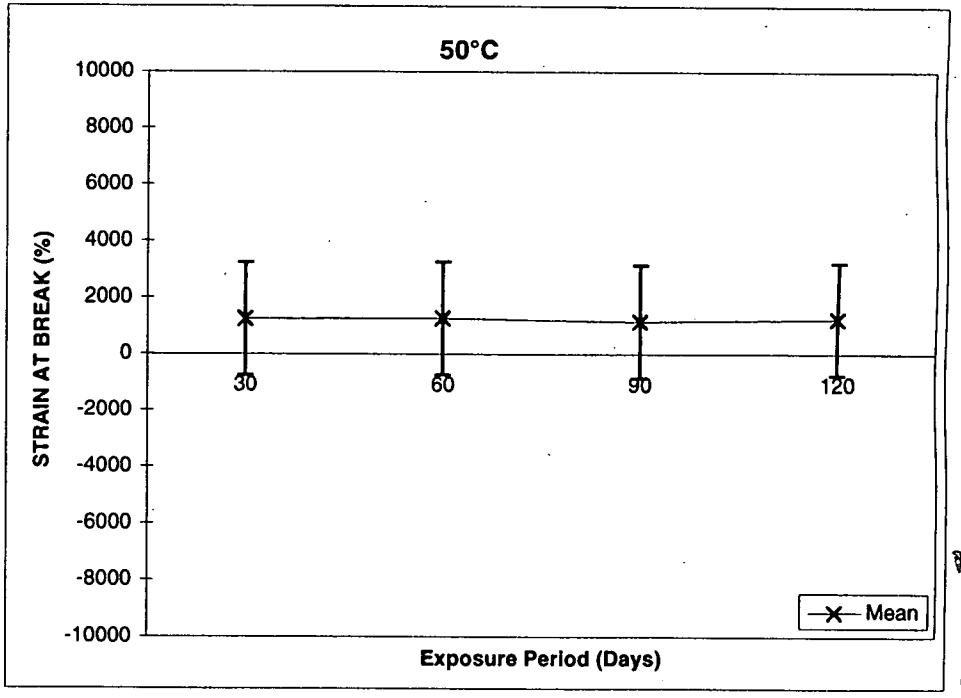
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1254	1315	1208	1320	1272	1274	46	0.0	1254	1315	1208	1320	1272	1274	46	0.0	VV
30	1215	1175	1322	1291	1278	1256	60	-1.4	1298	1197	1252	1175	1280	1240	53	-2.6	VV
60	1218	1318	1282	1308	1325	1290	44	1.3	1139	1295	1368	1232	1279	1263	85	-0.9	VV
90	1273	1257	1345	1212	1248	1267	49	-0.5	1072	1231	1271	1024	1151	1150	104	-9.7	VV
120	1368	1370	1303	1119	1112	1254	130	-1.5	1262	1276	1205	1235	1267	1249	29	-1.9	WM





© 1996 GEOSYNTEC CONSULTANTS

000250

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

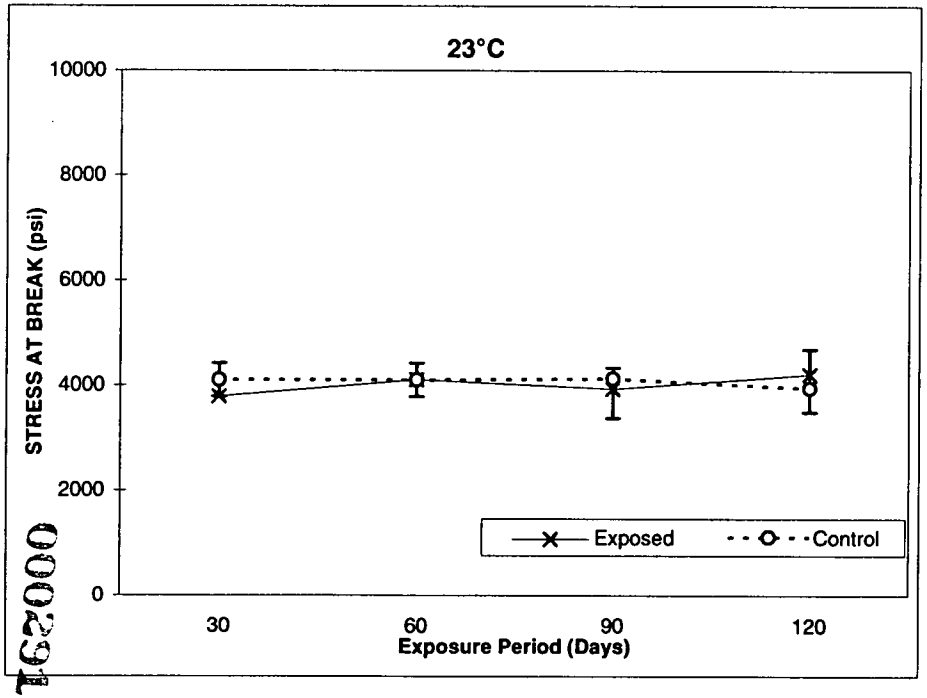
CHEMICAL COMPATIBILITY TEST RESULTS

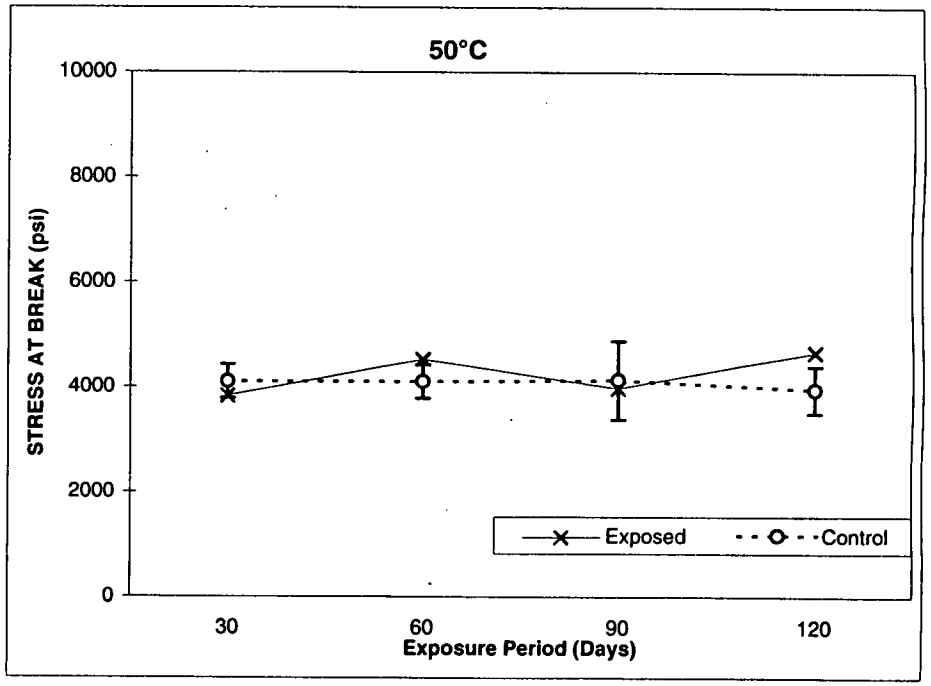
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (psi)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	3737.5	4025.0	4000.0	4162.5	4612.5	4108	321	0.000	3737.5	4025.0	4000.0	4162.5	4612.5	4108	321	0.000	VV
30	4495.0	3765.0	4422.5	2118.8	4127.5	3786	975	-7.833	3875.0	3892.5	3547.5	3862.5	3977.5	3831	165	-6.732	VV
Control	3737.5	4025.0	4000.0	4162.5	4612.5	4108	321	0.000	3737.5	4025.0	4000.0	4162.5	4612.5	4108	321	0.000	WM
60	4287.5	4417.5	3725.0	3915.0	4205.0	4110	283	0.061	4672.5	4265.0	4335.0	4987.5	4385.0	4529	300	10.262	VV
Control	4302.5	3717.5	3070.0	4885.0	4705.0	4136	746	0.000	4302.5	3717.5	3070.0	4885.0	4705.0	4136	746	0.000	WM
90	3760.0	4230.0	3892.5	4085.0	3745.0	3943	211	-4.678	4217.5	3960.0	3537.5	3907.5	4275.0	3980	294	-3.784	VV
Control	3210.0	4342.5	4255.0	3970.0	3990.0	3954	446	0.000	3210.0	4342.5	4255.0	3970.0	3990.0	3954	446	0.000	WM
120	4277.5	4067.5	4115.0	4170.0	4457.5	4218	155	6.678	4862.5	4685.0	4527.5	4832.5	4452.5	4672	181	18.174	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

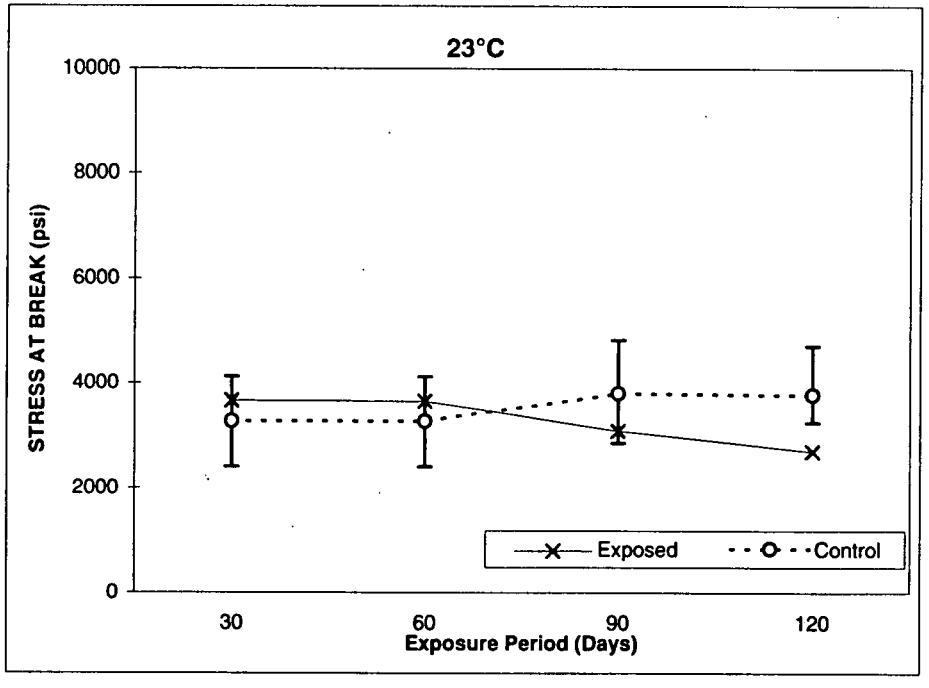
CHEMICAL COMPATIBILITY TEST RESULTS

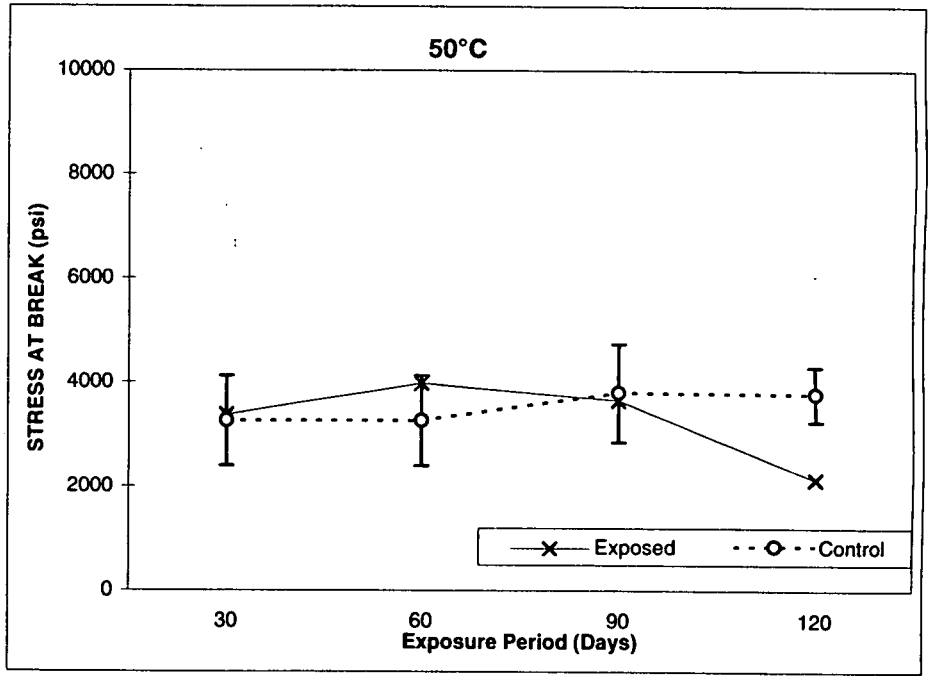
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	3781.3	3343.8	3293.8	1843.8	4081.3	3269	860	0.000	3781.3	3343.8	3293.8	1843.8	4081.3	3269	860	0.000	VV
30	3732.5	1860.0	4532.5	4412.5	3787.5	3665	1071	12.122	3397.5	3217.5	3552.5	2962.5	3745.0	3375	302	3.250	VV
Control	3781.3	3343.8	3293.8	1843.8	4081.3	3269	860	0.000	3781.3	3343.8	3293.8	1843.8	4081.3	3269	860	0.000	WM
60	3877.5	3237.5	4372.5	3357.5	3402.5	3650	472	11.648	3662.5	3737.5	4355.0	4412.5	3743.8	3982	368	21.828	VV
Control	4655.0	2300.0	4430.0	4112.5	3533.8	3806	942	0.000	4655.0	2300.0	4430.0	4112.5	3533.8	3806	942	0.000	WM
90	3187.5	4230.0	3002.5	3565.0	1482.5	3094	1016	-18.726	3917.5	3795.0	3442.5	2720.0	4392.5	3654	623	-4.013	VV
Control	4165.0	4060.0	3415.0	3032.5	4202.5	3775	524	0.000	4165.0	4060.0	3415.0	3032.5	4202.5	3775	524	0.000	WM
120	2610.0	3090.0	3542.5	2095.0	2180.0	2704	614	-28.384	1970.0	2467.5	1785.0	3142.5	1357.5	2145	685	-43.192	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000292

3827

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

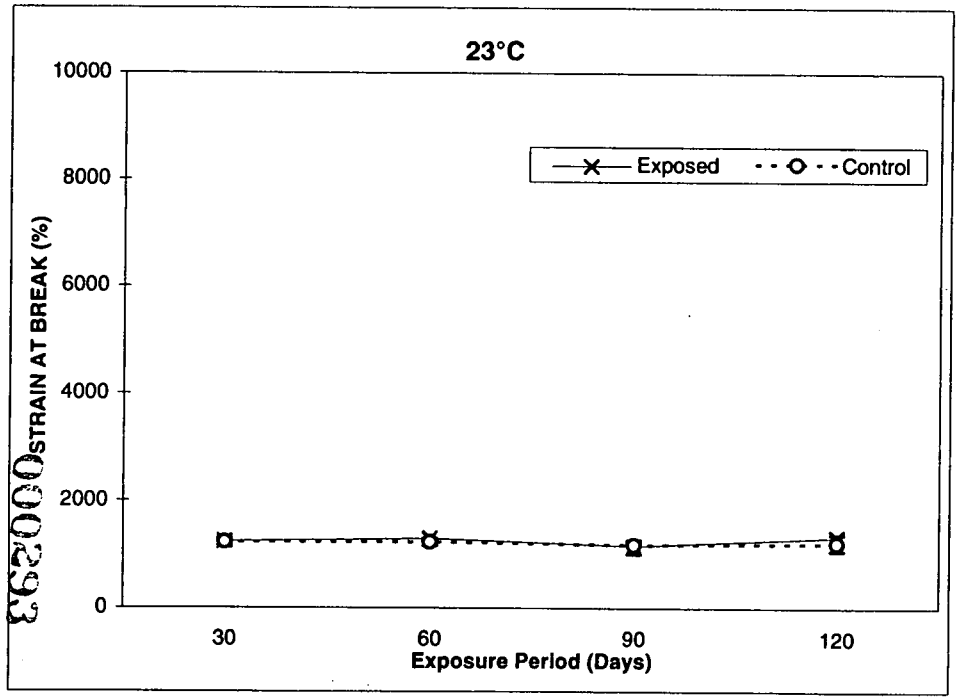
CHEMICAL COMPATIBILITY TEST RESULTS

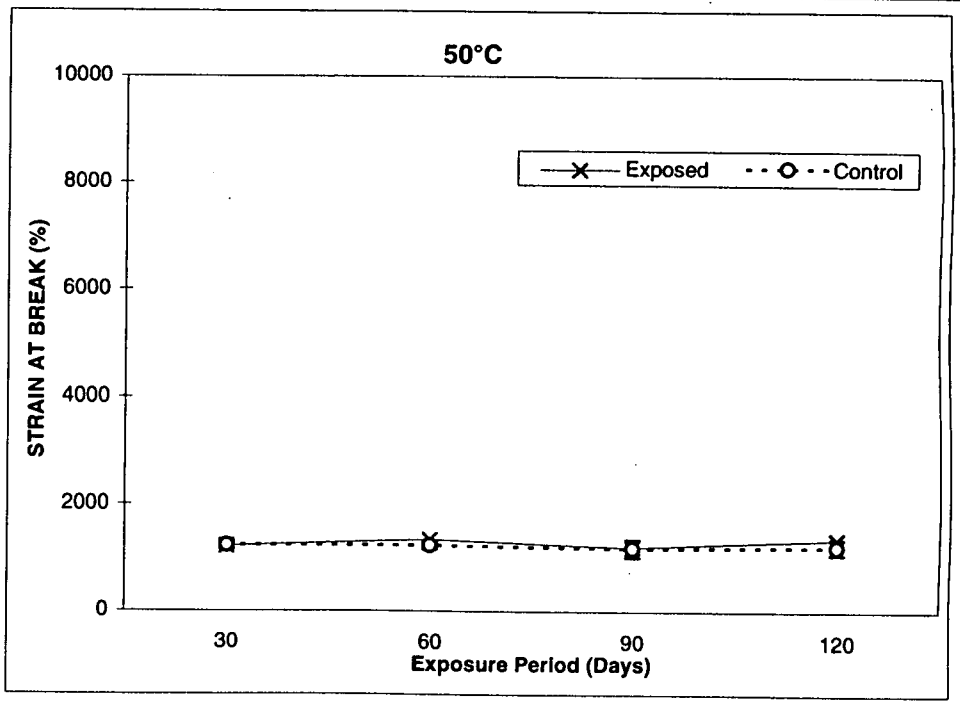
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1152	1218	1222	1224	1348	1233	71	0.000	1152	1218	1222	1224	1348	1233	71	0.000	VV
30	1330	1157	1285		1218	1248	76	1.192	1188	1256	1135	1252	1252	1217	54	-1.314	VV
Control	1152	1218	1222	1224	1348	1233	71	0.000	1152	1218	1222	1224	1348	1233	71	0.000	WM
60	1352	1385	1242	1212	1319	1302	73	5.613	1355	1253	1302	1448	1312	1334	73	8.209	VV
Control	1232	1078	949	1357	1302	1184	168	0.000	1232	1078	949	1357	1302	1184	168	0.000	WM
90	1166	1252	1128	1207	1068	1164	71	-1.631	1232	1171	1108	1216	1285	1202	67	1.597	VV
Control	996	1322	1300	1151	1319	1218	143	0.000	996	1322	1300	1151	1319	1218	143	0.000	WM
120	1316	1340	1328	1300	1362	1329	24	9.171	1365	1299	1346	1376	1343	1346	29	10.534	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

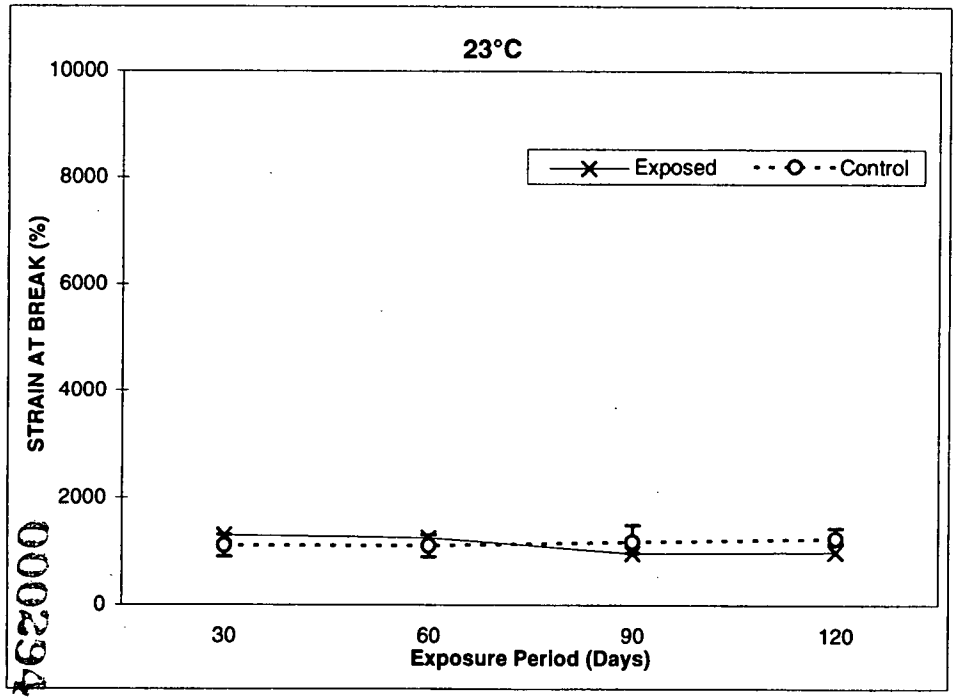
CHEMICAL COMPATIBILITY TEST RESULTS

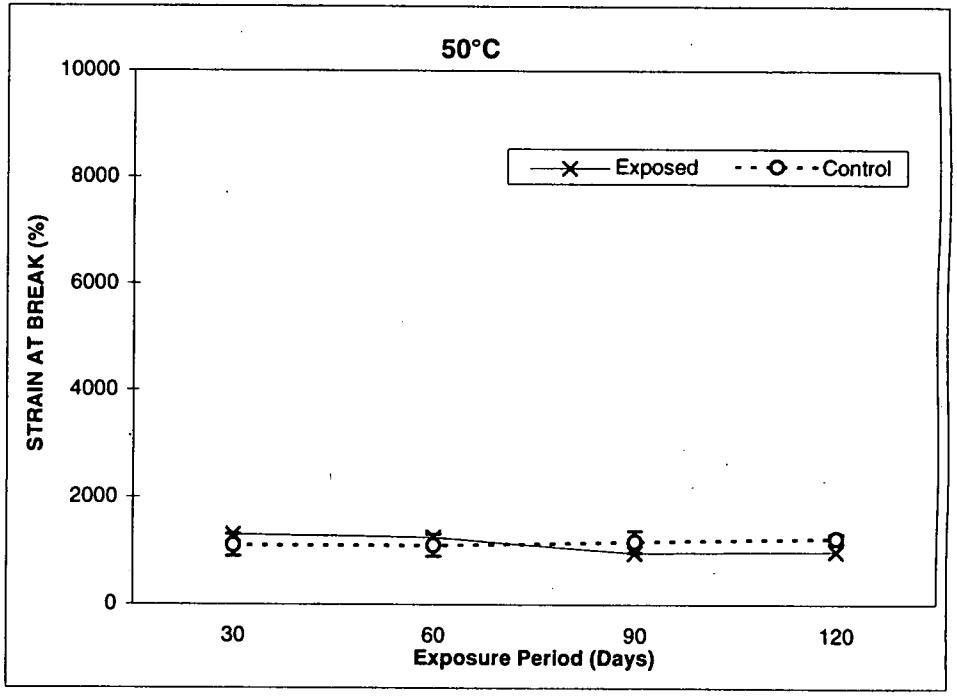
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1216	1135	1103	775	1308	1107	202	0.000	1216	1135	1103	775	1308	1107	202	0.000	VV
30	1190		1418	1404	1188	1300	128	17.384	1187	1131	1199	1152	1256	1185	48	7.000	VV
Control	1216	1135	1103	775	1308	1107	202	0.000	1216	1135	1103	775	1308	1107	202	0.000	WM
60	1316	1132	1443	1177	1185	1251	128	12.923	1149	1209	1338	1348	1177	1244	93	12.345	VV
Control	1369	885	1313	1251	1073	1178	198	0.000	1369	885	1313	1251	1073	1178	198	0.000	WM
90	1016	1267	1027	1102	434	969	316	-17.748	1277	1233	1134	879	1320	1169	176	-0.830	VV
Control	1276	1246	1105	1240	1337	1241	85	0.000	1276	1246	1105	1240	1337	1241	85	0.000	WM
120	994	1087	1150	888	849	993	128	-19.934	812	738	789	1079	747	833	141	-32.877	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000294

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

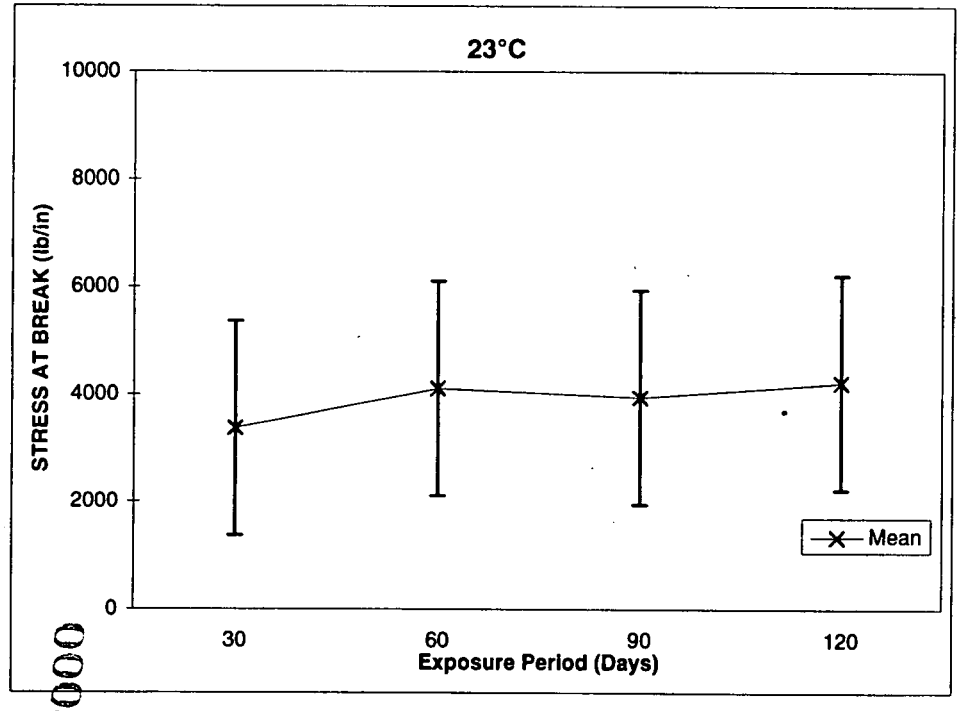
CHEMICAL COMPATIBILITY TEST RESULTS

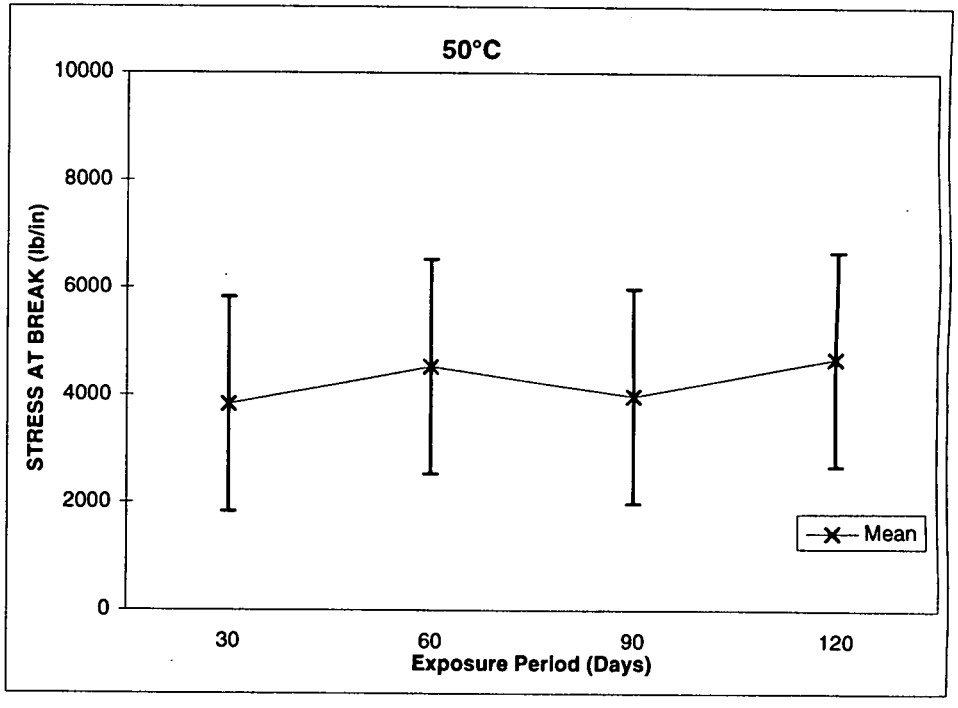
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (lbs/in)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	3737.5	4025.0	4000.0	4162.5	4612.5	4108	321	0.0	3737.5	4025.0	4000.0	4162.5	369.0	3259	1623	0.0	VV
30	4495.0	3765.0	4422.5	0.0	4127.5	3362	1901	-18.1	3875.0	3892.5	3547.5	3862.5	3977.5	3831	165	17.6	VV
60	4287.5	4417.5	3725.0	3915.0	4205.0	4110	283	0.1	4672.5	4265.0	4335.0	4987.5	4385.0	4529	300	39.0	VV
90	3760.0	4230.0	3892.5	4085.0	3745.0	3943	211	-4.0	4217.5	3960.0	3537.5	3907.5	4275.0	3980	294	22.1	VV
120	4277.5	4067.5	4115.0	4170.0	4457.5	4218	155	2.7	4862.5	4685.0	4527.5	4832.5	4452.5	4672	181	43.4	WM





© 1996 GEOSYNTEC CONSULTANTS

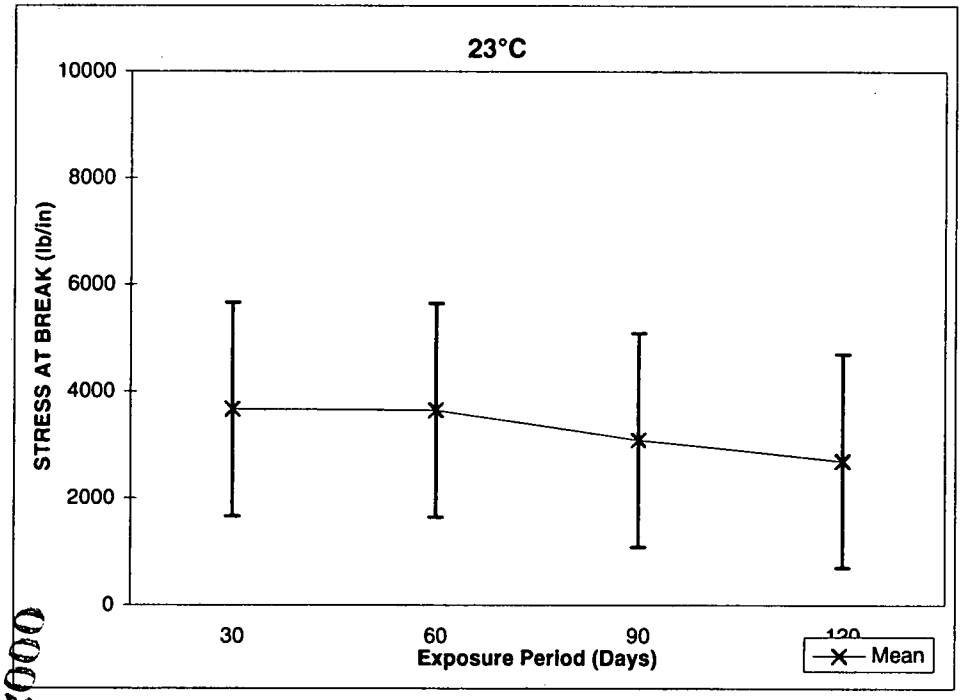
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

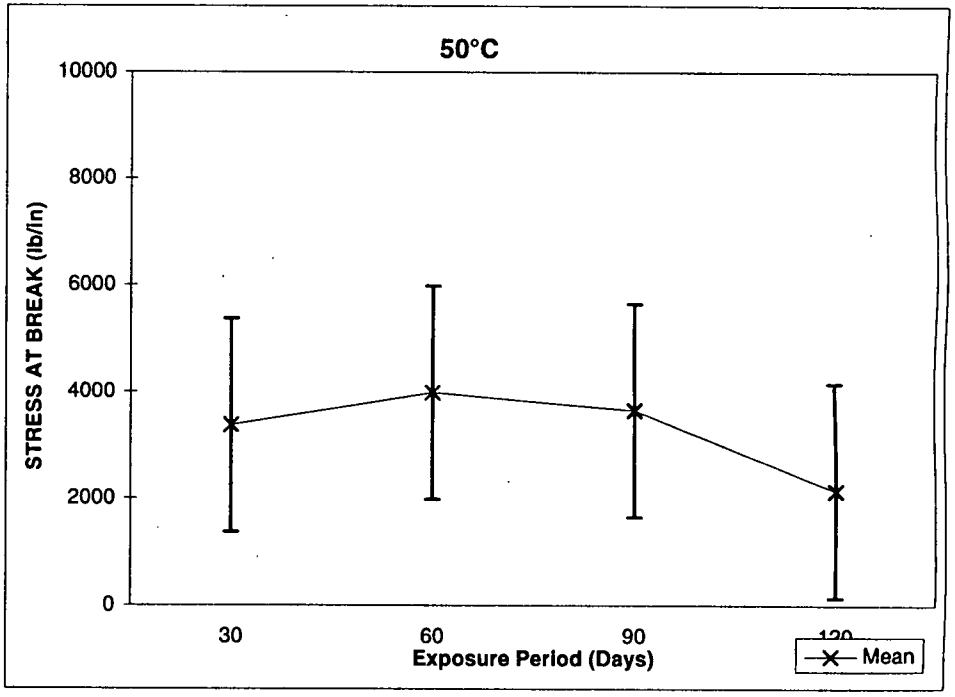
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*POLYFLEX*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRESS AT BREAK (lbs/in)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	3781.3	3343.8	3293.8	1843.8	4081.3	3269	860	0.0	3781.3	3343.8	3293.8	1843.8	4081.3	3269	860	0.0	VV
30	3732.5	1860.0	4532.5	4412.5	3787.5	3665	1071	12.1	3397.5	3217.5	3552.5	2962.5	3745.0	3375	302	3.3	VV
60	3877.5	3237.5	4372.5	3357.5	3402.5	3650	472	11.6	3662.5	3737.5	4355.0	4412.5	3743.8	3982	368	21.8	VV
90	3187.5	4230.0	3002.5	3565.0	1482.5	3094	1016	-5.4	3917.5	3795.0	3442.5	2720.0	4392.5	3654	623	11.8	VV
120	2610.0	3090.0	3542.5	2095.0	2180.0	2704	614	-17.3	1970.0	2467.5	1785.0	3142.5	1357.5	2145	685	-34.4	WM





© 1996 GEOSYNTEC CONSULTANTS

000296

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

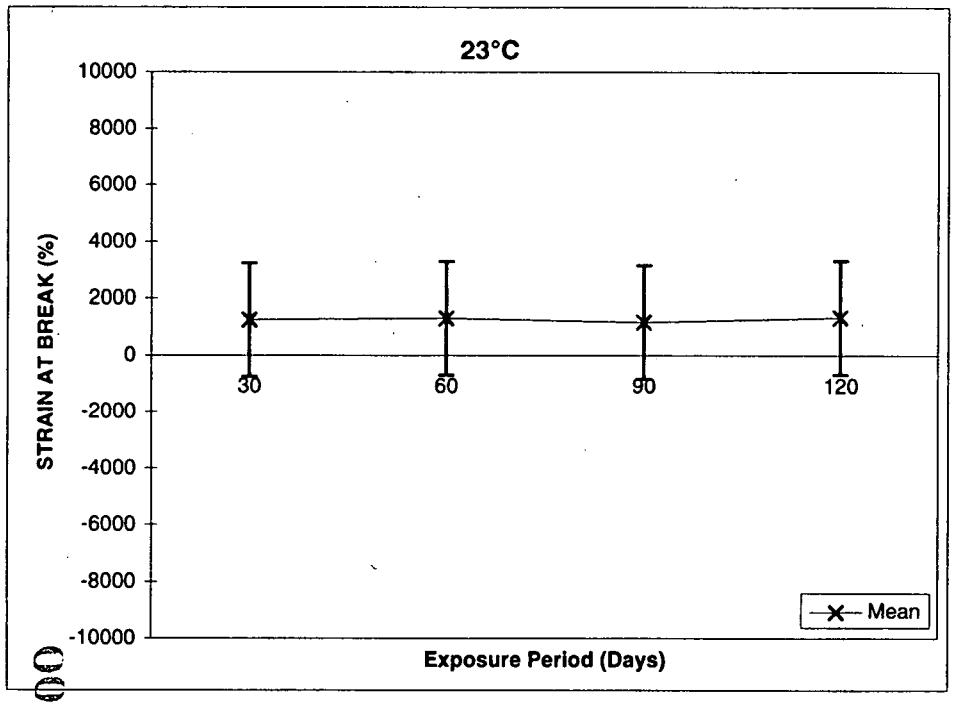
CHEMICAL COMPATIBILITY TEST RESULTS

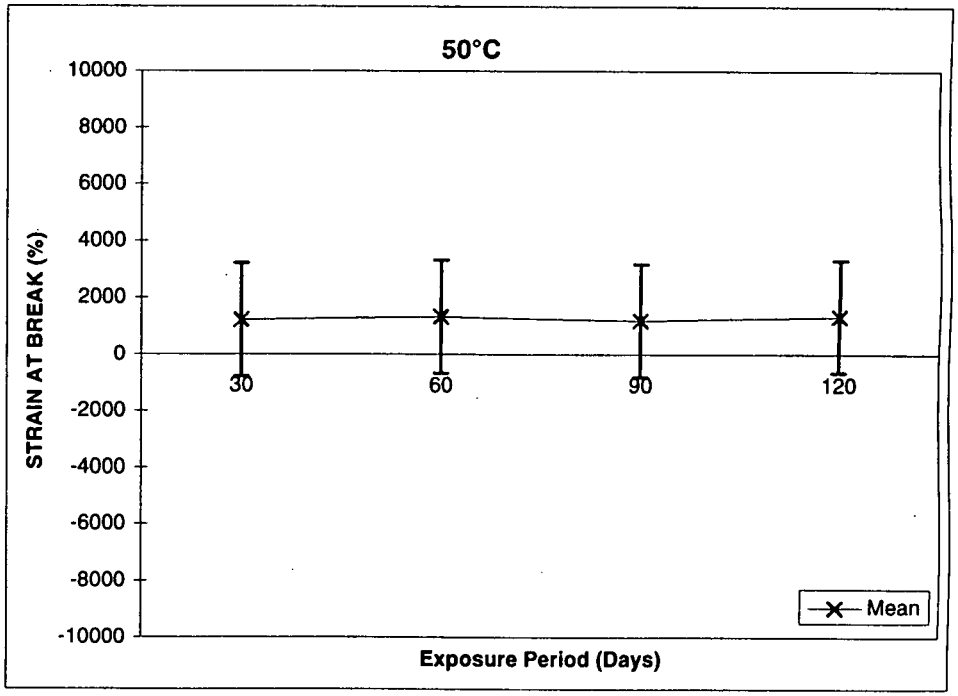
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1152	1218	1222	1224	1348	1233	71	0.0	1152	1218	1222	1224	1348	1233	71	0.0	VV
30	1330	1157	1285		1218	1248	76	1.2	1188	1256	1135	1252	1252	1217	54	-1.3	VV
60	1352	1385	1242	1212	1319	1302	73	5.6	1355	1253	1302	1448	1312	1334	73	8.2	VV
90	1166	1252	1128	1207	1068	1164	71	-5.6	1232	1171	1108	1216	1285	1202	67	-2.5	VV
120	1316	1340	1328	1300	1362	1329	24	7.8	1365	1299	1346	1376	1343	1346	29	9.2	WM





© 1996 GEOSYNTEC CONSULTANTS

0002997

2 8 3

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

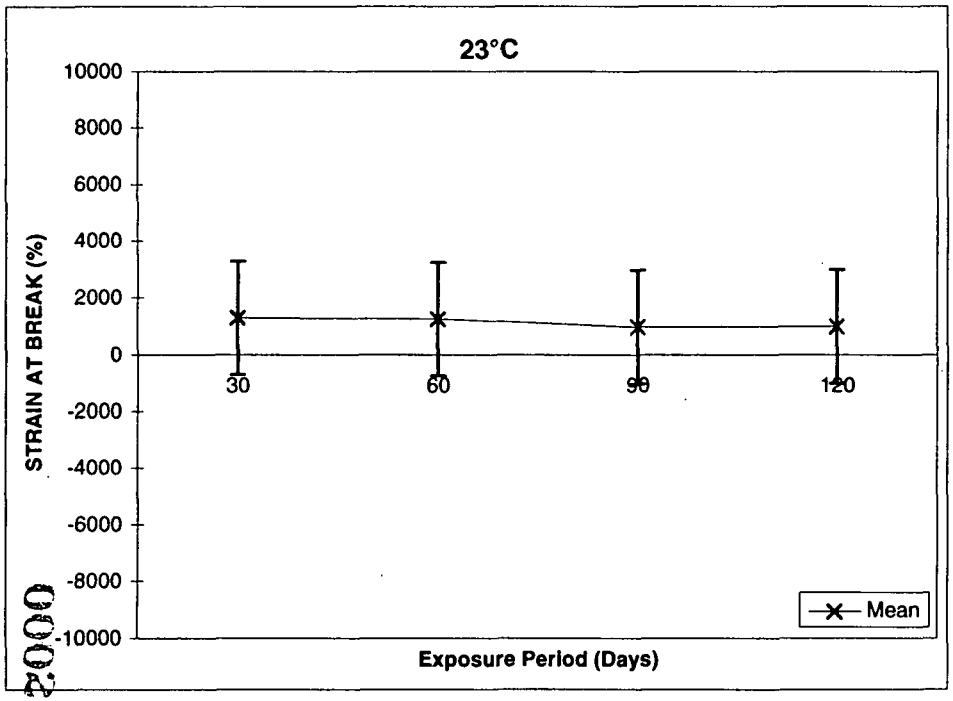
CHEMICAL COMPATIBILITY TEST RESULTS

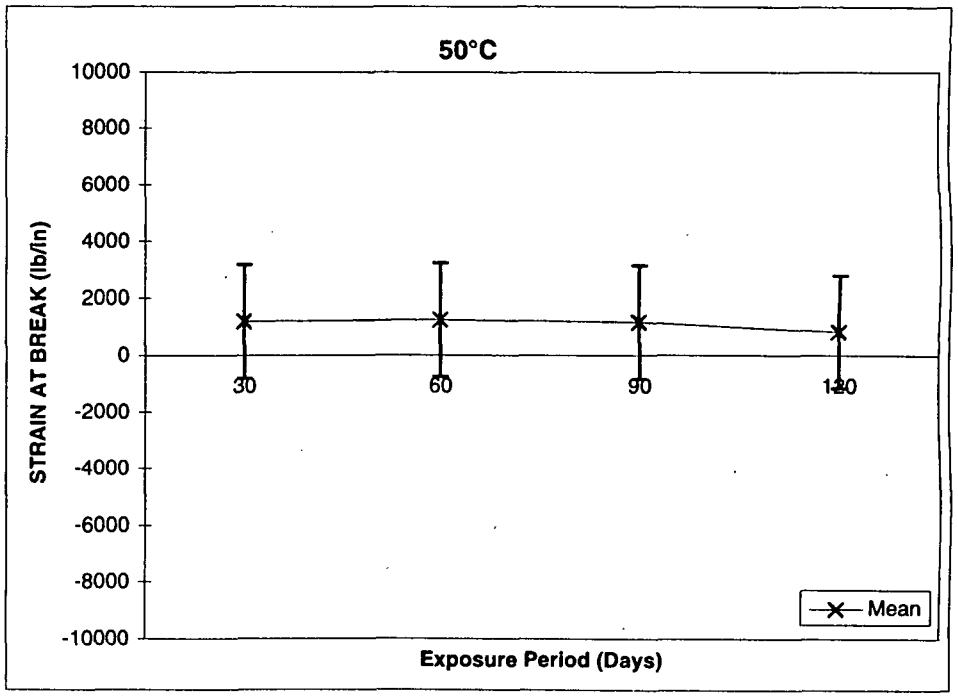
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1216	1135	1103	775	1308	1107	202	0.0	1216	1135	1103	775	1308	1107	202	0.0	VV
30	1190		1418	1404	1188	1300	128	17.4	1187	1131	1199	1152	1256	1185	48	7.0	VV
60	1316	1132	1443	1177	1185	1251	128	12.9	1149	1209	1338	1348	1177	1244	93	12.3	VV
90	1016	1267	1027	1102	434	969	316	-12.5	1277	1233	1134	879	1320	1169	176	5.5	VV
120	994	1087	1150	888	849	993	128	-10.3	812	738	789	1079	747	833	141	-24.8	WM





© 1996 GEOSYNTEC CONSULTANTS

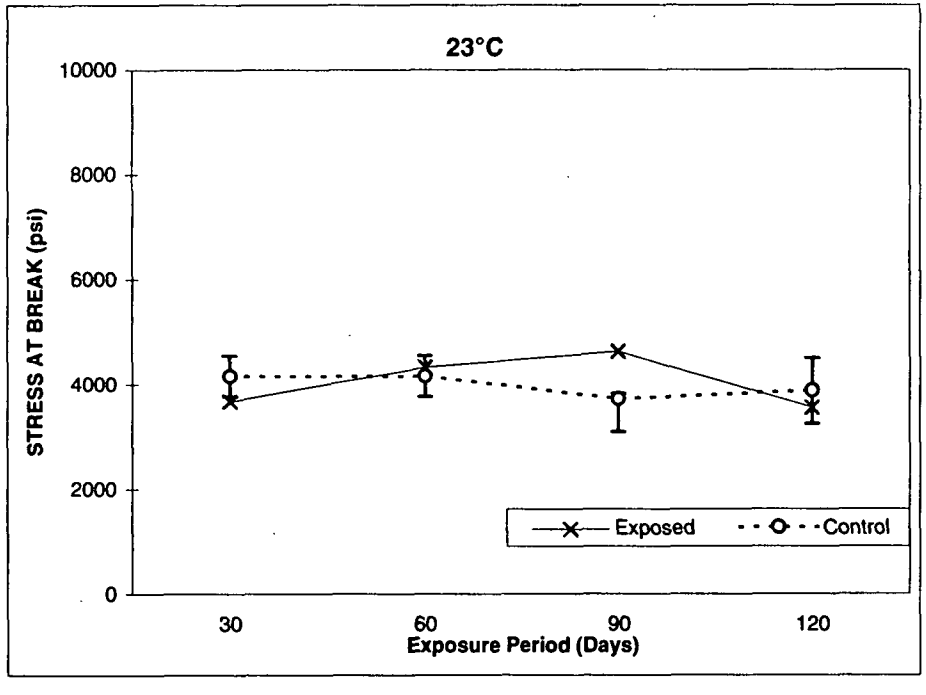
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

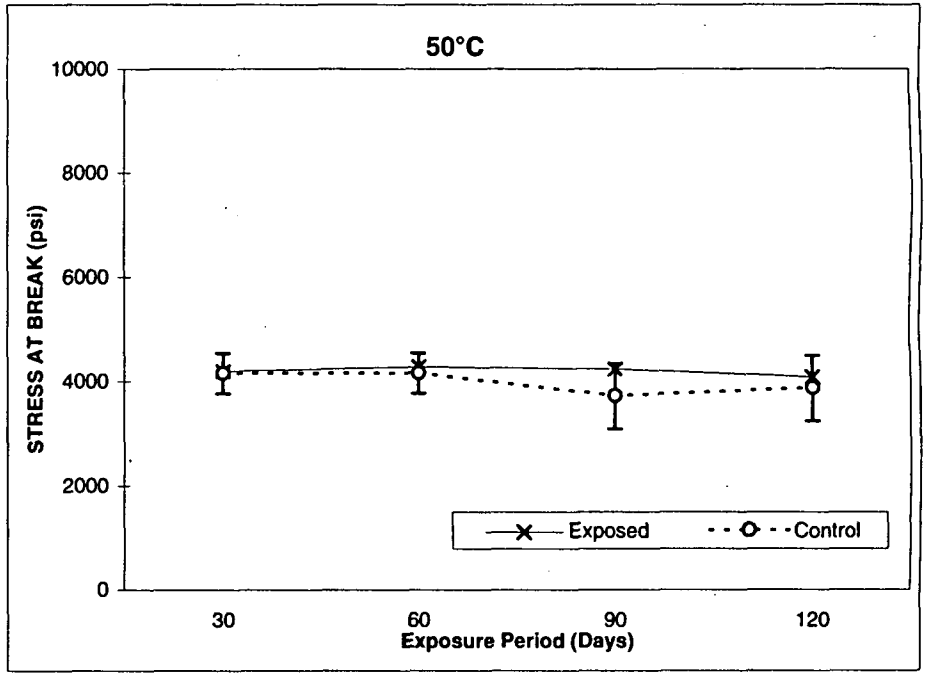
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*SERROT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRESS AT BREAK (psi)
DIRECTION: ROLL

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	3556.3	4575.0	4100.0	4431.3	4162.5	4165	392	0.000	3556.3	4575.0	4100.0	4431.3	4162.5	4165	392	0.000	VV
30	4082.5	4395.0	1590.0	4277.5	4027.5	3675	1175	-11.777	4472.5	4222.5	3755.0	4277.5	4290.0	4204	268	0.924	VV
Control	3556.3	4575.0	4100.0	4431.3	4162.5	4165	392	0.000	3556.3	4575.0	4100.0	4431.3	4162.5	4165	392	0.000	WM
60	4112.5	4481.3	4375.0	4506.3	4218.8	4339	170	4.172	3818.8	4587.5	4068.8	4700.0	4275.0	4290	363	3.001	VV
Control	4075.0	4040.0	4165.0	3703.8	2650.0	3727	627	0.000	4075.0	4040.0	4165.0	3703.8	2650.0	3727	627	0.000	WM
90	4600.0	4607.5	4790.0	4515.0	4655.0	4634	101	24.331	4050.0	4275.0	4125.0	4356.3	4400.0	4241	150	13.806	VV
Control	4310.0	4222.5	4420.0	2977.5	3475.0	3881	627	0.000	4310.0	4222.5	4420.0	2977.5	3475.0	3881	627	0.000	WM
120	3750.0	3885.0	4282.5	2710.0	3125.0	3551	627	-8.516	4345.0	4355.0	3711.3	4233.8	3776.3	4084	315	5.237	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

0002999

I-83 2

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

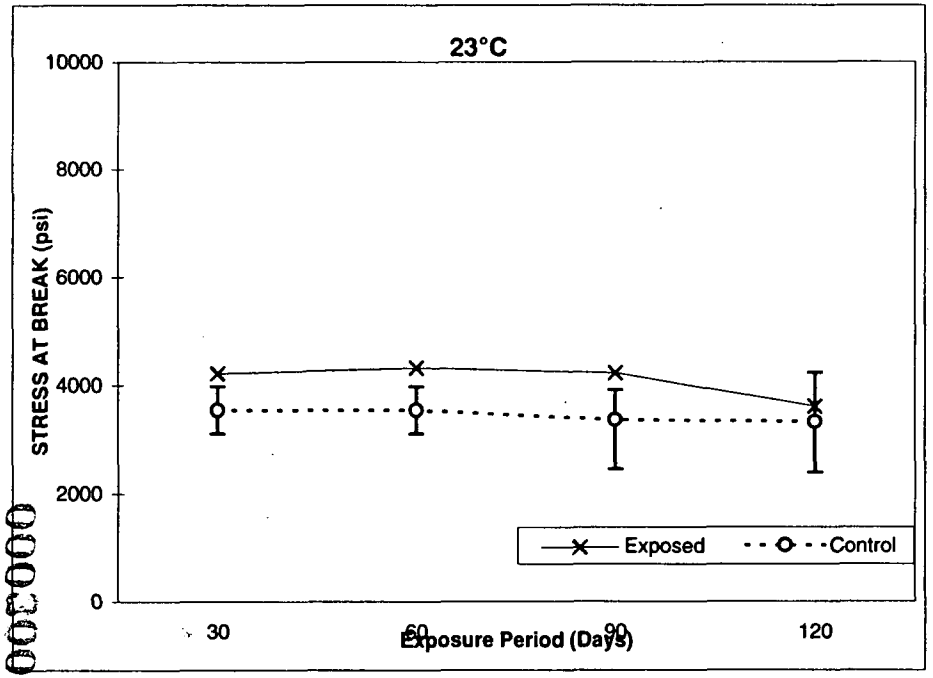
CHEMICAL COMPATIBILITY TEST RESULTS

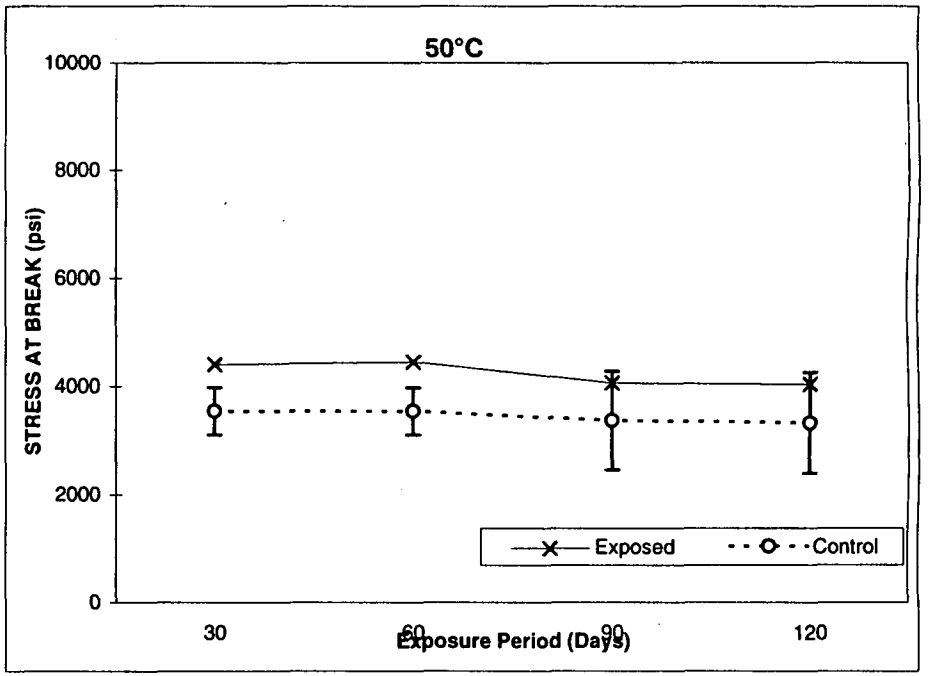
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	4025.0	3375.0	3893.8	2918.8	3518.8	3546	440	0.000	4025.0	3375.0	3893.8	2918.8	3518.8	3546	440	0.000	VV
30	4075.0	4442.5	4637.5	4242.5	3667.5	4213	371	18.802	4807.5	4427.5	4197.5	4252.5	4307.5	4399	244	24.032	VV
Control	4025.0	3375.0	3893.8	2918.8	3518.8	3546	440	0.000	4025.0	3375.0	3893.8	2918.8	3518.8	3546	440	0.000	WM
60	4162.5	4718.8	3918.8	4281.3	4525.0	4321	312	21.854	4000.0	4581.3	4568.8	4531.3	4556.3	4448	251	25.414	VV
Control	4165.0	3562.5	3152.5	1911.3	4057.5	3370	911	0.000	4165.0	3562.5	3152.5	1911.3	4057.5	3370	911	0.000	WM
90	4247.5	4712.5	3350.0	4131.3	4687.5	4226	554	25.402	4280.0	4027.5	4577.5	3587.5	3870.0	4069	380	20.736	VV
Control	4222.5	3032.5	4412.5	2490.0	2470.0	3326	936	0.000	4222.5	3032.5	4412.5	2490.0	2470.0	3326	936	0.000	WM
120	4402.5	4067.5	3780.0	1875.0	3957.5	3617	1000	8.751	4437.5	4500.0	3731.3	3906.3	3662.5	4048	395	21.711	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000300

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

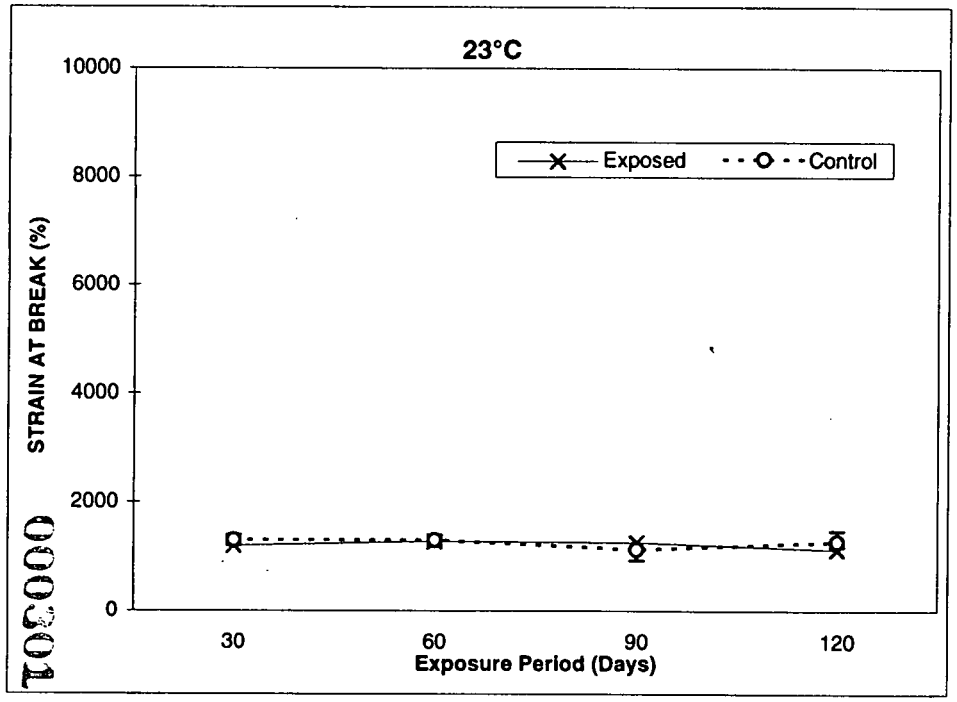
CHEMICAL COMPATIBILITY TEST RESULTS

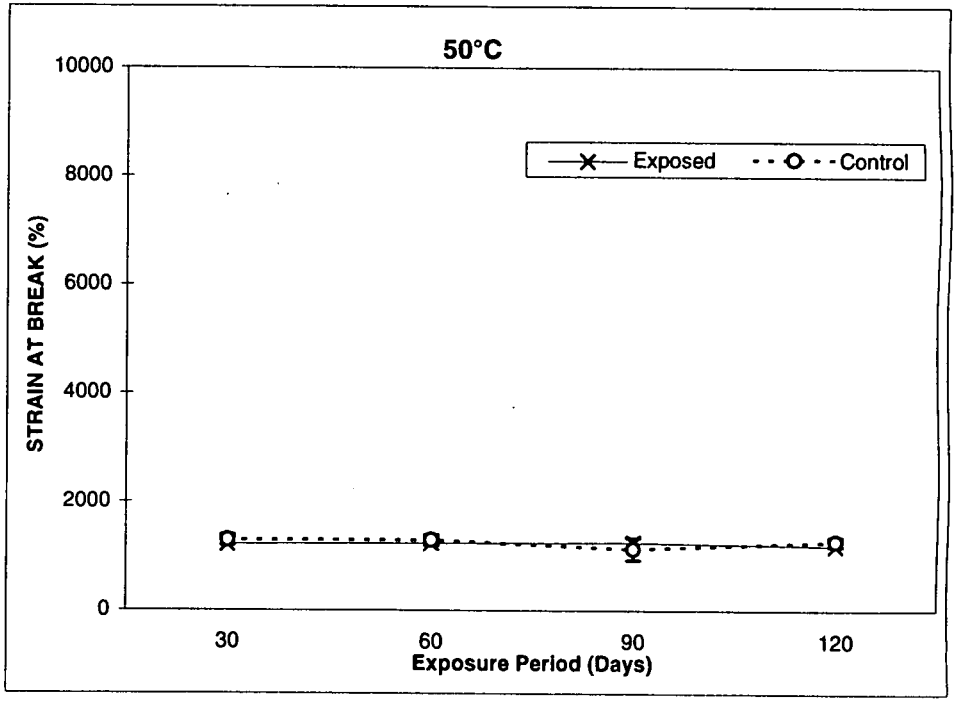
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1143	1366	1307	1378	1336	1306	95	0.000	1143	1366	1307	1378	1336	1306	95	0.000	VV
30	1208	1289	1036	1253	1194	1196	97	-8.423	1295	1229	1125	1236	1242	1225	62	-6.172	VV
Control	1143	1366	1307	1378	1336	1306	95	0.000	1143	1366	1307	1378	1336	1306	95	0.000	WM
60	1218	1328	1285	1328	1250	1282	48	-1.853	1111	1305	1198	1365	1258	1247	98	-4.487	VV
Control	1257	1274	1225	1163	785	1141	203	0.000	1257	1274	1225	1163	785	1141	203	0.000	WM
90	1242	1228	1311	1246	1288	1263	35	10.704	1212	1264	1232	1283	1301	1258	36	10.301	VV
Control	1287	1328	1344	1304	1132	1279	85	0.000	1287	1328	1344	1304	1132	1279	85	0.000	WM
120	1154	1335	1271	845	1092	1139	190	-10.909	1267	1269	1100	1231	1119	1197	82	-6.396	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

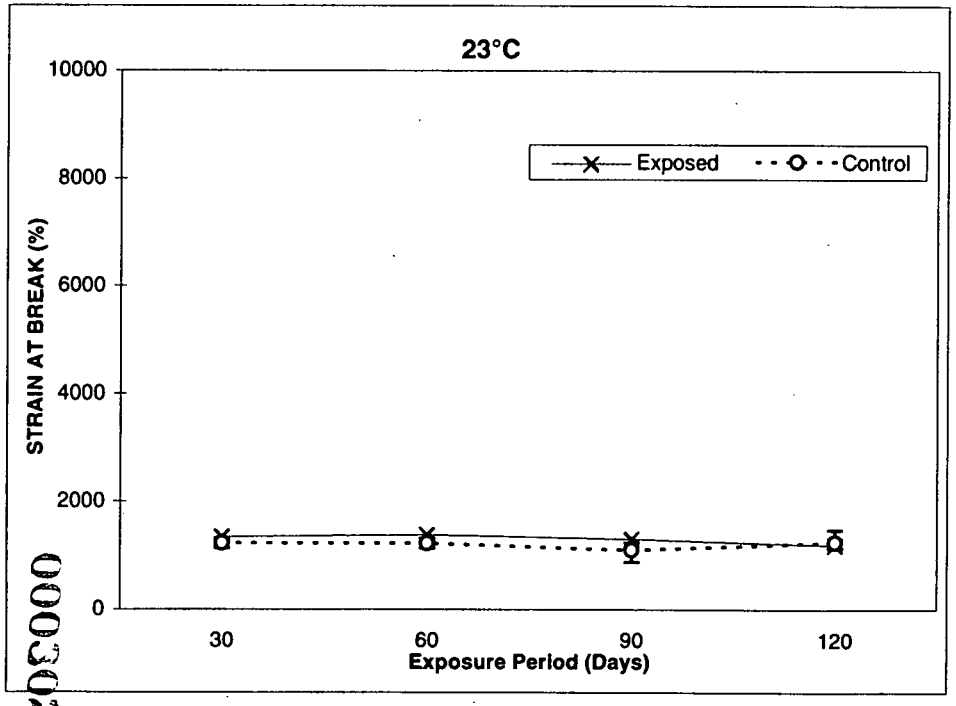
CHEMICAL COMPATIBILITY TEST RESULTS

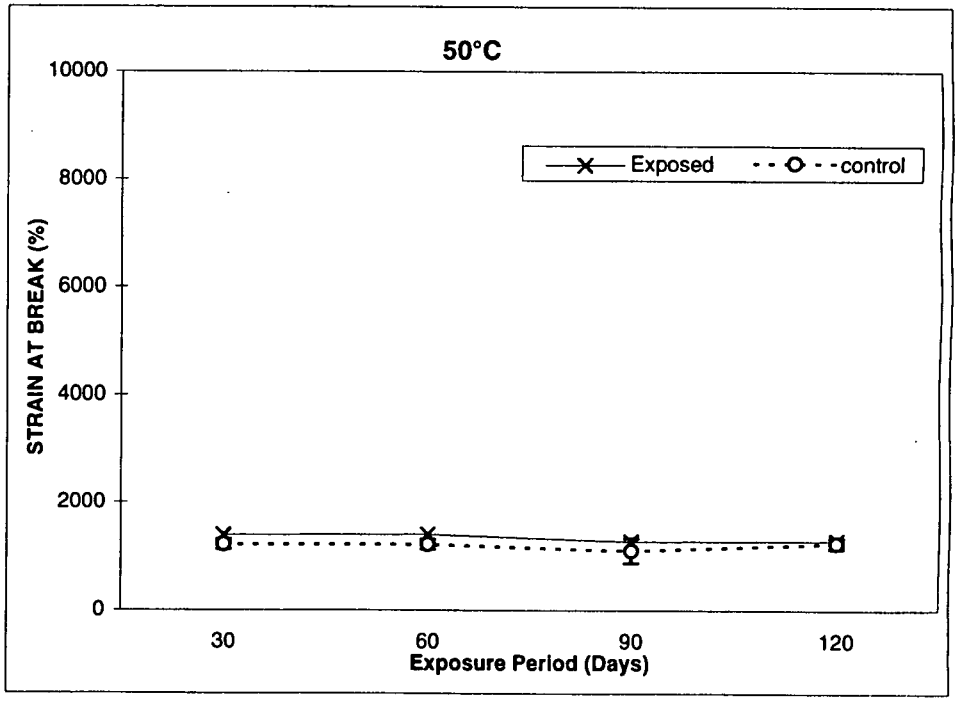
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1343	1172	1302	1119	1204	1228	93	0.000	1343	1172	1302	1119	1204	1228	93	0.000	VV
30	1295	1413	1454	1352	1198	1342	101	9.316	1507	1412	1350	1354	1363	1397	66	13.779	VV
Control	1343	1172	1302	1119	1204	1228	93	0.000	1343	1172	1302	1119	1204	1228	93	0.000	WM
60	1345	1499	1267	1363	1431	1381	88	12.459	1273	1450	1441	1432	1441	1407	75	14.609	VV
Control	1310	1135	1071	742	1295	1111	230	0.000	1310	1135	1071	742	1295	1111	230	0.000	WM
90	1286	1421	1098	1275	1434	1303	136	17.300	1329	1261	1408	1141	1261	1280	99	15.247	VV
Control	1359	1185	1366	1204	1143	1251	104	0.000	1359	1185	1366	1204	1143	1251	104	0.000	WM
120	1389	1297	1212	812	1269	1196	224	-4.451	1412	1423	1223	1256	1175	1298	113	3.708	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

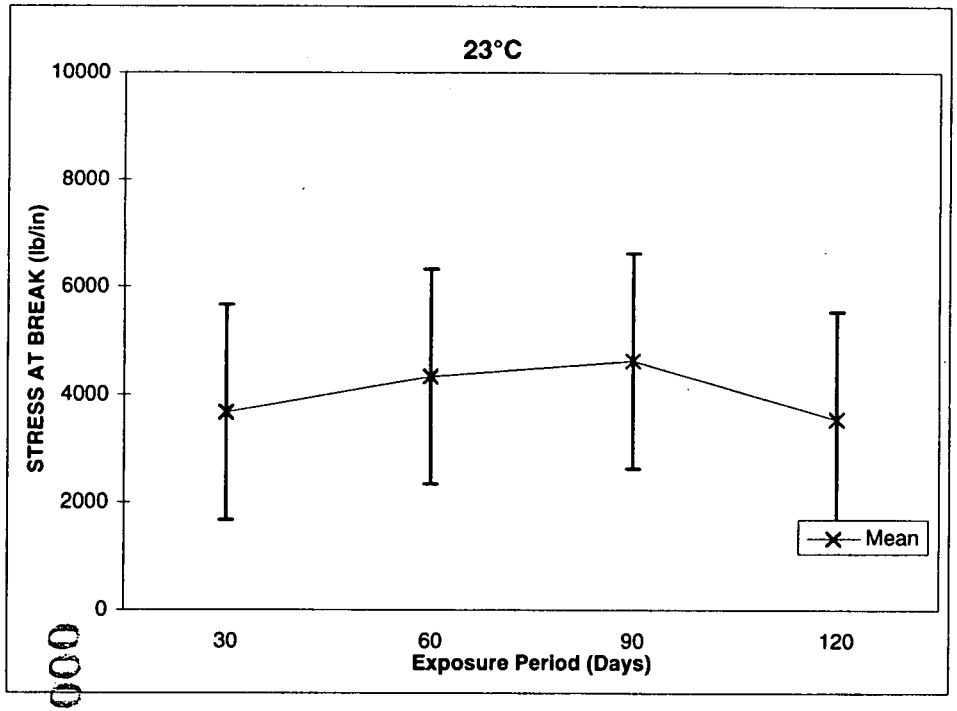
CHEMICAL COMPATIBILITY TEST RESULTS

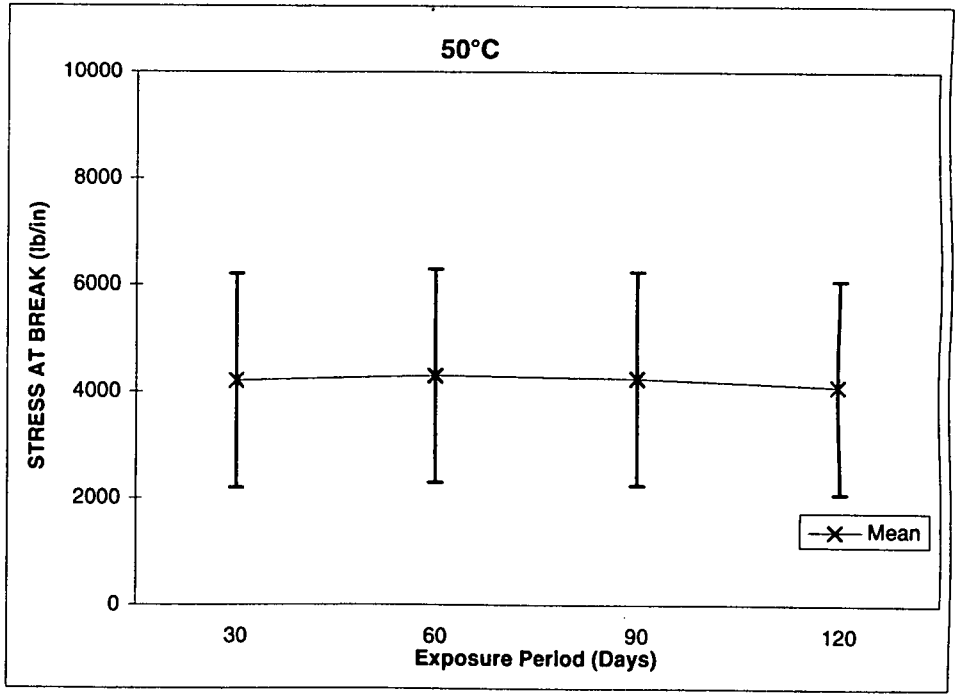
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (lbs/in)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	3556.3	4575.0	4100.0	4431.3	4162.5	4165	392	0.0	3556.3	4575.0	4100.0	4431.3	4162.5	4165	392	0.0	VV
30	4082.5	4395.0	1590.0	4277.5	4027.5	3675	1175	-11.8	4472.5	4222.5	3755.0	4277.5	4290.0	4204	268	0.9	VV
60	4112.5	4481.3	4375.0	4506.3	4218.8	4339	170	4.2	3818.8	4587.5	4068.8	4700.0	4275.0	4290	363	3.0	VV
90	4600.0	4607.5	4790.0	4515.0	4655.0	4634	101	11.2	4050.0	4275.0	4125.0	4356.3	4400.0	4241	150	1.8	VV
120	3750.0	3885.0	4282.5	2710.0	3125.0	3551	627	-14.8	4345.0	4355.0	3711.3	4233.8	3776.3	4084	315	-1.9	WM





© 1996 GEOSYNTEC CONSULTANTS

000303

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

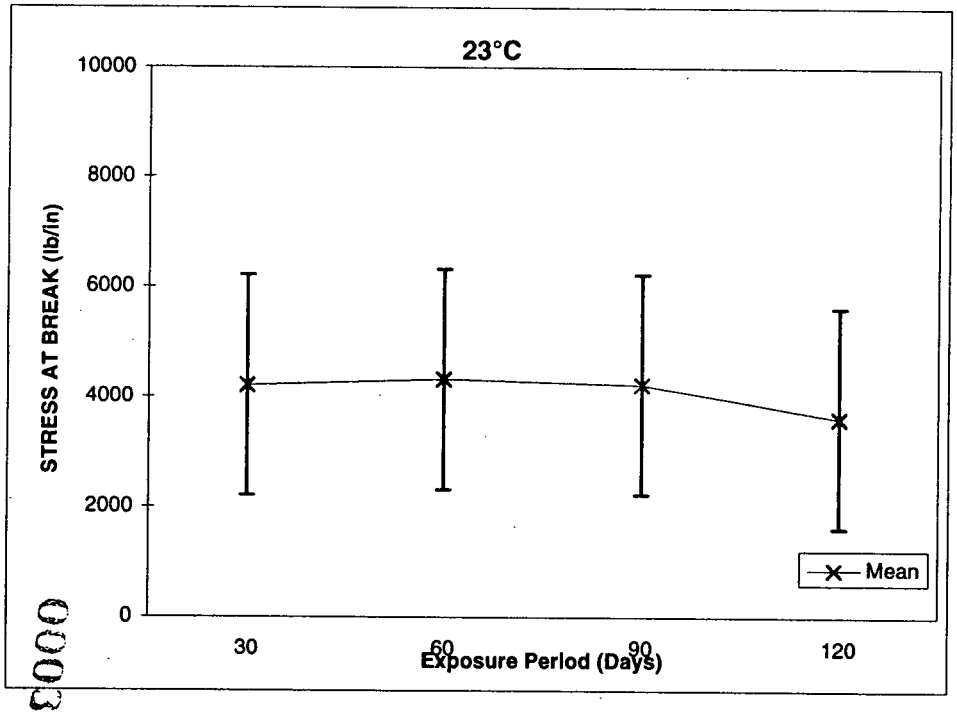
CHEMICAL COMPATIBILITY TEST RESULTS

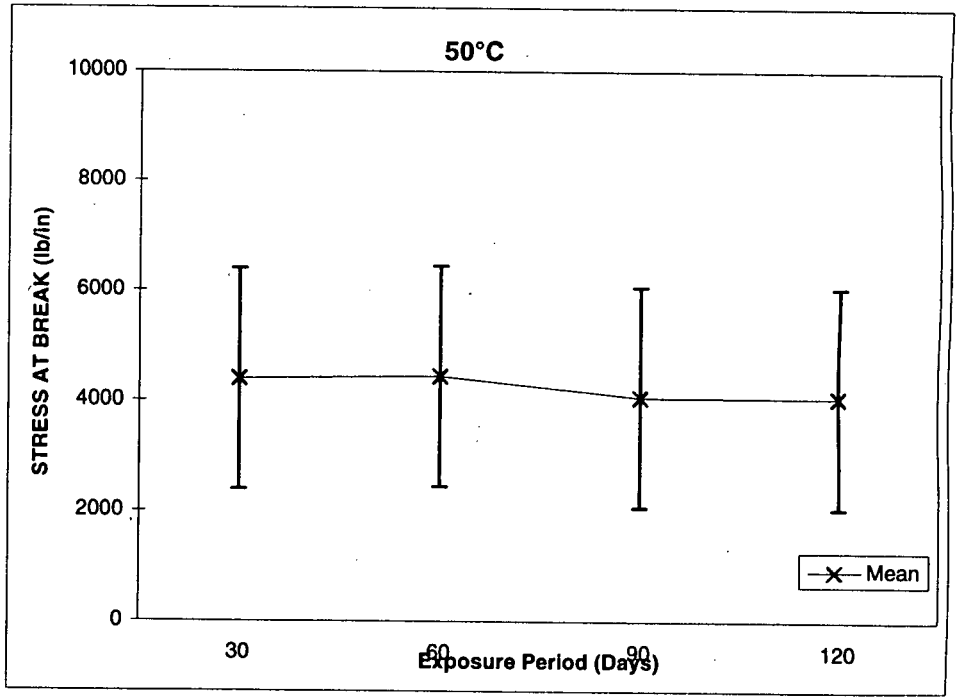
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRESS AT BREAK (lbs/in)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	4025.0	3375.0	3893.8	2918.8	3518.8	3546	440	0.0	4025.0	3375.0	3893.8	2918.8	3518.8	3546	440	0.0	VV
30	4075.0	4442.5	4637.5	4242.5	3667.5	4213	371	18.8	4807.5	4427.5	4197.5	4252.5	4307.5	4399	244	24.0	VV
60	4162.5	4718.8	3918.8	4281.3	4525.0	4321	312	21.9	4000.0	4581.3	4568.8	4531.3	4556.3	4448	251	25.4	VV
90	4247.5	4712.5	3350.0	4131.3	4687.5	4226	554	19.2	4280.0	4027.5	4577.5	3587.5	3870.0	4069	380	14.7	VV
120	4402.5	4067.5	3780.0	1875.0	3957.5	3617	1000	2.0	4437.5	4500.0	3731.3	3906.3	3662.5	4048	395	14.1	WM





© 1996 GEOSYNTEC CONSULTANTS

000304

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

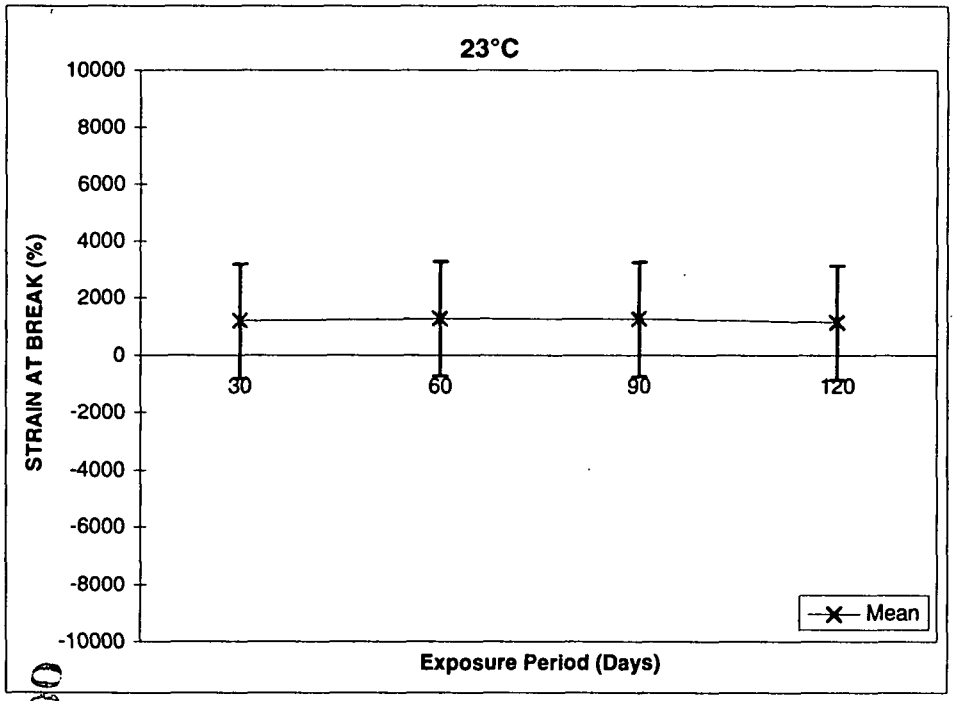
CHEMICAL COMPATIBILITY TEST RESULTS

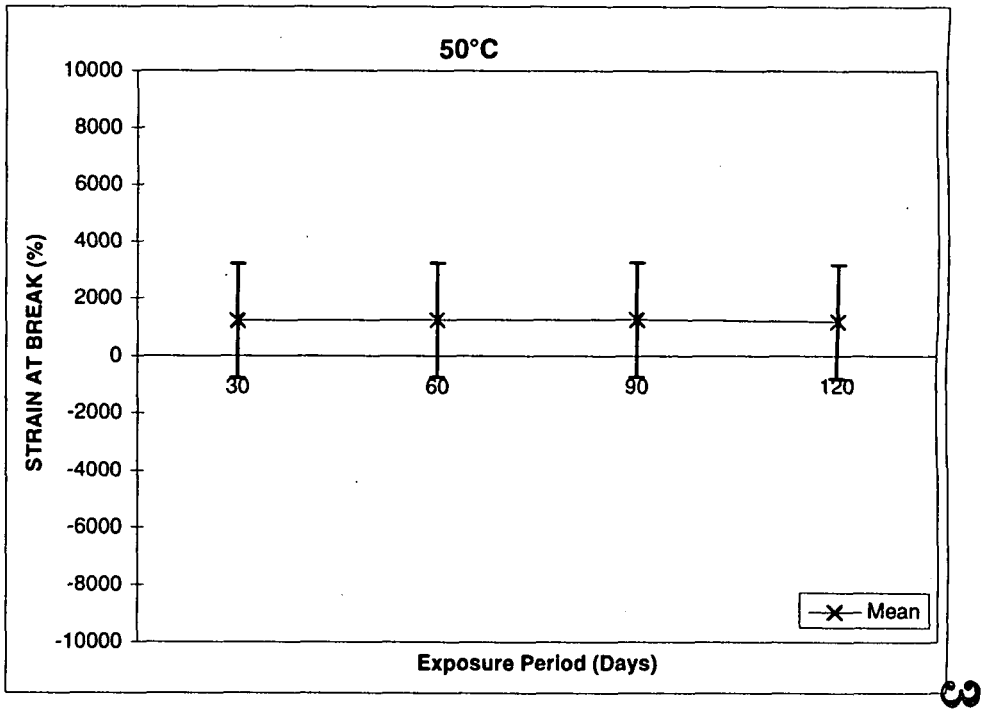
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	1143	1366	1307	1378	1336	1306	95	0.0	1143	1366	1307	1378	1336	1306	95	0.0	VV
30	1208	1289	1036	1253	1194	1196	97	-8.4	1295	1229	1125	1236	1242	1225	62	-6.2	VV
60	1218	1328	1285	1328	1250	1282	48	-1.9	1111	1305	1198	1365	1258	1247	98	-4.5	VV
90	1242	1228	1311	1246	1288	1263	35	-3.3	1212	1264	1232	1283	1301	1258	36	-3.6	VV
120	1154	1335	1271	845	1092	1139	190	-12.8	1267	1269	1100	1231	1119	1197	82	-8.3	WM





© 1996 GEOSYNTEC CONSULTANTS

000305

2 of 3

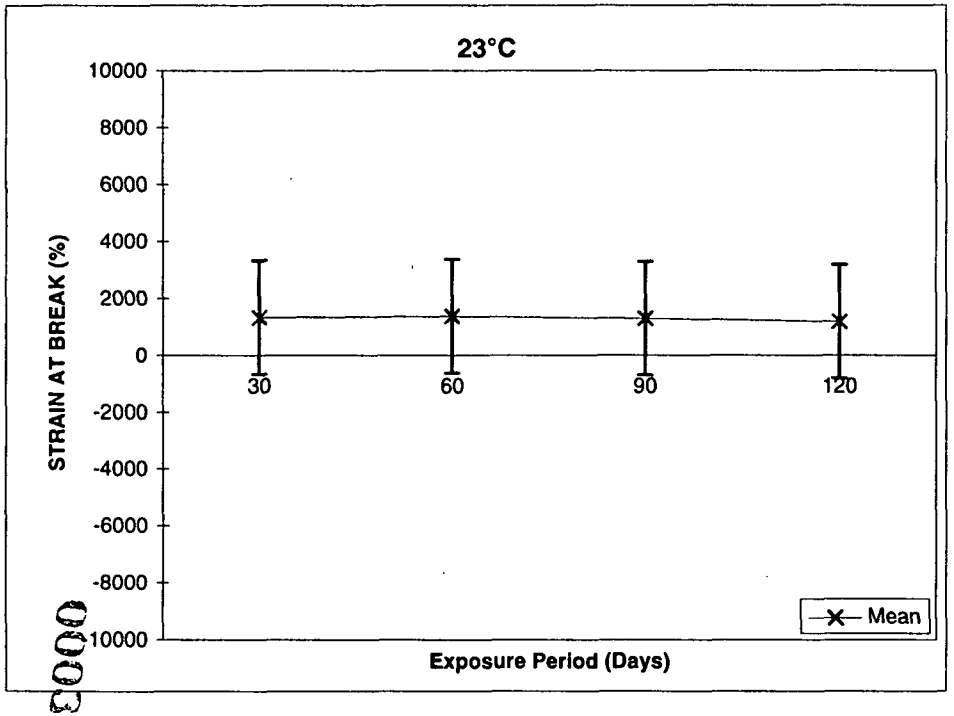
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

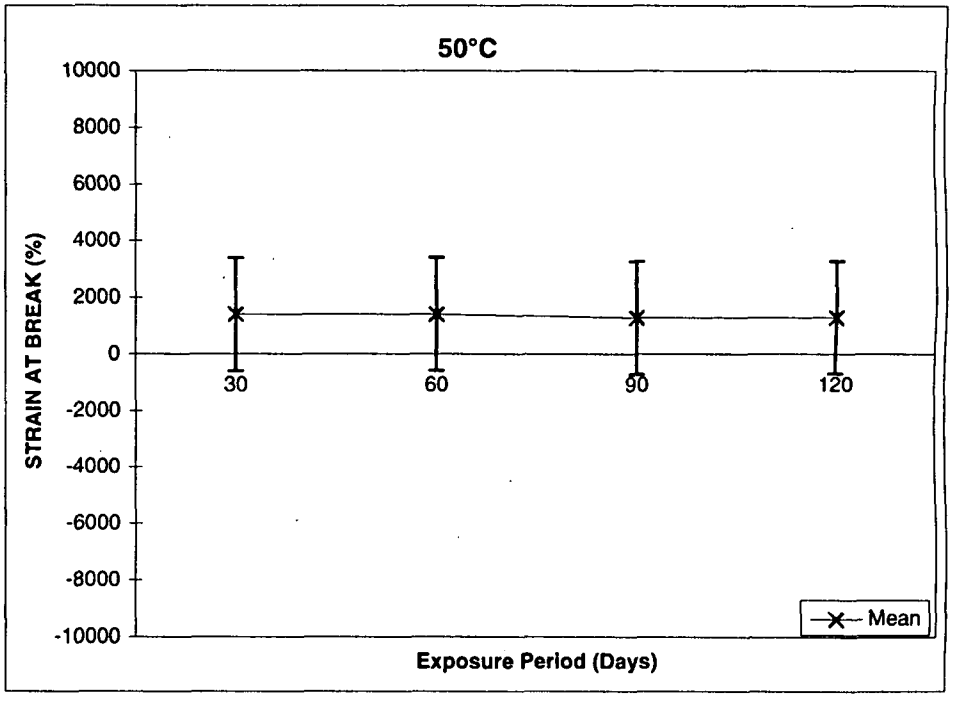
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*SERROT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): STRAIN AT BREAK (%)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	1343	1172	1302	1119	1204	1228	93	0.0	1343	1172	1302	1119	1204	1228	93	0.0	VV
30	1295	1413	1454	1352	1198	1342	101	9.3	1507	1412	1350	1354	1363	1397	66	13.8	VV
60	1345	1499	1267	1363	1431	1381	88	12.5	1273	1450	1441	1432	1441	1407	75	14.6	VV
90	1286	1421	1098	1275	1434	1303	136	6.1	1329	1261	1408	1141	1261	1280	99	4.2	VV
120	1389	1297	1212	812	1269	1196	224	-2.6	1412	1423	1223	1256	1175	1298	113	5.7	WM





© 1996 GEOSYNTEC CONSULTANTS

000306

3867

2.9 Modulus of Elasticity

Rationale of Test

Modulus of elasticity is a measure of the stiffness of a material and is calculated from a tangent line drawn from a point on the steepest part of the initial portion of a geomembrane stress/strain curve. Like stress at yield, modulus of elasticity decreases when the material absorbs chemicals from leachate and increases when it is crosslinked by the action of high energy radiation.

Results and Discussion

The following observations were made regarding the modulus of elasticity of the five geomembranes.

GSE-SLT Geomembrane. The modulus of elasticity of both the roll and cross-roll directions was generally constant during the 120 days of leachate exposure. Although there were some fluctuations in the data, the mean values of the exposed samples were within one standard deviation of the control value means. In addition, no appreciable differences were observed between the 23°C (73°F) and 50°C (122°F) data sets. Finally, the modulus of elasticity values were parallel to those of stress at yield.

NSC Geomembrane. The modulus of elasticity values in both the roll and cross-roll directions were variable during the 120 days of leachate exposure. Most of the mean values of the exposed samples were outside of one standard deviation of the control value means. Both the 23°C (73°F) and 50°C (122°F) samples experienced similar changes. Modulus of elasticity values were not consistent with stress at yield values.

GSE-Gundle Geomembrane. Modulus of elasticity values in the roll direction were variable, and most of the mean values of the exposed samples were outside of one standard deviation of the control value means. In contrast, the modulus of elasticity values of the cross-roll direction sample were nearly constant and slightly

Draft

higher than the control samples values. There was no appreciable difference between the 23°C (73°F) and the 50°C (122°F) data. Finally, modulus of elasticity values during the 120 days of leachate exposure appear to parallel stress at yield values.

PolyFlex Geomembrane. The modulus of elasticity values of the roll direction 23°C (73°F) samples were inconsistent. The mean values of the exposed samples were generally more than one standard deviation outside of the mean values of the control samples. In contrast, modulus of elasticity values of the 50°C (122°F) roll direction and the 23°C (73°F) and 50°C (122°F) cross-roll direction samples were not variable, with values slightly above the modulus at elasticity values of the control samples, but were within one standard deviation of the control value means. There were no appreciable differences between the 23°C (73°F) and 50°C (122°F) values. Modulus of elasticity values and stress at yield values of the exposed samples did not correlate with one another (stress at yield was variable).

Serrot Geomembrane. Modulus of elasticity values of the roll direction sample were lower than the control values in the range of approximately 6 to 16 percent, with the 23°C (73°F) samples appearing to be more consistent than the 50°C (122°F) samples. However, a decreasing trend was not observed. Most of the mean values of the exposed samples were outside of one standard deviation of the control value means. No significant difference was observed regarding the percent change values for the exposed samples.

The modulus of elasticity values of the exposed roll direction and cross-roll direction samples were lower than the control samples in the range of approximately 5 to 10 percent. However, a decreasing trend was not observed. In addition, most of the mean values of the exposed samples were outside of one standard deviation of the control value means. No appreciable difference was observed between the 23°C (73°F) and 50°C (122°F) samples. In general, the modulus of elasticity values of the exposed sample did not vary consistently with the stress at yield values.

Draft

The variability of the modulus of elasticity values of the exposed samples is typical for HDPE test results in USEPA Method 9090 testing programs. In these test results, most of the mean values of the exposed samples were outside of one standard deviation of the control value means.

These results indicate that there was significant variability in modulus of elasticity in the five geomembranes. However, the changes that occurred in modulus of elasticity of the exposed samples were not consistent with a mechanism of leachate interaction. There were no observable trends in the data, and no appreciable differences between the 23°C (73°F) and 50°C (122°F) data. Also, since the yield stress of the geomembranes did not appear to be impacted by the leachate and the measured physical properties were constant during the 120-day exposure period, modulus of elasticity was not expected to be affected. Therefore, it is likely that the changes (which are small) observed in modulus of elasticity of the exposed geomembranes are due to material and experimental variability.

Conclusion

The modulus of elasticity of the geomembranes was not measurably affected by the 120 day exposure to the test leachate.

draft

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

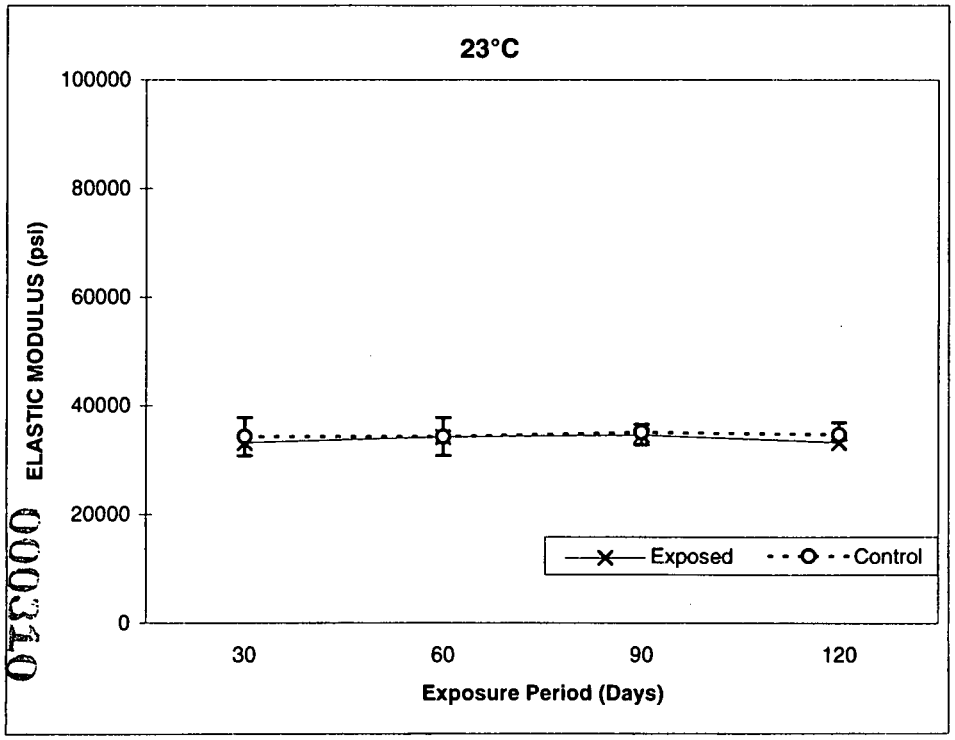
CHEMICAL COMPATIBILITY TEST RESULTS

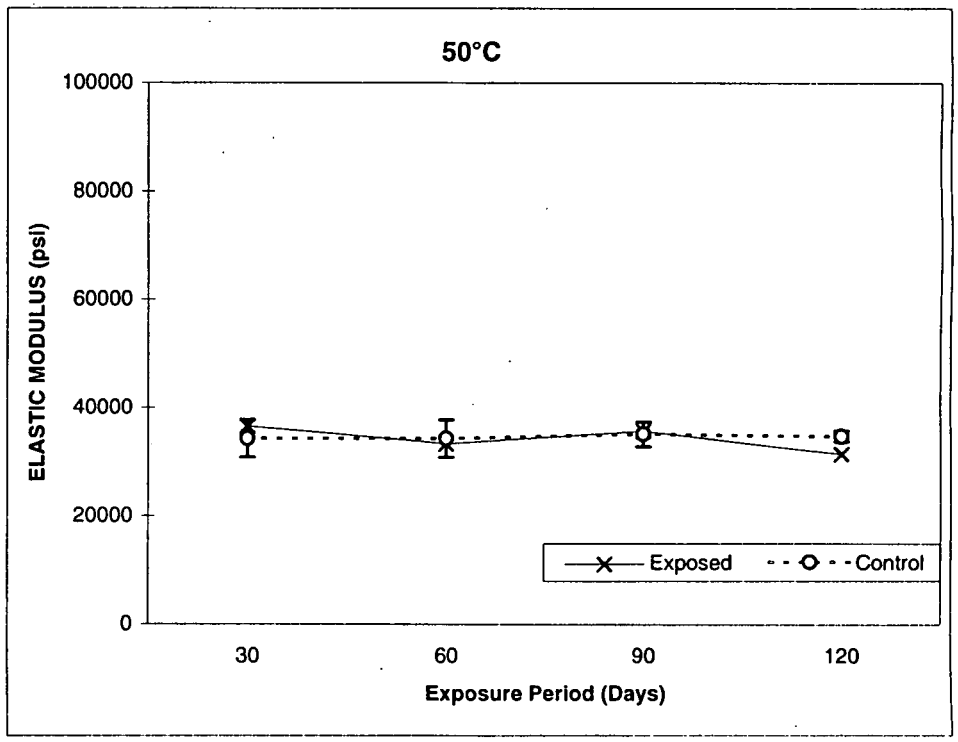
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): ELASTIC MODULUS (psi)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	36920	31280	33960	30860	38750	34354	3454	0.000	36920	31280	33960	30860	38750	34354	3454	0.000	CR
30	35240	30280	33580	32960	34090	33230	1849	-3.272	34450	36820	38020	37490	36270	36610	1377	6.567	CR
Control	36920	31280	33960	30860	38750	34354	3454	0.000	36920	31280	33960	30860	38750	34354	3454	0.000	WM
60	32900	33020	32540	36430	36470	34272	1996	-0.239	30840	35560	34260	30560	35680	33380	2511	-2.835	CR
Control	31580	35630	36620	37390	34770	35198	2252	0.000	31580	35630	36620	37390	34770	35198	2252	0.000	WM
90	32330	34390	35500	36260	34680	34632	1480	-1.608	36800	36070	34660	34400	36580	35702	1106	1.432	VV
Control	34570	36050	35550	33830	33900	34780	991	0.000	34570	36050	35550	33830	33900	34780	991	0.000	WM
120	32080	31540	34460	34280	34200	33312	1388	-4.221	30180	31200	31560	31500	33130	31514	1060	-9.390	WM





000340

382

Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

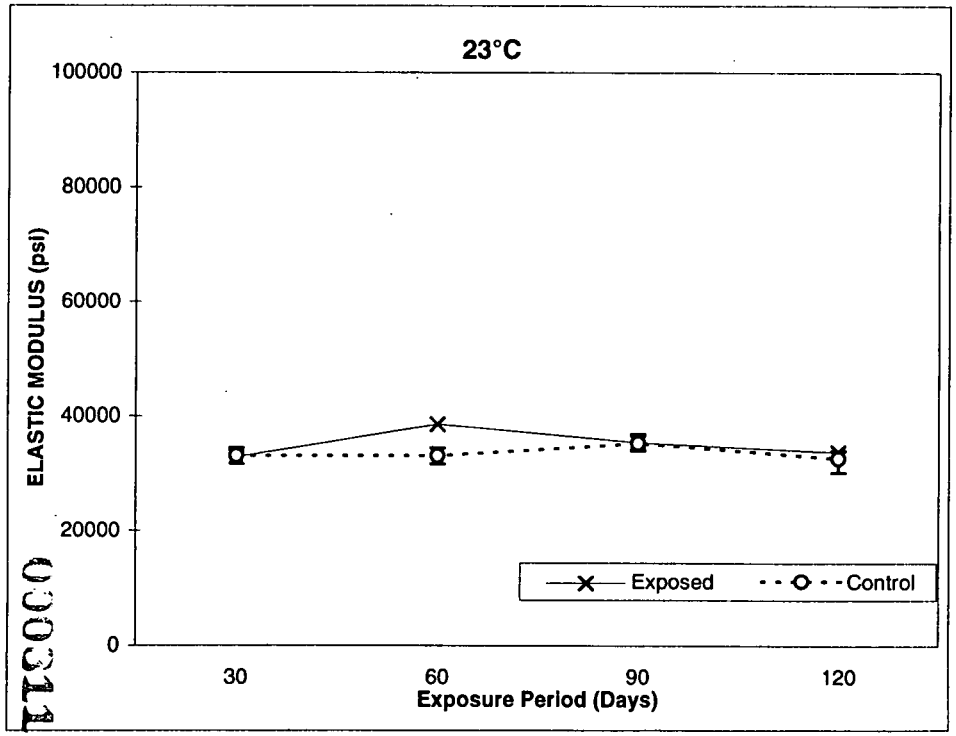
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

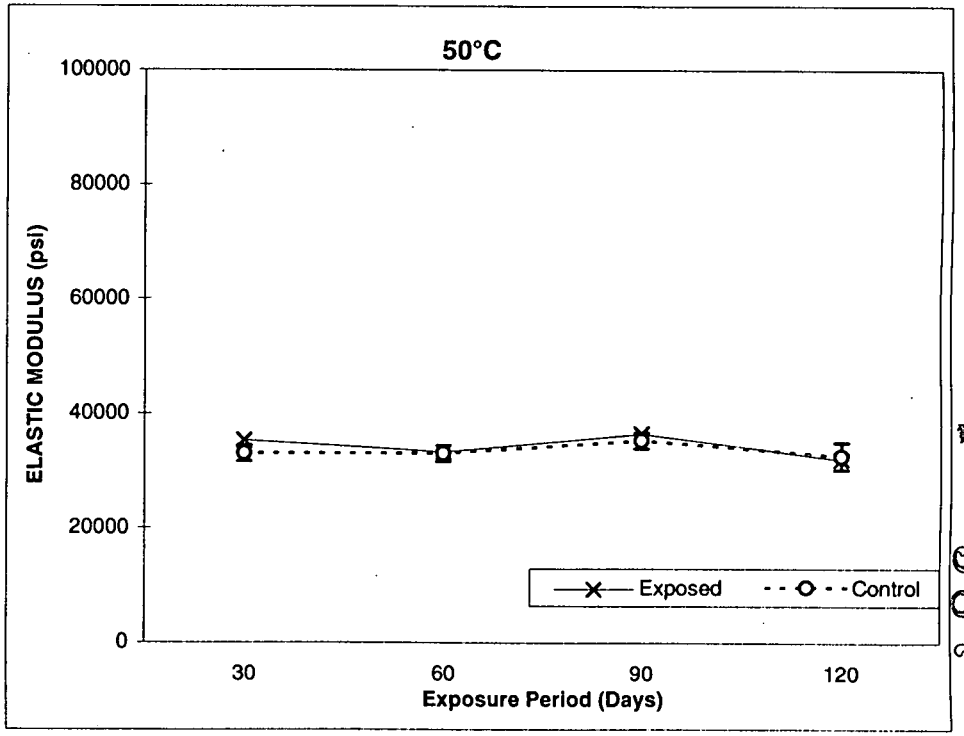
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*GSE - SLT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): ELASTIC MODULUS (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	34090	31880	33010	35000	31760	33148	1403	0.000	34090	31880	33010	35000	31760	33148	1403	0.000	CR
30	34940	32200	30390	30611	36580	32944	2726	-0.615	36840	36920	35410	35280	32370	35364	1842	6.685	CR
Control	34090	31880	33010	35000	31760	33148	1403	0.000	34090	31880	33010	35000	31760	33148	1403	0.000	WM
60	33120	38830	42200	40610	38210	38594	3436	16.429	34890	32290	32140	32670	34910	33380	1401	0.700	CR
Control	34080	37390	34170	35580	35840	35412	1364	0.000	34080	37390	34170	35580	35840	35412	1364	0.000	WM
90	33340	37510	35120	35090	36600	35532	1599	0.339	37240	38560	34850	37900	34100	36530	1951	3.157	VV
Control	36820	33000	30750	31570	31580	32744	2418	0.000	36820	33000	30750	31570	31580	32744	2418	0.000	WM
120	33280	33540	33960	34420	33950	33830	438	3.317	33350	32550	32650	31550	30360	32092	1162	-1.991	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

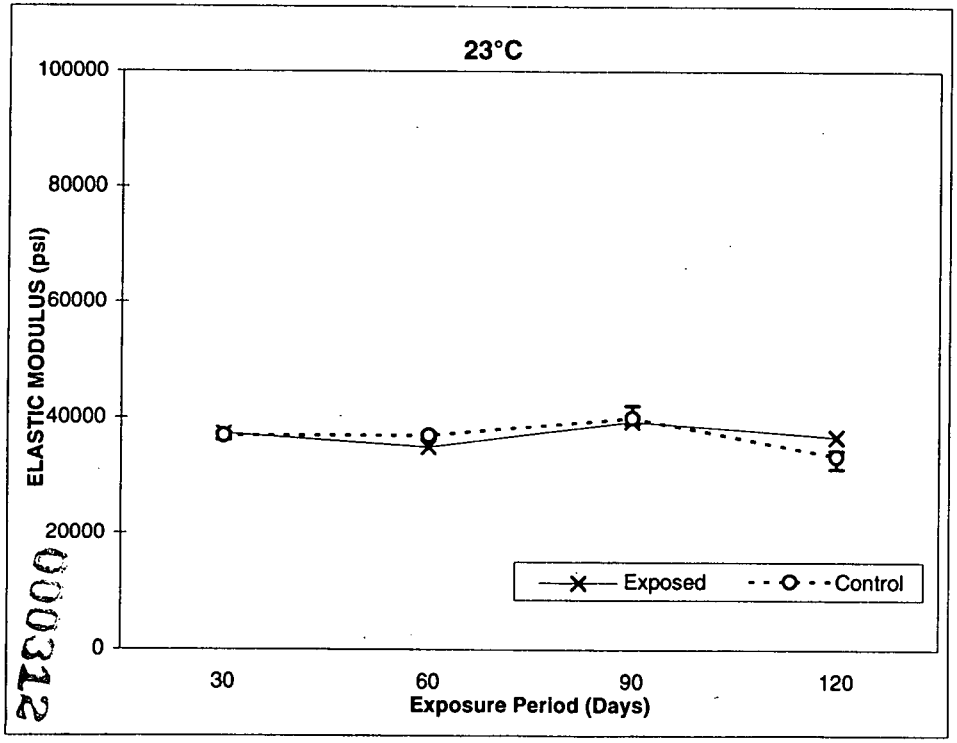
CHEMICAL COMPATIBILITY TEST RESULTS

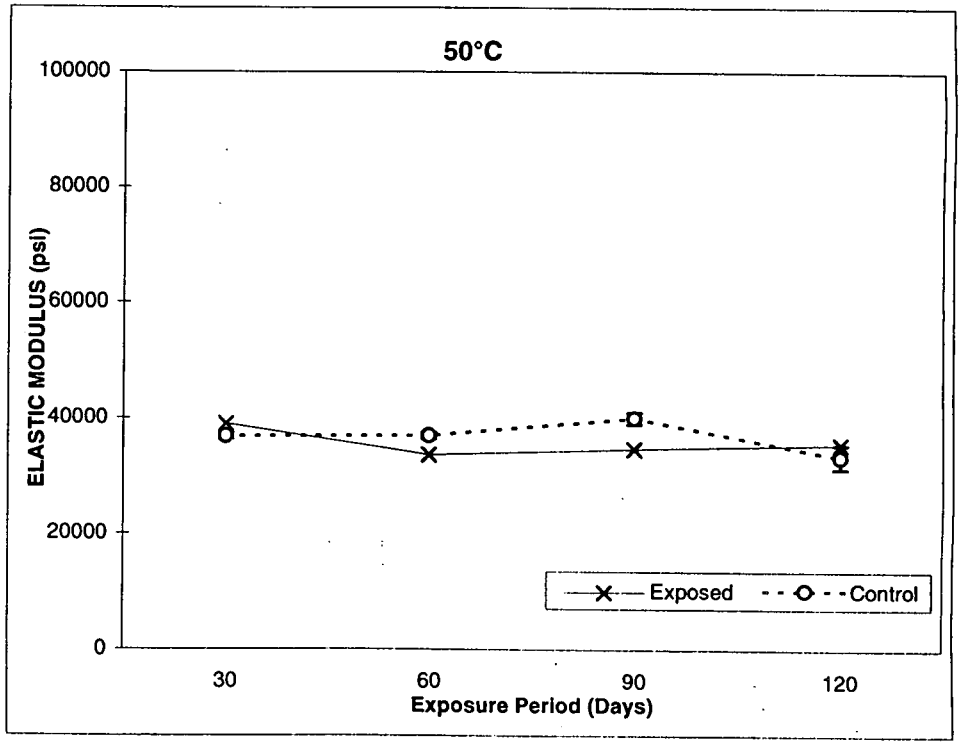
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): ELASTIC MODULUS (psi)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	36580	37570	37150	37050	36140	36898	551	0.000	36580	37570	37150	37050	36140	36898	551	0.000	CR
30	35470	38300	37190	37730	37530	37244	1070	0.938	37700	40240	40210	38560	38240	38990	1169	5.670	CR
Control	36580	37570	37150	37050	36140	36898	551	0.000	36580	37570	37150	37050	36140	36898	551	0.000	WM
60	35310	38790	34420	28430	37770	34944	4050	-5.296	33950	29540	34150	33570	36940	33630	2649	-8.857	CR
Control	38950	39120	41500	40510	40050	40026	1047	0.000	38950	39120	41500	40510	40050	40026	1047	0.000	WM
90	40930	36510	39480	41800	38120	39368	2127	-1.644	33300	36550	35690	29680	38500	34744	3391	-13.196	VV
Control	33790	34110	35490	29900	33980	33454	2097	0.000	33790	34110	35490	29900	33980	33454	2097	0.000	WM
120	37620	37190	37690	35930	35370	36760	1050	9.882	35130	36730	34940	35860	35390	35610	715	6.445	WM





000312

382

Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

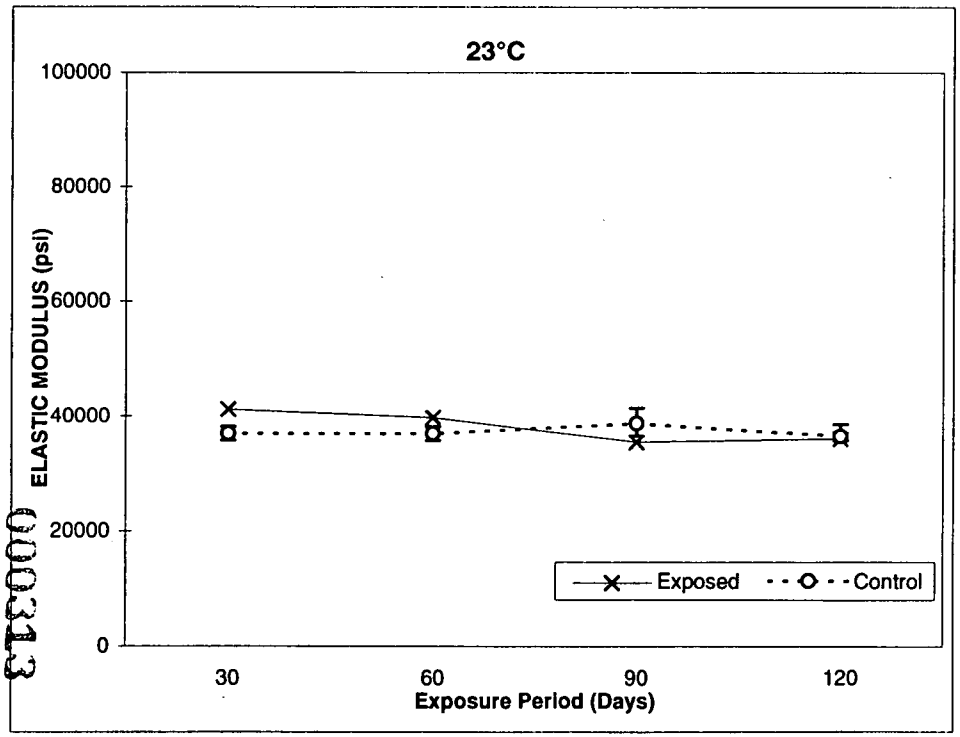
CHEMICAL COMPATIBILITY TEST RESULTS

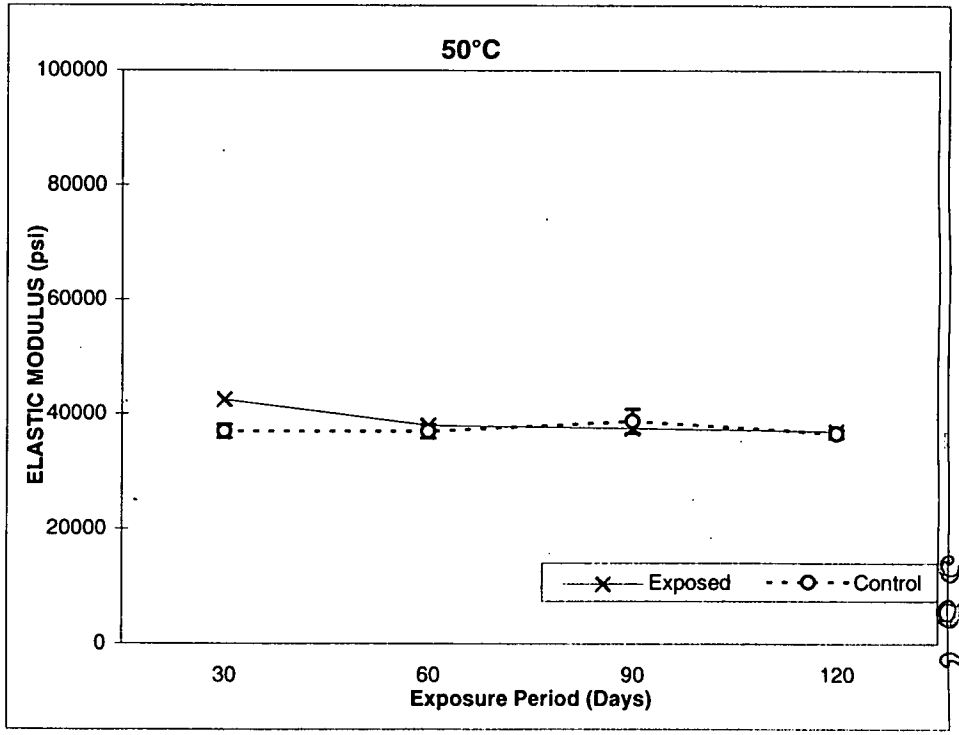
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): ELASTIC MODULUS (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	38410	35470	36310	36560	37980	36946	1219	0.000	38410	35470	36310	36560	37980	36946	1219	0.000	CR
30	38820	40560	42660	41190	42890	41224	1663	11.579	40100	42890	44400	41010	44260	42532	1926	15.119	CR
Control	38410	35470	36310	36560	37980	36946	1219	0.000	38410	35470	36310	36560	37980	36946	1219	0.000	WM
60	44340	42030	38280	36030	38170	39770	3345	7.644	36910	37340	42300	37020	36440	38002	2424	2.858	CR
Control	35790	40610	37260	40460	39800	38784	2148	0.000	35790	40610	37260	40460	39800	38784	2148	0.000	WM
90	34600	33480	33040	39810	36600	35506	2772	-8.452	36410	36870	36470	39540	38200	37498	1351	-3.316	VV
Control	36400	36790	36390	35540	37520	36528	718	0.000	36400	36790	36390	35540	37520	36528	718	0.000	WM
120	36990	34980	37360	36220	34830	36076	1147	-1.237	36190	37000	36840	37630	36750	36882	518	0.969	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000313

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

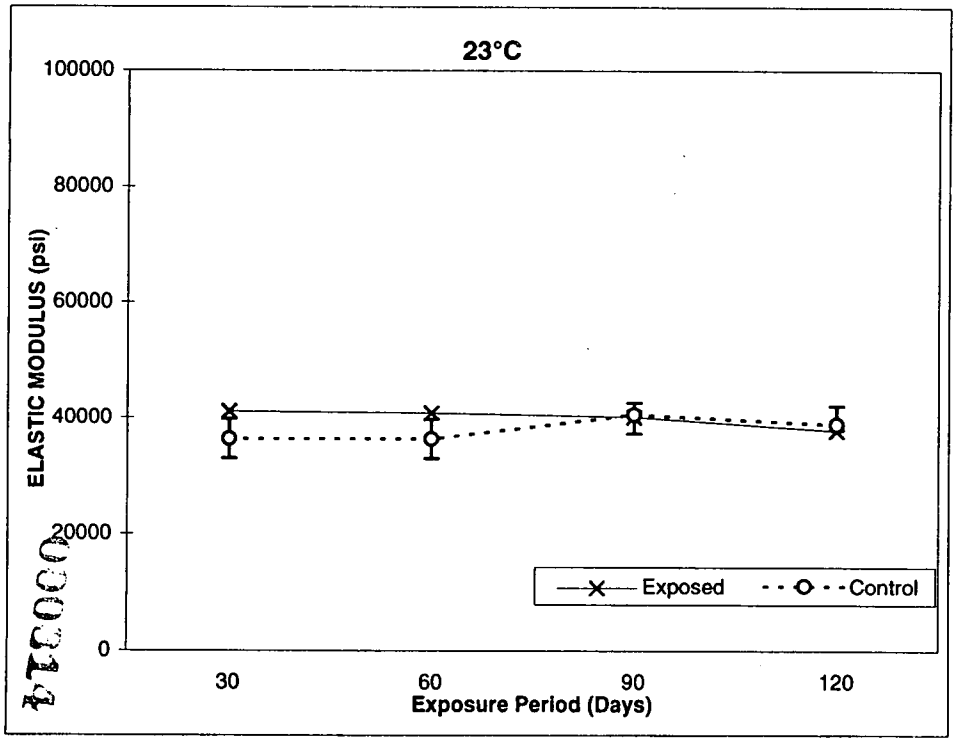
CHEMICAL COMPATIBILITY TEST RESULTS

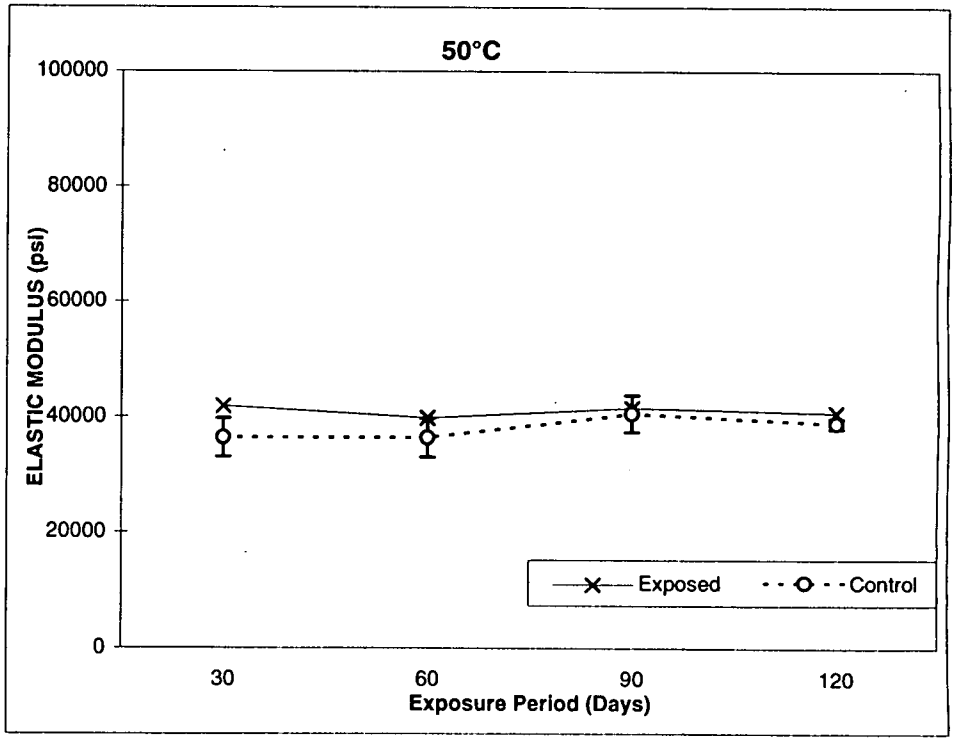
CLIENT:	*FERMCO*
METHOD:	*ASTM D638*
DATE TESTED:	*06/14/96*

GEOSYNTEC JOB NO.:	*GE 3900*
MATERIAL TYPE:	*GSE Gundle*
CHARACTERISTICS:	*80 mil HDPE Geomembrane*
IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): ELASTIC MODULUS (psi)
DIRECTION: ROLL

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	41930	36790	35110	33060	35080	36394	3365	0.000	41930	36790	35110	33060	35080	36394	3365	0.000	CR
30	38450	41560	41200	40390	43980	41116	2003	12.975	42050	41730	42550	39480	43410	41844	1466	14.975	CR
Control	41930	36790	35110	33060	35080	36394	3365	0.000	41930	36790	35110	33060	35080	36394	3365	0.000	WM
60	39470	38600	41280	42890	41950	40838	1769	12.211	40220	44380	39540	33090	41880	39822	4200	9.419	CR
Control	38780	45890	41280	37780	39290	40604	3218	0.000	38780	45890	41280	37780	39290	40604	3218	0.000	WM
90	39330	37350	42540	39680	42050	40190	2124	-1.020	41110	39810	40360	43920	42480	41536	1667	2.295	VV
Control	39650	38910	38830	37540	39810	38948	899	0.000	39650	38910	38830	37540	39810	38948	899	0.000	WM
120	38590	37420	38160	38730	36660	37912	866	-2.660	40530	39700	42030	40420	41150	40766	874	4.668	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

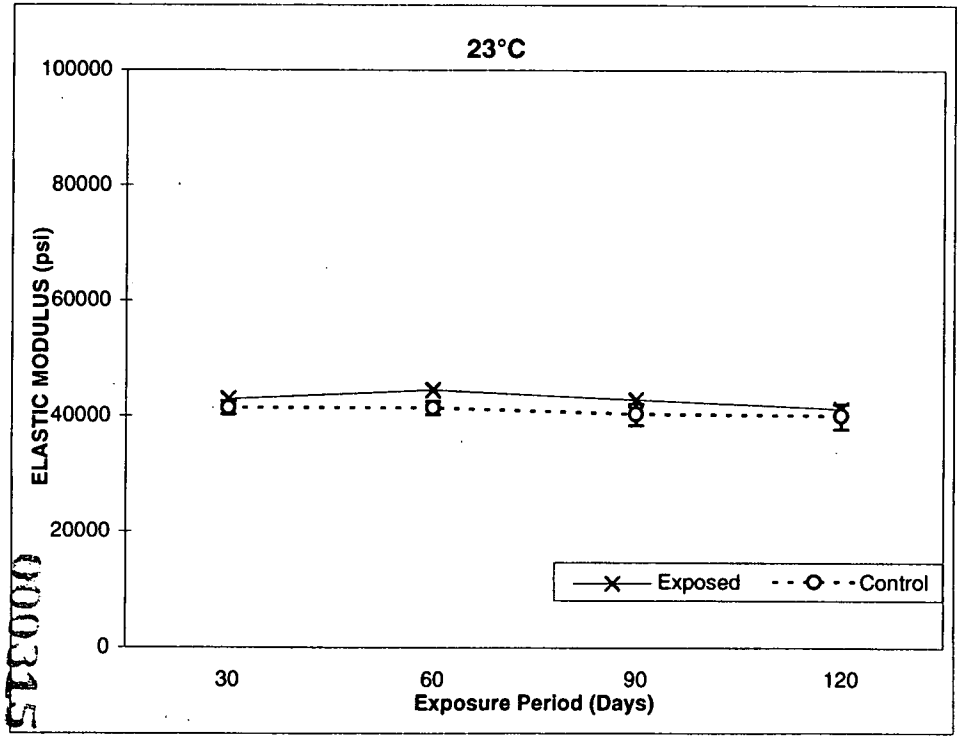
CHEMICAL COMPATIBILITY TEST RESULTS

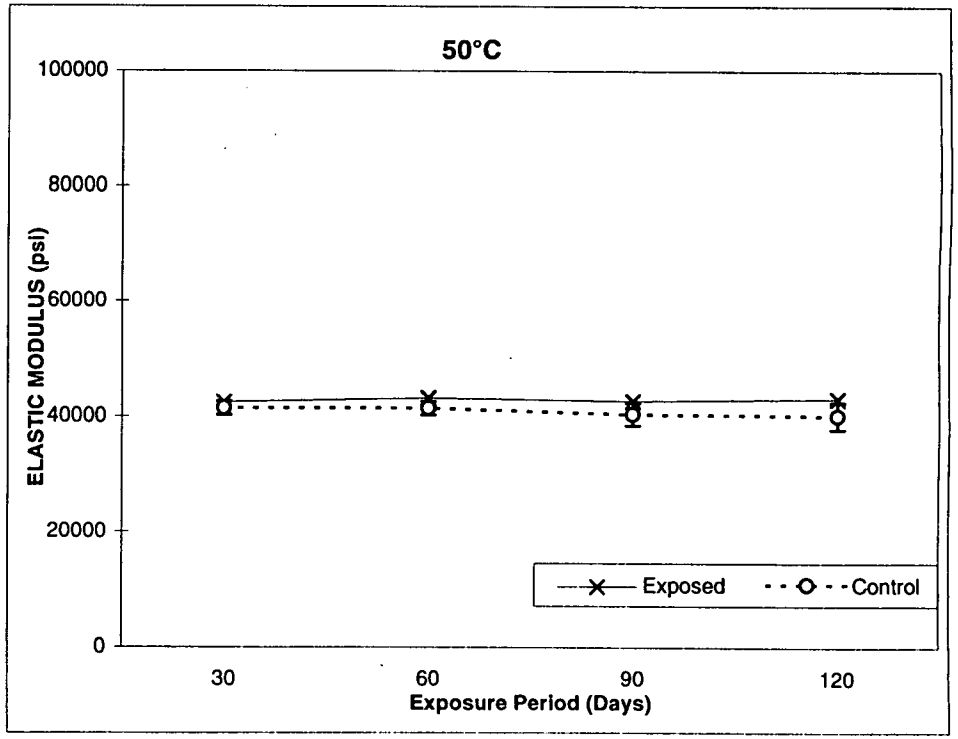
CLIENT:	*FERMCO*
METHOD:	*ASTM D638*
DATE TESTED:	*06/14/96*

GEOSYNTEC JOB NO.:	*GE 3900*
MATERIAL TYPE:	*GSE Gundle*
CHARACTERISTICS:	*80 mil HDPE Geomembrane*
IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): ELASTIC MODULUS (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	42900	39920	42000	40620	41840	41456	1182	0.000	42900	39920	42000	40620	41840	41456	1182	0.000	CR
30	41140	40640	40490	47700	44700	42934	3174	3.565	39840	43960	42440	42440	43680	42472	1628	2.451	CR
Control	42900	39920	42000	40620	41840	41456	1182	0.000	42900	39920	42000	40620	41840	41456	1182	0.000	WM
60	42000	44570	45990	46140	43840	44508	1703	7.362	41450	44210	43770	42850	43760	43208	1100	4.226	CR
Control	39570	42740	38900	42380	38690	40456	1952	0.000	39570	42740	38900	42380	38690	40456	1952	0.000	WM
90	44940	40140	42590	42900	43820	42878	1783	5.987	42840	43740	40100	42120	44720	42704	1752	5.557	VV
Control	41130	37290	41110	43160	38400	40218	2354	0.000	41130	37290	41110	43160	38400	40218	2354	0.000	WM
120	38900	39100	41900	42970	43860	41346	2252	2.805	42560	41670	44080	44730	42570	43122	1248	7.221	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

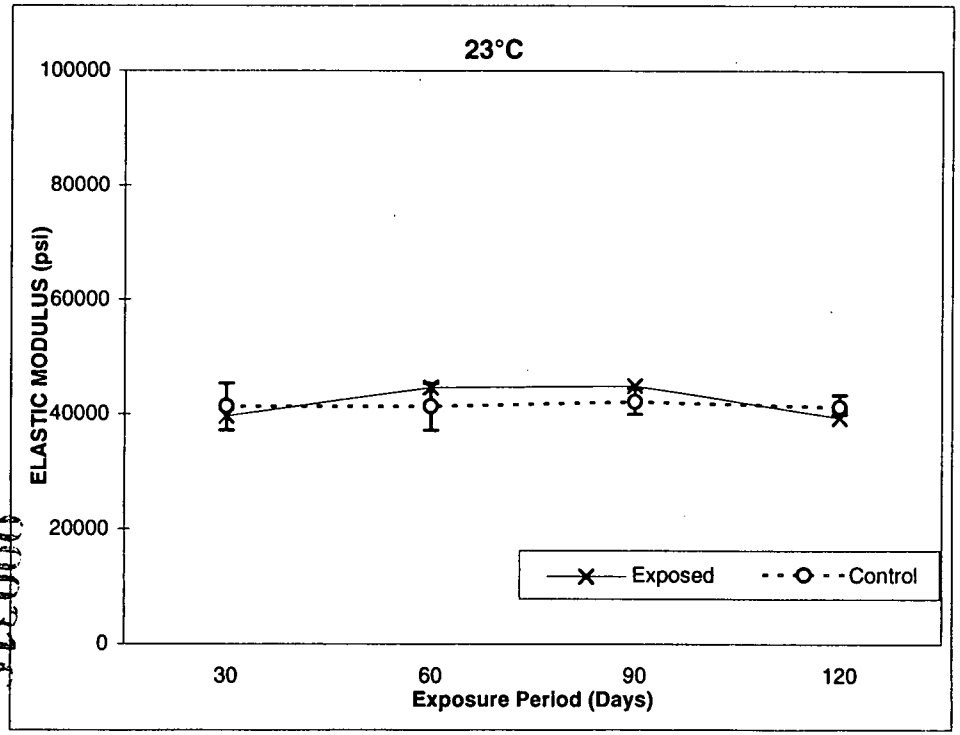
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

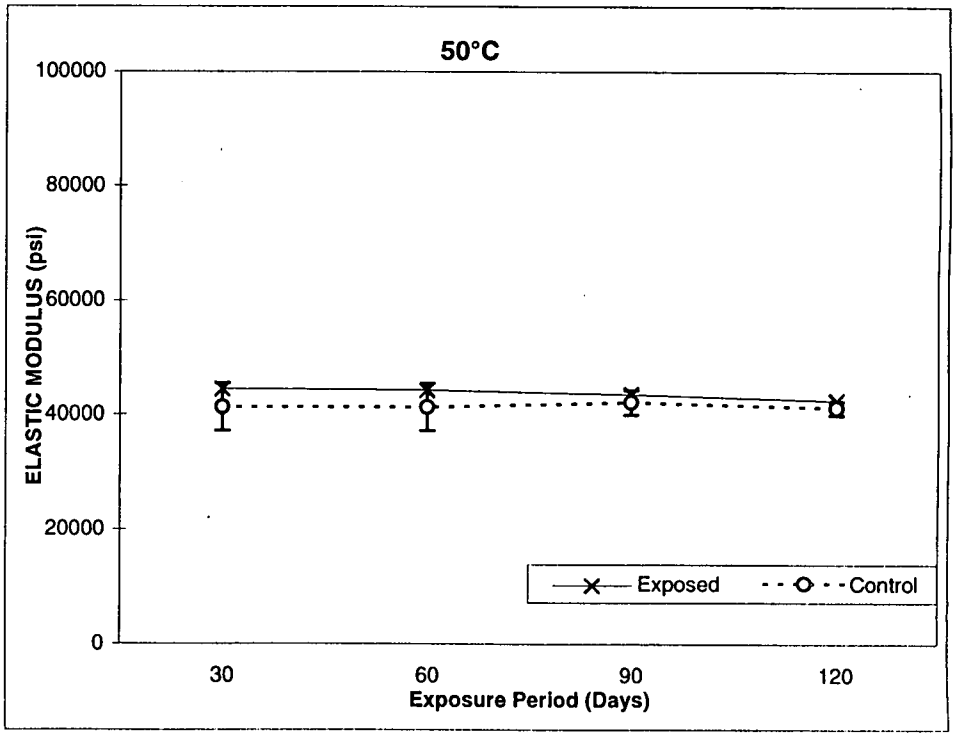
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D638*	*MATERIAL TYPE:*	*POLYFLEX*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): ELASTIC MODULUS (psi)
DIRECTION: ROLL

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	37600	41480	45210	36810	45520	41324	4092	0.000	37600	41480	45210	36810	45520	41324	4092	0.000	CR
30	38290	39010	45160	39440	36490	39678	3265	-3.983	44930	42470	47160	42510	45020	44418	1973	7.487	CR
Control	37600	41480	45210	36810	45520	41324	4092	0.000	37600	41480	45210	36810	45520	41324	4092	0.000	WM
60	44590	43610	43130	44030	47560	44584	1748	7.889	44840	43640	42370	44590	45660	44220	1260	7.008	CR
Control	42610	41890	42960	38870	44630	42192	2112	0.000	42610	41890	42960	38870	44630	42192	2112	0.000	WM
90	44040	45180	45740	48000	41630	44918	2336	6.461	42260	48260	41770	41920	43710	43584	2725	3.299	WM
Control	42890	39620	41950	40900	41070	41286	1223	0.000	42890	39620	41950	40900	41070	41286	1223	0.000	WM
120	37260	40070	38800	39920	41040	39418	1445	-4.525	42990	40600	41610	44610	42860	42534	1518	3.023	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

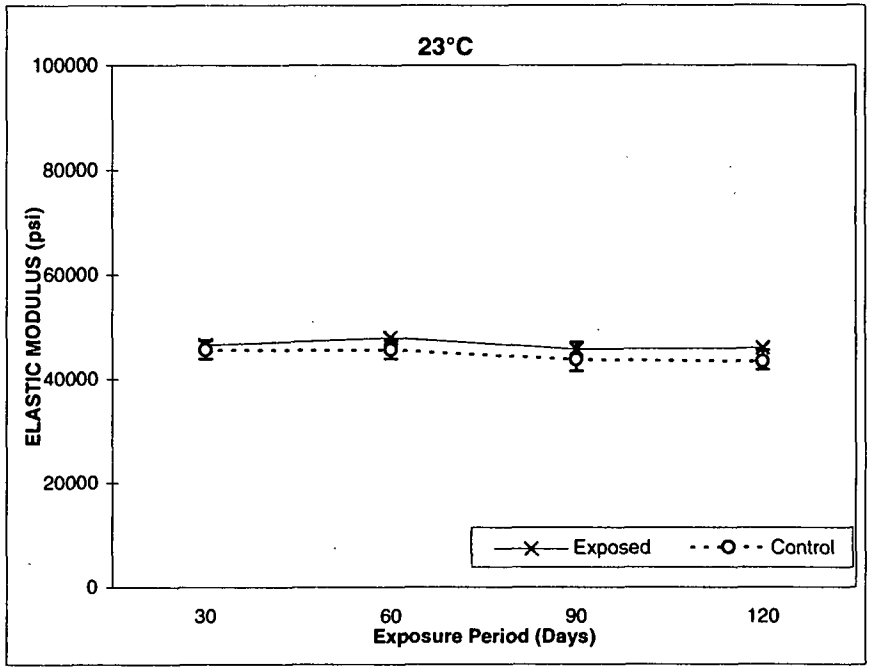
CHEMICAL COMPATIBILITY TEST RESULTS

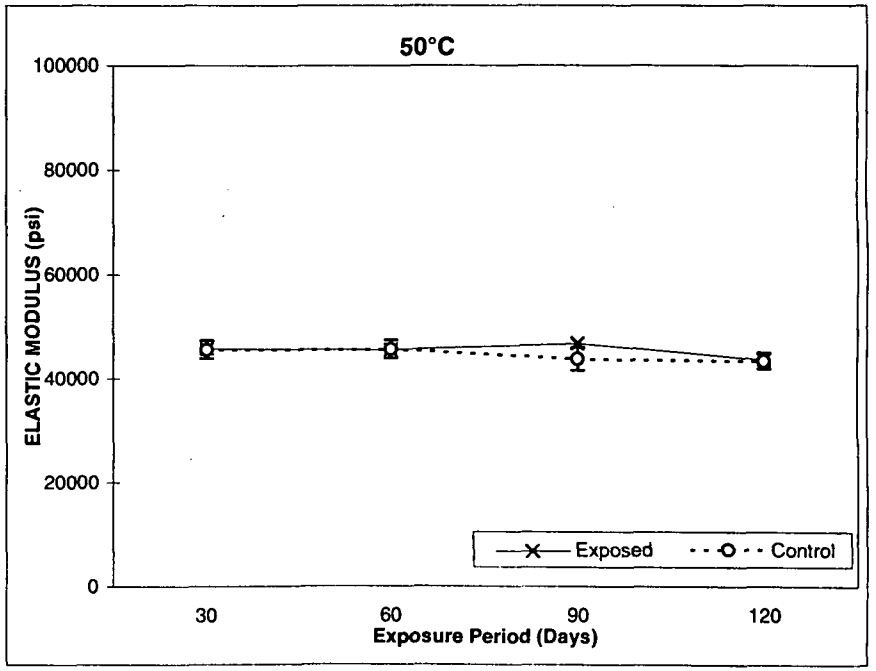
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): ELASTIC MODULUS (psi)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	45940	45570	45220	43260	48210	45640	1771	0.000	45940	45570	45220	43260	48210	45640	1771	0.000	CR
30	49190	51400	43580	42700	45820	46538	3697	1.968	41180	43120	45700	50640	48380	45804	3828	0.359	CR
Control	45940	45570	45220	43260	48210	45640	1771	0.000	45940	45570	45220	43260	48210	45640	1771	0.000	WM
60	46380	49780	49550	48220	45330	47852	1953	4.847	43280	46580	46790	44320	46470	45488	1588	-0.333	CR
Control	40090	44110	43840	44850	45940	43766	2210	0.000	40090	44110	43840	44850	45940	43766	2210	0.000	WM
90	50470	45940	44910	41140	46290	45750	3338	4.533	49330	45090	48370	41030	49680	46700	3651	6.704	WM
Control	43840	44360	41780	45120	41670	43354	1556	0.000	43840	44360	41780	45120	41670	43354	1556	0.000	WM
120	45890	44590	46340	47460	45590	45974	1050	6.043	42340	45540	41400	45860	42860	43600	1990	0.567	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000317

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

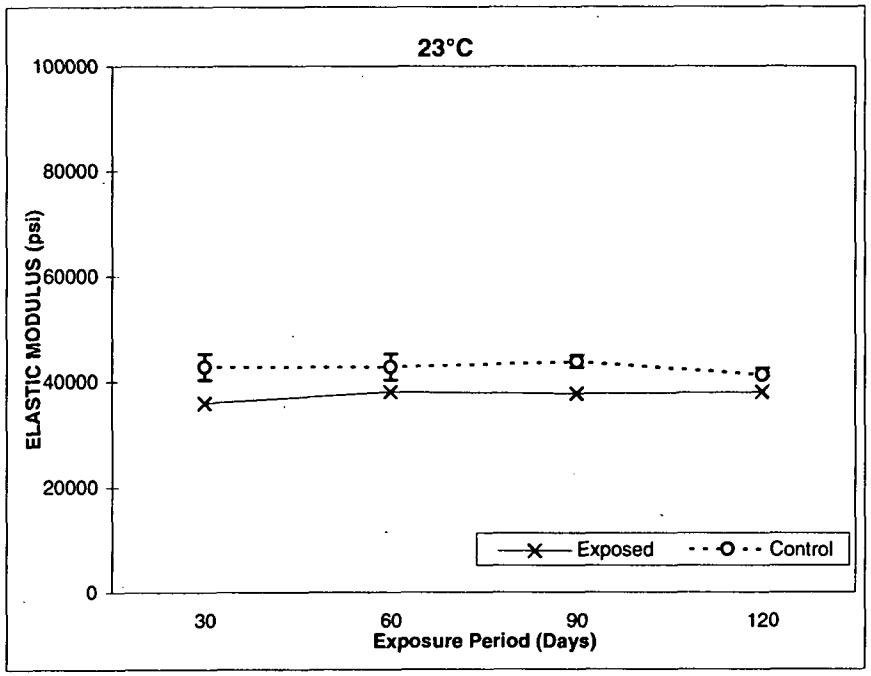
CHEMICAL COMPATIBILITY TEST RESULTS

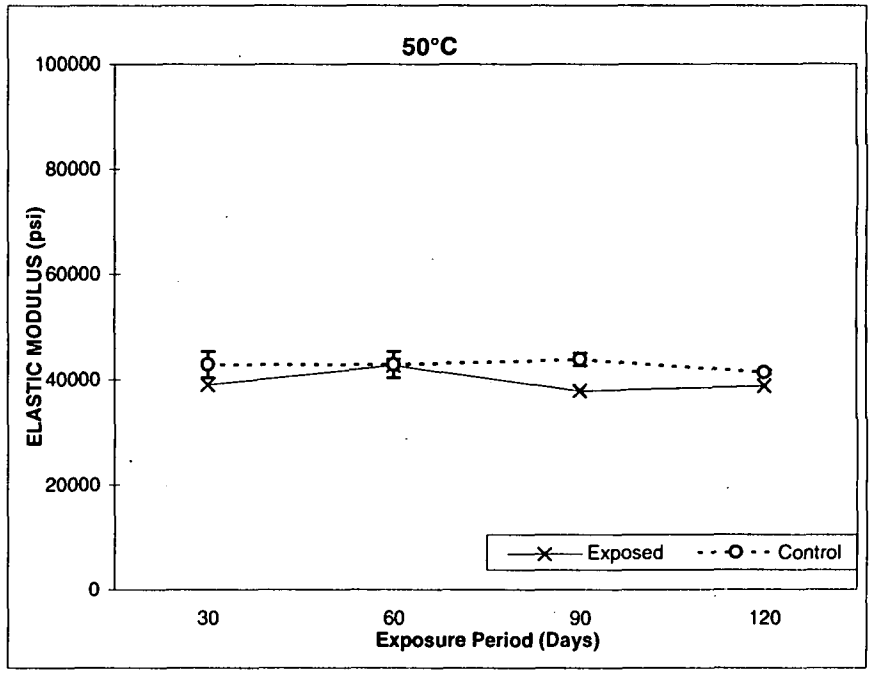
CLIENT: FERMCO
METHOD: ASTM D638
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): ELASTIC MODULUS (psi)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	40360	43800	46510	40940	42580	42838	2461	0.000	40360	43800	46510	40940	42580	42838	2461	0.000	CR
30	31910	39430	42580	28880	36980	35956	5555	-16.065	38420	40380	39010	37750	39550	39022	1013	-8.908	CR
Control	40360	43800	46510	40940	42580	42838	2461	0.000	40360	43800	46510	40940	42580	42838	2461	0.000	WM
60	38110	40050	35930	39780	36670	38108	1829	-11.042	42790	41650	44100	41980	42770	42658	947	-0.420	CR
Control	44390	44840	44630	42000	43270	43826	1187	0.000	44390	44840	44630	42000	43270	43826	1187	0.000	WM
90	38210	38310	35970	37240	38980	37742	1169	-13.882	38110	36100	37800	35840	41380	37846	2215	-13.645	WM
Control	41400	41640	41380	40670	41680	41354	406	0.000	41400	41640	41380	40670	41680	41354	406	0.000	WM
120	36010	39110	38370	38420	38370	38056	1186	-7.975	38900	36420	39360	39230	39970	38776	1373	-6.234	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000318

387

2.10 Initial Tearing Resistance

Rationale for Test

Initial tearing resistance is a measure of the resistance of a material to being torn. A test specimen is tested in tension and is pulled in a direction that is perpendicular to the direction of a pre-existing tear. As with yield stress and modulus of elasticity, initial tearing resistance is reduced when the material absorbs volatile constituents.

Results and Discussion

The following observations were made regarding the initial tear resistance of the five HDPE geomembranes.

GSE-SLT Geomembrane. Initial tear resistance values of the exposed geomembranes showed some variability. However, with the exception of the 23°C (73°F) roll direction sample, most of mean values of the exposed samples were within one standard deviation of the control value means. In addition, there were no significant differences between the 23°C (73°F) and 50° (122°F) data sets.

NSC Geomembrane. Initial tear resistance values of the geomembranes varied slightly during 120 days of exposure; however, approximately 50 percent of the mean values of the exposed samples were within one standard deviation of the control value means. In addition, the 50°C (122°F) samples of the roll and cross-roll direction samples show similar behavior (i.e., at 120 days, the roll and cross-roll direction samples experienced an increase of approximately 11 percent and 13 percent respectively).

GSE-Gundle Geomembrane. Initial tear resistance values of the exposed geomembranes were generally constant until the 90-day exposure period, at which point the exposed sample tear resistances were decreased by approximately 4 to 7 percent. In addition, a similar reduction was evident in the 120-day test results. Approximately 50 percent of the mean values (the 30-day and 60-day values) of the exposed samples were within one standard deviation of the control value

Draft

means. Moreover, the 50°C (122°F) samples appeared to undergo a slightly more accelerated reduction, compared to the 23°C (73°F) samples. This result is inconsistent with the measured tensile properties, which did not undergo such a reduction.

Polyflex Geomembrane. The results of initial tear resistance were variable, although the percent changes were small. In addition, the results of the exposed roll and cross-roll direction samples experienced parallel changes. Moreover, the percent changes occurring in the 23° (73°F) and 50°C (122°F) were similar. Finally, these results are consistent with the tensile properties, which were also slightly variable.

Serrot Geomembrane. The initial tear resistance of the 23°C (73°F) roll and cross roll direction samples and 50°C (122°F) roll and cross roll direction samples experienced parallel changes. However, the data were slightly variable (i.e., no trends were observed). Most of the mean values of the exposed samples were within one standard deviation of the mean values of the control samples. The percent changes appear to be slightly higher in the 50°C (122°F) samples. Finally, these results are consistent with the measured tensile properties, which also displayed some variability.

Initial tearing resistance for the exposed samples of the five geomembranes displayed similar results. The results were generally variable, although the percent changes were small. No significant trends were observed, and the results were consistent with the tensile properties, which also did not display significant trends. The observed changes in the initial tearing resistance are not likely due to action of the leachate because data trends were not observed, and, in most cases, the results 50°C (122°F) samples were similar to the results 23°C (73°F) samples.

Conclusion

The initial tearing resistances of the five geomembranes were not measurably impacted after 120 days of exposure to the test leachate.

Draft

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

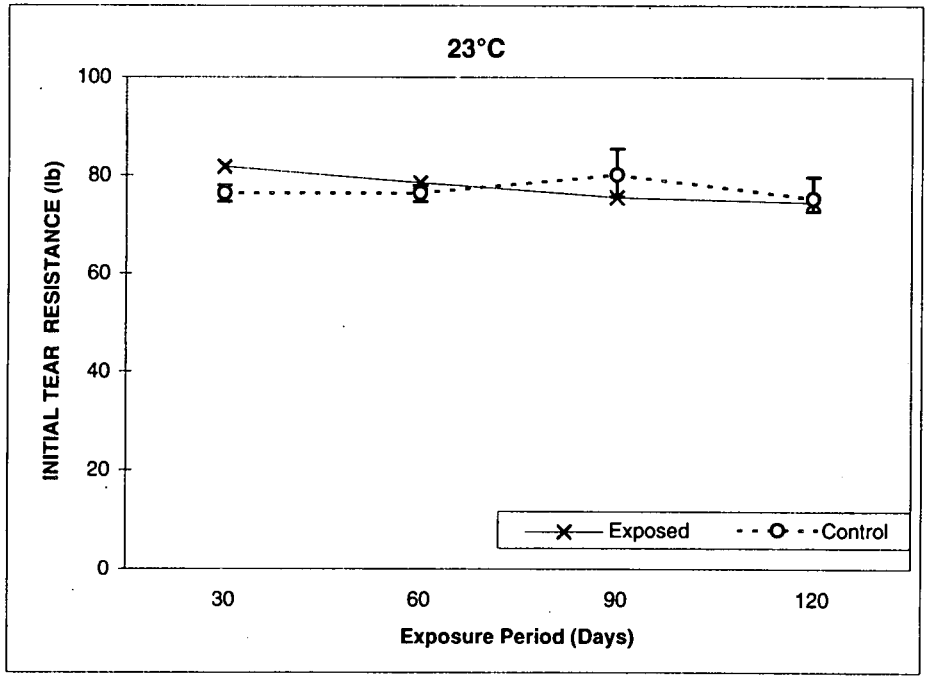
CHEMICAL COMPATIBILITY TEST RESULTS

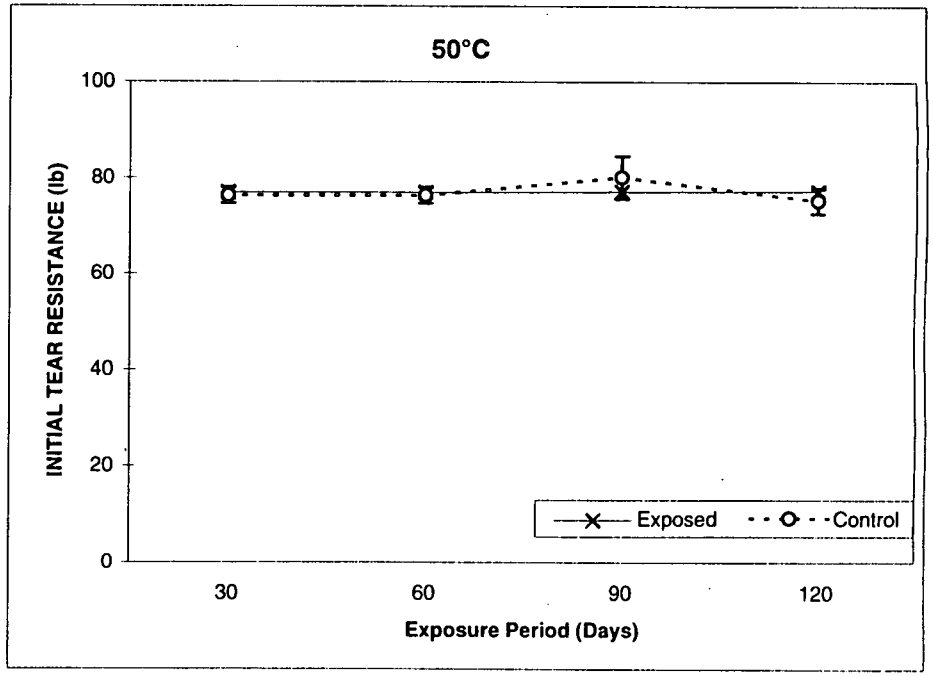
CLIENT: FERMCO
METHOD: ASTM D1004
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): INITIAL TEAR RESISTANCE (lb)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	75	79	77	76	75	76.4	1.7	0.000	75	79	77	76	75	76.4	1.7	0.000	VV
30	81	82	88	79	79	81.8	3.7	7.068	78	79	76	78	74	77.0	2.0	0.785	VV
Control	75	79	77	76	75	76.4	1.7	0.000	75	79	77	76	75	76.4	1.7	0.000	WM
60	80	79	76	80	78	78.6	1.7	2.880	82	74	76	80	73	77.0	3.9	0.785	VV
Control	75	87	80	78	81	80.2	4.4	0.000	75	87	80	78	81	80.2	4.4	0.000	WM
90	81	71	75	81	70	75.6	5.3	-5.736	76	82	77	72	79	77.2	3.7	-3.741	WM
Control	78	72	78	74	75	75.4	2.6	0.000	78	72	78	74	75	75.4	2.6	0.000	WM
120	76	72	80	73	72	74.6	3.4	-1.061	74	78	77	80	78	77.4	2.2	2.653	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

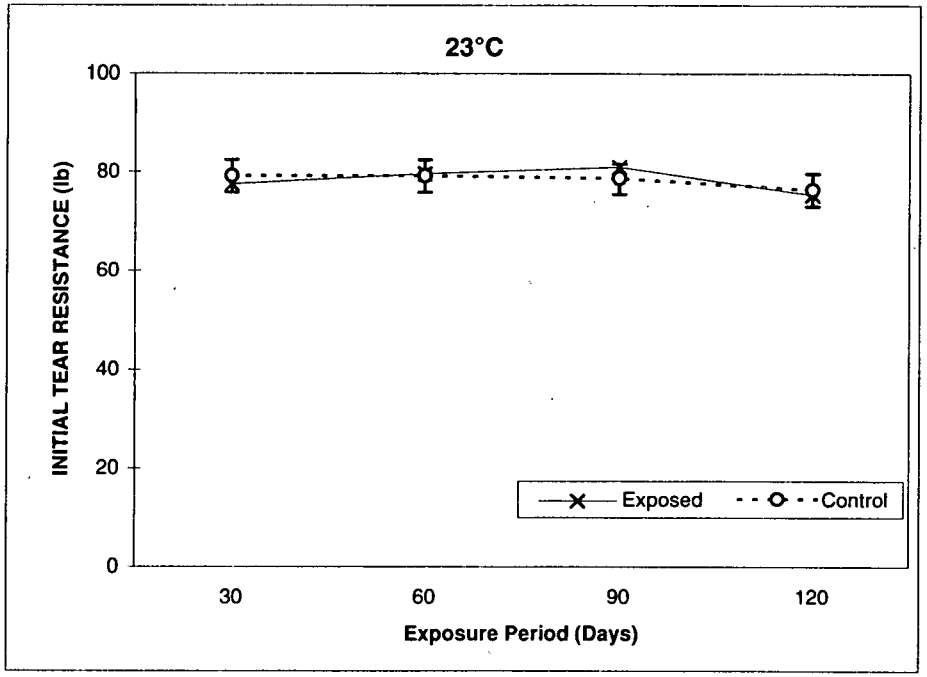
CHEMICAL COMPATIBILITY TEST RESULTS

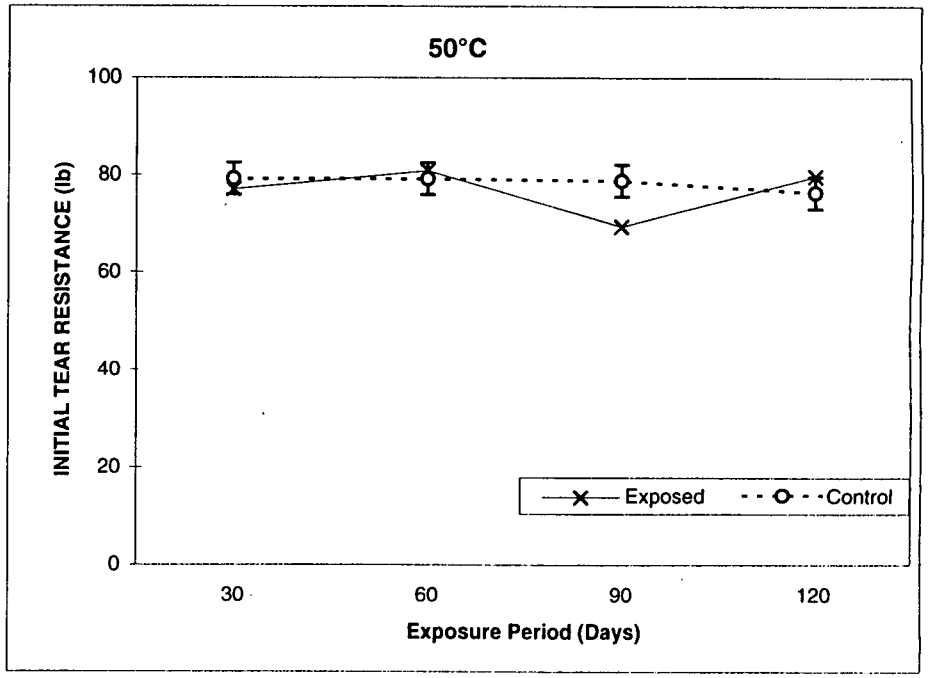
CLIENT: FERMCO
METHOD: ASTM D1004
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): INITIAL TEAR RESISTANCE (lb)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	78	78	85	78	77	79.2	3.3	0.000	78	78	85	78	77	79.2	3.3	0.000	VV
30	77	79	74	74	84	77.6	4.2	-2.020	77	74	76	79	79	77.0	2.1	-2.778	VV
Control	78	78	85	78	77	79.2	3.3	0.000	78	78	85	78	77	79.2	3.3	0.000	WM
60	75	80	79	81	83	79.6	3.0	0.505	75	86	79	80	84	80.8	4.3	2.020	VV
Control	78	79	78	84	75	78.8	3.3	0.000	78	79	78	84	75	78.8	3.3	0.000	WM
90	84	80	79	84	78	81.0	2.8	2.792	69	69	71	69	69	69.4	0.9	-11.929	WM
Control	72	80	78	74	78	76.4	3.3	0.000	72	80	78	74	78	76.4	3.3	0.000	WM
120	74	75	74	78	76	75.4	1.7	-1.309	79	85	77	79	79	79.8	3.0	4.450	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000323

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

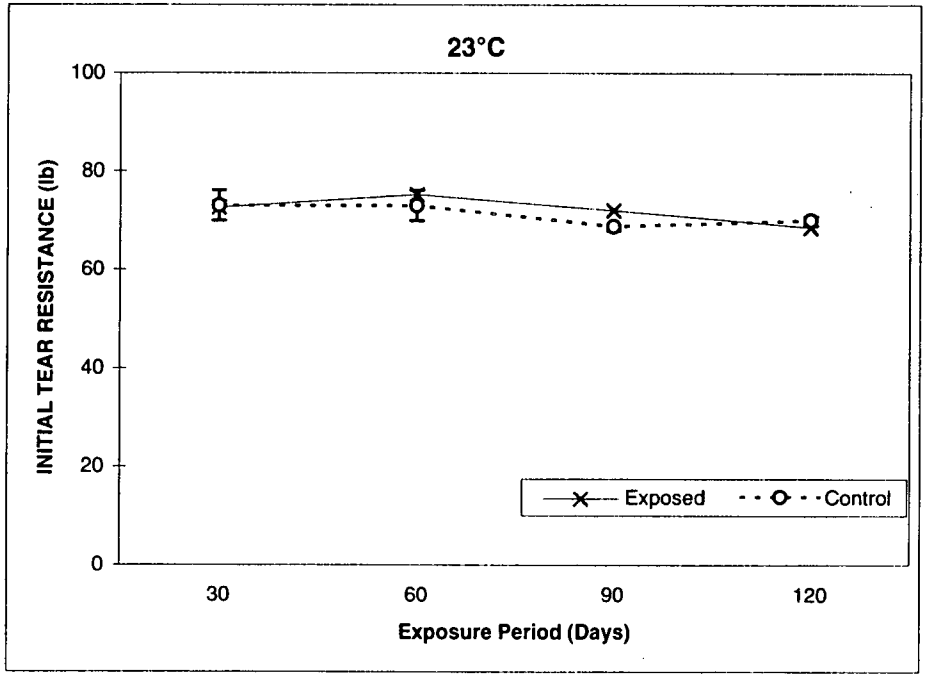
CHEMICAL COMPATIBILITY TEST RESULTS

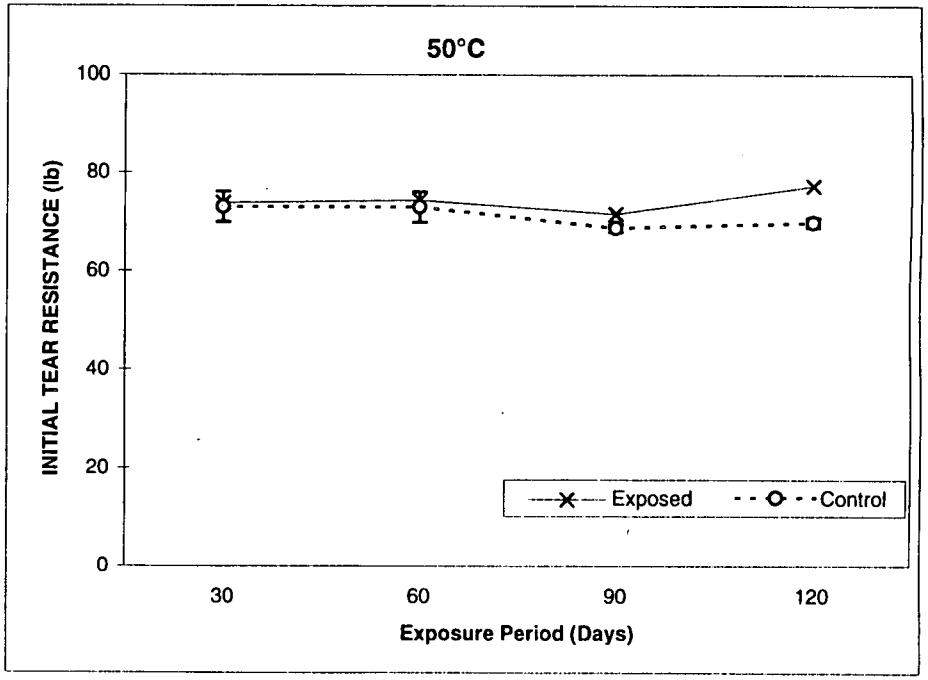
CLIENT: FERMCO
METHOD: ASTM D1004
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): INITIAL TEAR RESISTANCE (lb)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	71	71	78	74	71	73.0	3.1	0.000	71	71	78	74	71	73.0	3.1	0.000	VV
30	70	73	75	73	72	72.6	1.8	-0.548	76	72	74	75	72	73.8	1.8	1.096	VV
Control	71	71	78	74	71	73.0	3.1	0.000	71	71	78	74	71	73.0	3.1	0.000	WM
60	76	76	74	74	76	75.2	1.1	3.014	76	75	75	73	73	74.4	1.3	1.918	VV
Control	68	69	70	68	69	68.8	0.8	0.000	68	69	70	68	69	68.8	0.8	0.000	WM
90	72	72	72	72	72	72.0	0.0	4.651	71	73	74	70	70	71.6	1.8	4.070	WM
Control	71	70	69	69	71	70.0	1.0	0.000	71	70	69	69	71	70.0	1.0	0.000	WM
120	69	68	68	68	70	68.6	0.9	-2.000	74	78	77	80	78	77.4	2.2	10.571	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000324

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

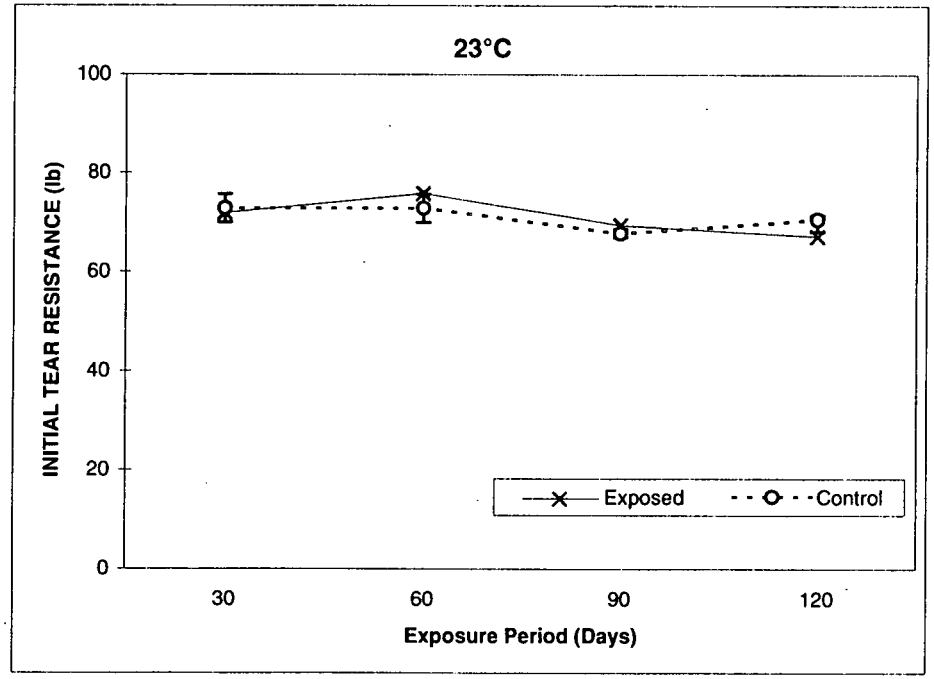
CHEMICAL COMPATIBILITY TEST RESULTS

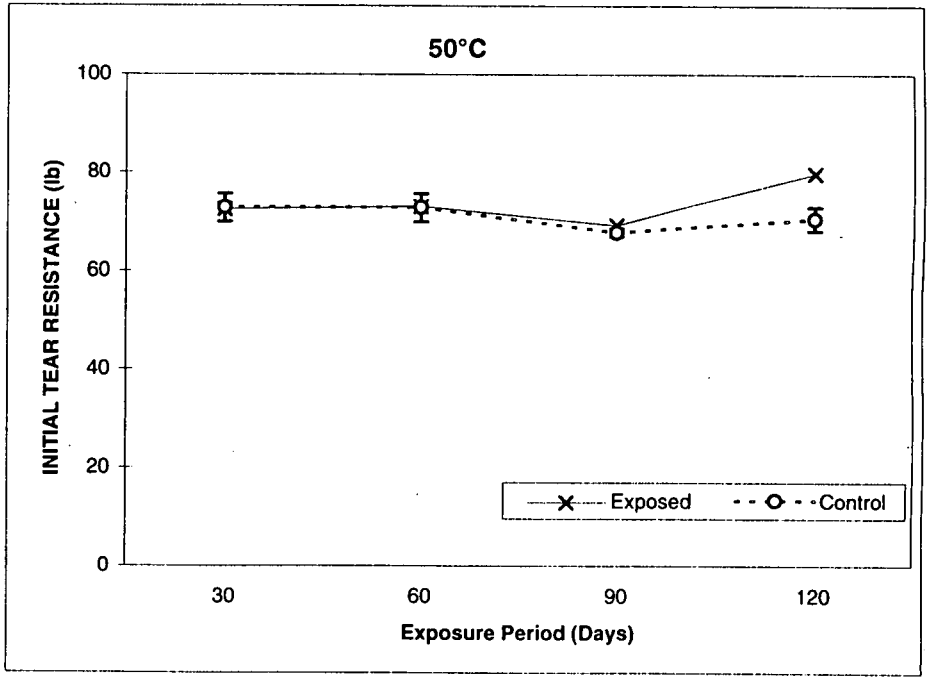
CLIENT: FERMCO
METHOD: ASTM D1004
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): INITIAL TEAR RESISTANCE (lb)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	77	73	72	73	69	72.8	2.9	0.000	77	73	72	73	69	72.8	2.9	0.000	VV
30	73	71	69	72	74	71.8	1.9	-1.374	71	74	75	70	72	72.4	2.1	-0.549	VV
Control	77	73	72	73	69	72.8	2.9	0.000	77	73	72	73	69	72.8	2.9	0.000	WM
60	74	76	76	74	79	75.8	2.0	4.121	74	73	70	74	74	73.0	1.7	0.275	VV
Control	68	69	67	68	67	67.8	0.8	0.000	68	69	67	68	67	67.8	0.8	0.000	WM
90	69	69	71	69	69	69.4	0.9	2.360	68	67	71	72	68	69.2	2.2	2.065	WM
Control	68	70	72	74	69	70.6	2.4	0.000	68	70	72	74	69	70.6	2.4	0.000	WM
120	68	67	67	67	67	67.2	0.4	-4.816	79	85	77	79	79	79.8	3.0	13.031	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000325

382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

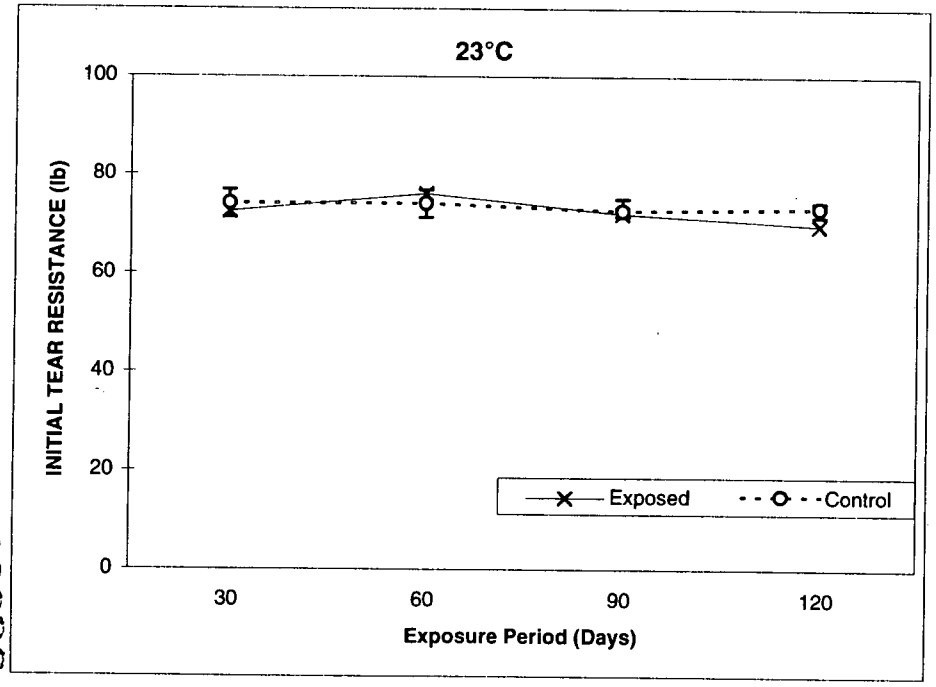
CHEMICAL COMPATIBILITY TEST RESULTS

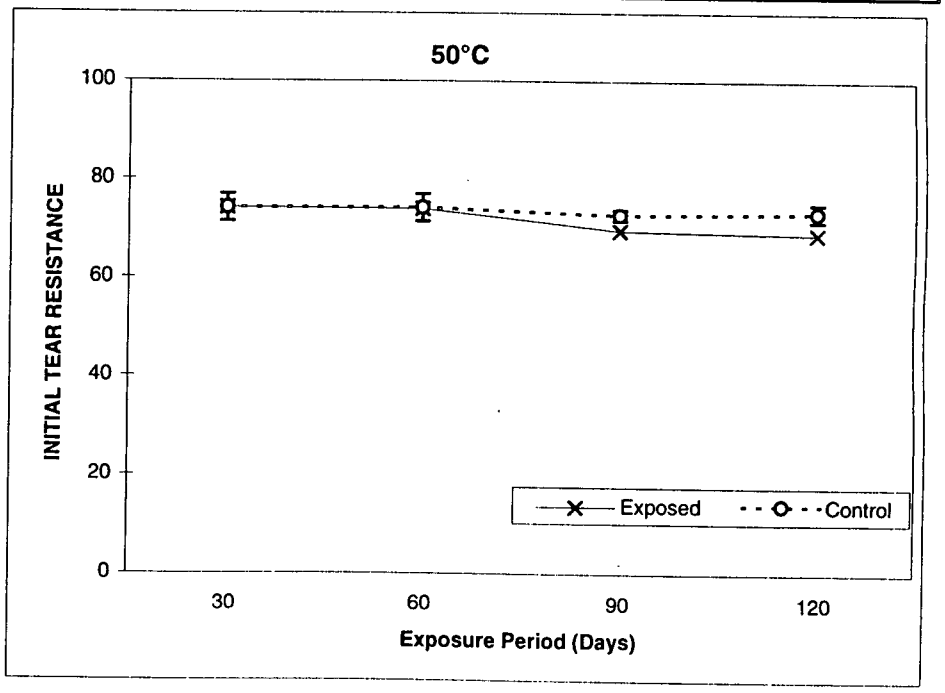
CLIENT: FERMCO
METHOD: ASTM D1004
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): INITIAL TEAR RESISTANCE (lb)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	76	75	70	77	73	74.2	2.8	0.000	76	75	70	77	73	74.2	2.8	0.000	VV
30	71	72	74	75	71	72.6	1.8	-2.156	73	74	73	77	74	74.2	1.6	0.000	VV
Control	76	75	70	77	73	74.2	2.8	0.000	76	75	70	77	73	74.2	2.8	0.000	WM
60	72	78	77	78	76	76.2	2.5	2.695	74	74	73	73	76	74.0	1.2	-0.270	VV
Control	74	72	74	72	72	72.8	1.1	0.000	74	72	74	72	72	72.8	1.1	0.000	WM
90	74	71	69	72	75	72.2	2.4	-0.824	68	71	71	69	69	69.6	1.3	-4.396	WM
Control	75	75	72	74	71	73.4	1.8	0.000	75	75	72	74	71	73.4	1.8	0.000	WM
120	70	69	70	70	70	69.8	0.4	-4.905	67	71	70	69	68	69.0	1.6	-5.995	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000326

387

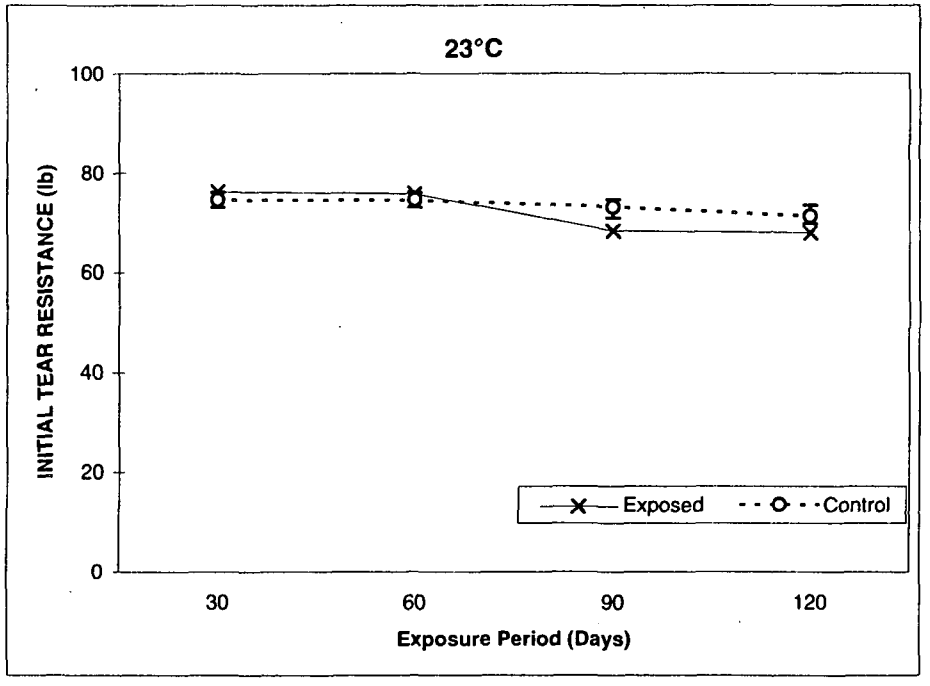
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

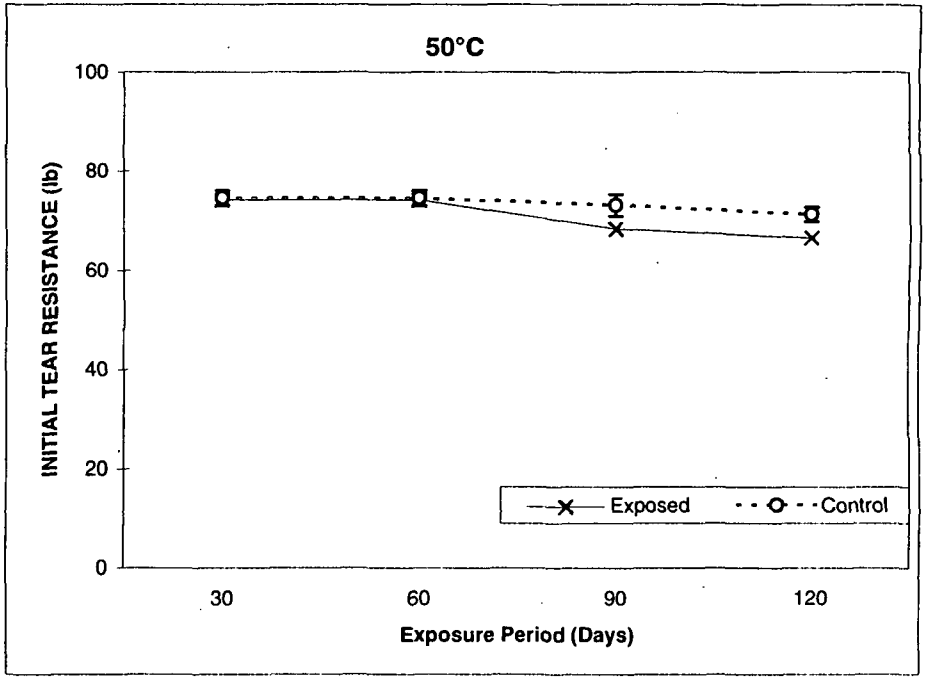
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*ASTM D1004*	*MATERIAL TYPE:*	*GSE Gundle*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): INITIAL TEAR RESISTANCE (lb)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	75	73	76	76	73	74.6	1.5	0.000	75	73	76	76	73	74.6	1.5	0.000	VV
30	76	73	76	77	79	76.2	2.2	2.145	70	73	74	75	79	74.2	3.3	-0.536	VV
Control	75	73	76	76	73	74.6	1.5	0.000	75	73	76	76	73	74.6	1.5	0.000	WM
60	75	74	74	77	79	75.8	2.2	1.609	74	74	72	78	73	74.2	2.3	-0.536	VV
Control	74	75	75	72	70	73.2	2.2	0.000	74	75	75	72	70	73.2	2.2	0.000	WM
90	69	66	70	69	68	68.4	1.5	-6.557	67	68	71	67	69	68.4	1.7	-6.557	WM
Control	72	71	69	72	73	71.4	1.5	0.000	72	71	69	72	73	71.4	1.5	0.000	WM
120	68	69	67	69	67	68.0	1.0	-4.762	67	67	66	65	68	66.6	1.1	-6.723	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

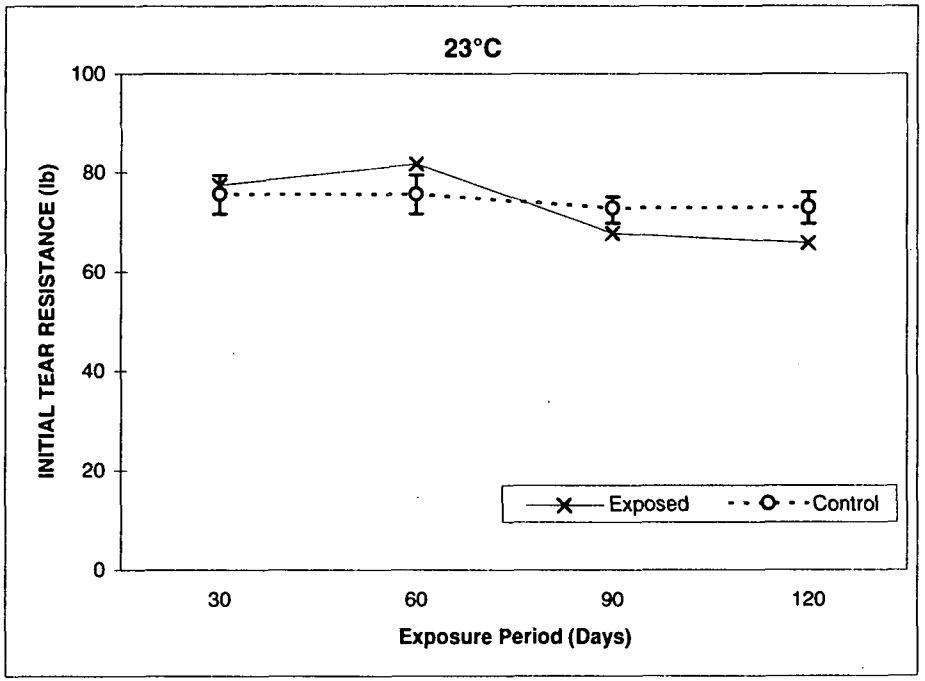
CHEMICAL COMPATIBILITY TEST RESULTS

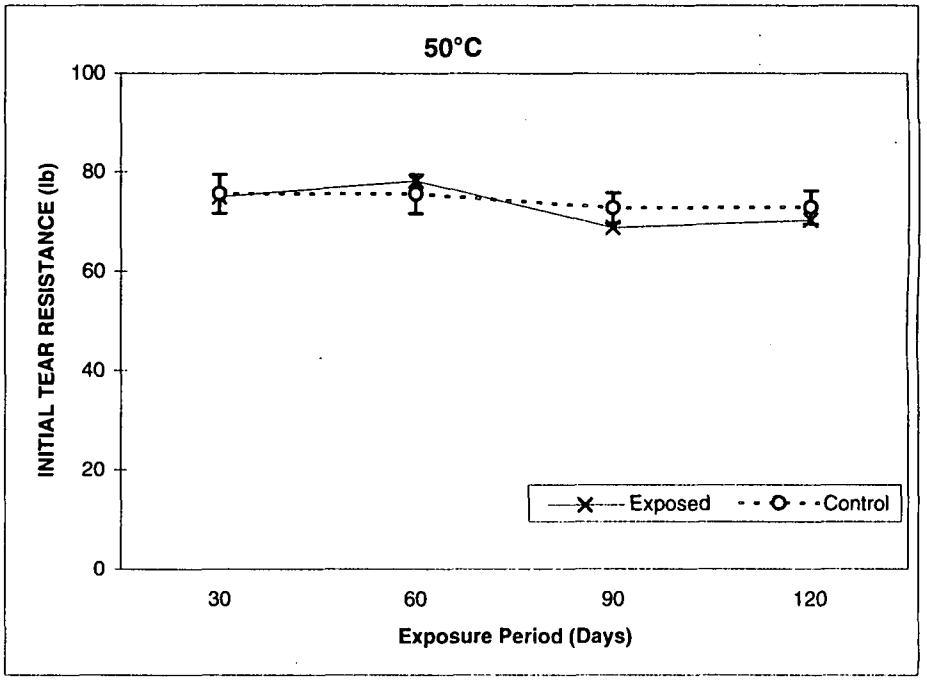
CLIENT: FERMCO
METHOD: ASTM D1004
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): INITIAL TEAR RESISTANCE (lb)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	70	73	79	78	78	75.6	3.9	0.000	70	73	79	78	78	75.6	3.9	0.000	VV
30	74	75	83	79	76	77.4	3.6	2.381	74	76	71	77	77	75.0	2.5	-0.794	VV
Control	70	73	79	78	78	75.6	3.9	0.000	70	73	79	78	78	75.6	3.9	0.000	WM
60	84	82	81	84	78	81.8	2.5	8.201	74	79	84	76	78	78.2	3.8	3.439	VV
Control	69	73	74	71	77	72.8	3.0	0.000	69	73	74	71	77	72.8	3.0	0.000	WM
90	71	66	66	68	68	67.8	2.2	-6.907	68	73	67	67	69	68.9	2.2	-5.396	WM
Control	78	74	70	70	73	73.0	3.3	0.000	78	74	70	70	73	73.0	3.3	0.000	WM
120	65	64	67	71	62	65.8	3.4	-9.863	72	69	70	70	71	70.4	1.1	-3.562	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000328

! - 382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

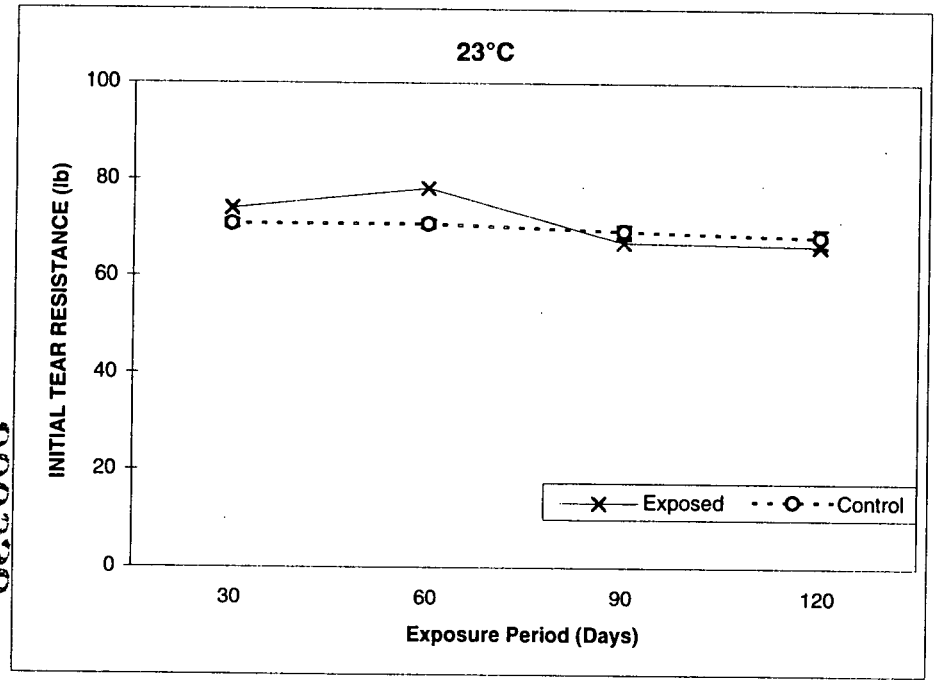
CHEMICAL COMPATIBILITY TEST RESULTS

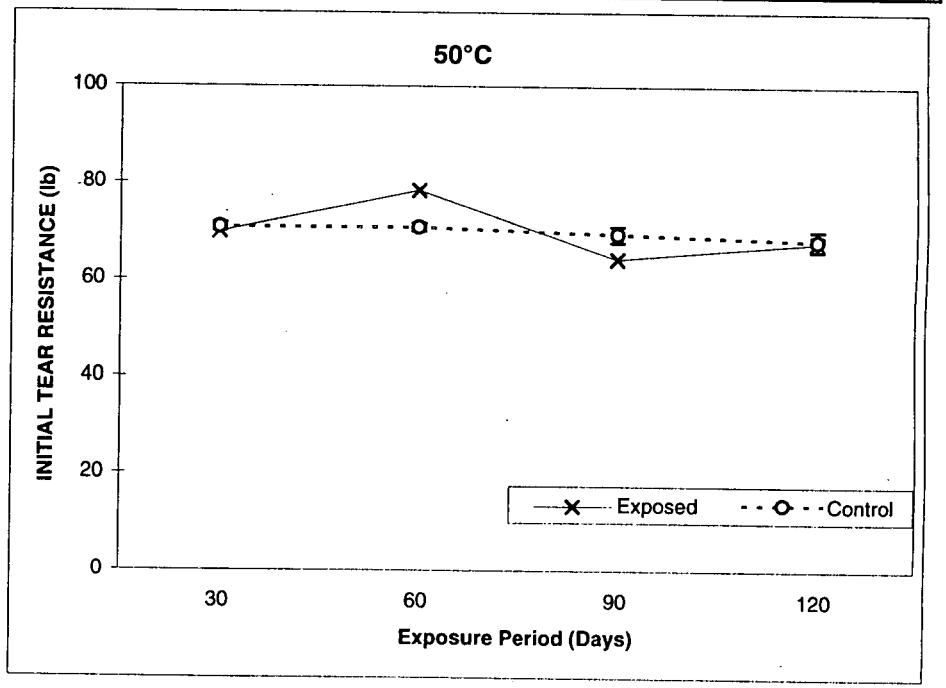
CLIENT: FERMCO
METHOD: ASTM D1004
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): INITIAL TEAR RESISTANCE (lb)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	70	71	70	71	72	70.8	0.8	0.000	70	71	70	71	72	70.8	0.8	0.000	VV
30	73	72	73	75	77	74.0	2.0	4.520	69	69	70	70	71	69.8	0.8	-1.412	VV
Control	70	71	70	71	72	70.8	0.8	0.000	70	71	70	71	72	70.8	0.8	0.000	WM
60	78	79	80	76	78	78.2	1.5	10.452	80	79	79	76	78	78.4	1.5	10.734	VV
Control	70	68	69	72	68	69.4	1.7	0.000	70	68	69	72	68	69.4	1.7	0.000	WM
90	68	66	69	66	67	67.0	1.2	-3.496	65	68	61	65	62	64.3	2.6	-7.386	WM
Control	66	69	70	66	70	68.2	2.0	0.000	66	69	70	66	70	68.2	2.0	0.000	WM
120	63	68	67	65	69	66.4	2.4	-2.639	70	70	68	65	66	67.8	2.3	-0.587	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000329

382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

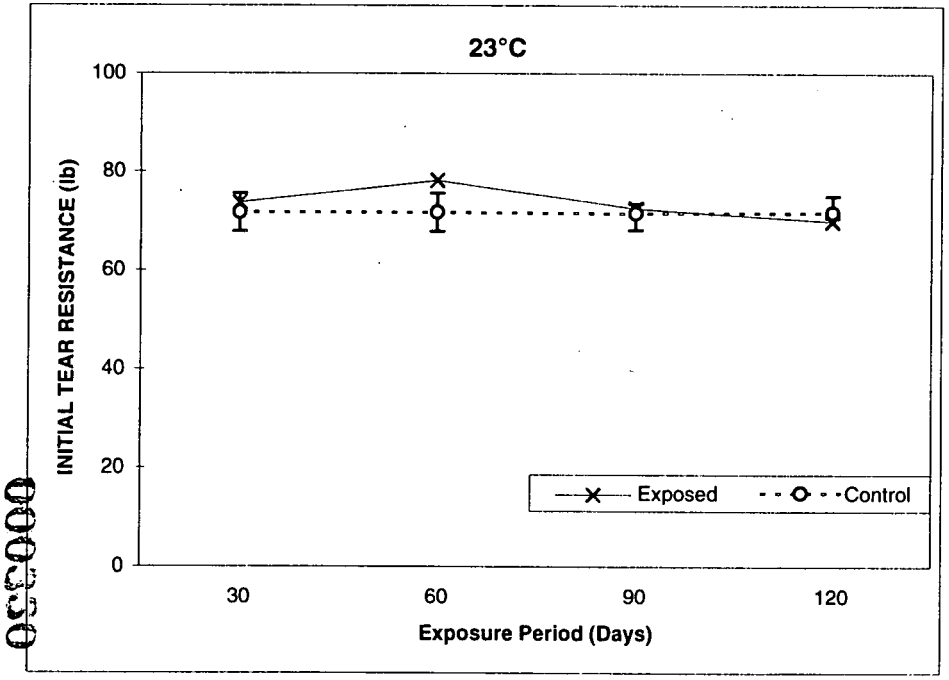
CHEMICAL COMPATIBILITY TEST RESULTS

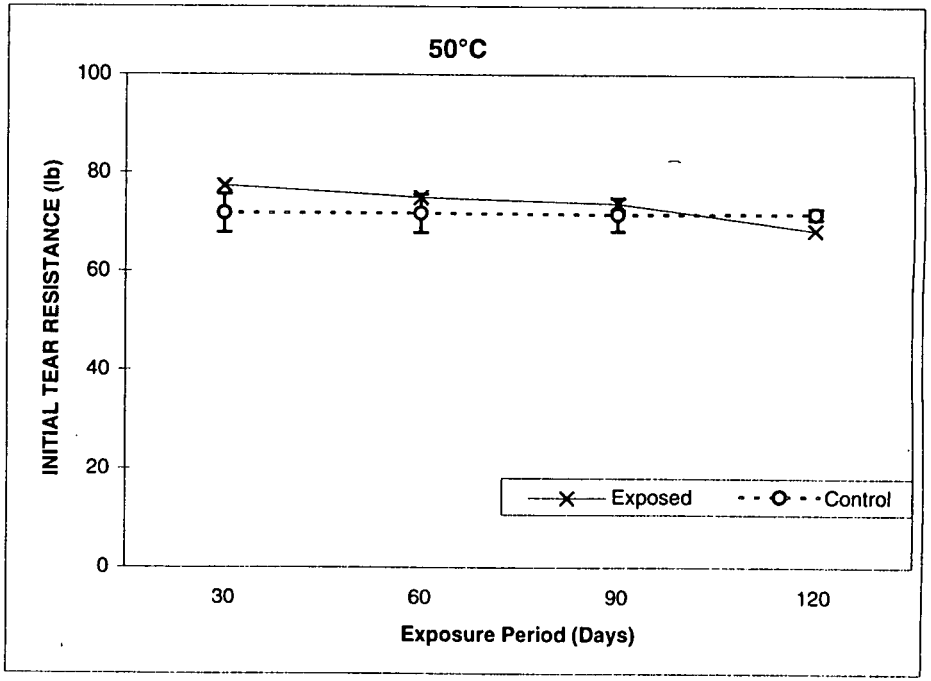
CLIENT: FERMCO
METHOD: ASTM D1004
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): INITIAL TEAR RESISTANCE (lb)
DIRECTION: ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	70	66	73	76	74	71.8	3.9	0.000	70	66	73	76	74	71.8	3.9	0.000	VV
30	73	75	73	74	74	73.8	0.8	2.786	78	80	76	74	79	77.4	2.4	7.799	VV
Control	70	66	73	76	74	71.8	3.9	0.000	70	66	73	76	74	71.8	3.9	0.000	WM
60	76	79	78	79	79	78.2	1.3	8.914	73	76	75	75	76	75.0	1.2	4.457	VV
Control	74	76	71	68	69	71.6	3.4	0.000	74	76	71	68	69	71.6	3.4	0.000	WM
90	70	75	72	74	73	72.6	2.0	1.394	73	75	72	73	77	73.8	2.0	3.103	WM
Control	72	73	70	72	72	71.8	1.1	0.000	72	73	70	72	72	71.8	1.1	0.000	WM
120	69	70	69	72	70	70.0	1.2	-2.507	69	68	67	71	67	68.4	1.7	-4.735	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000330

382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

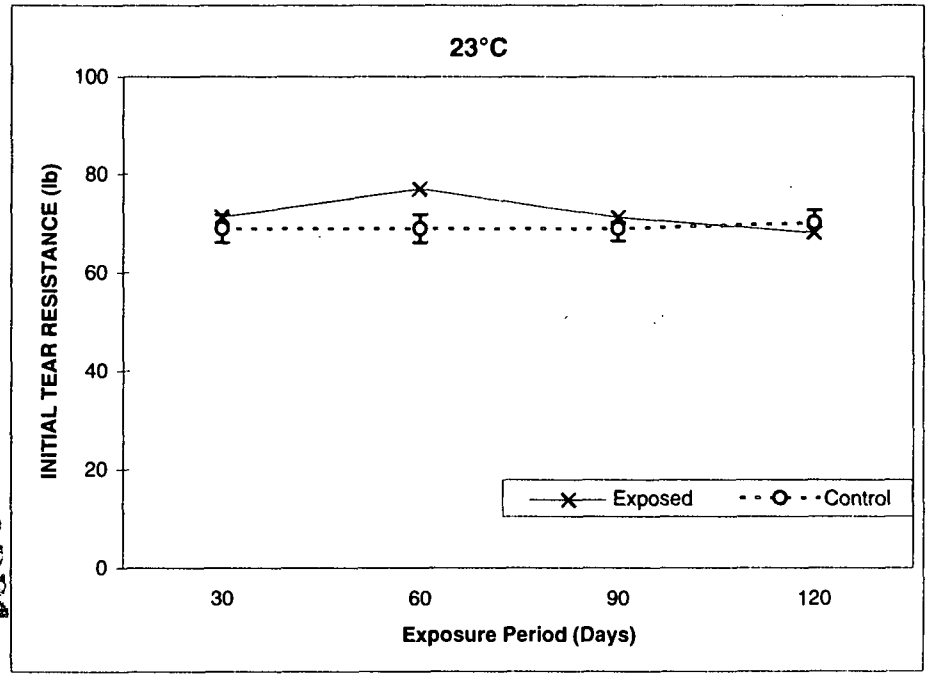
CHEMICAL COMPATIBILITY TEST RESULTS

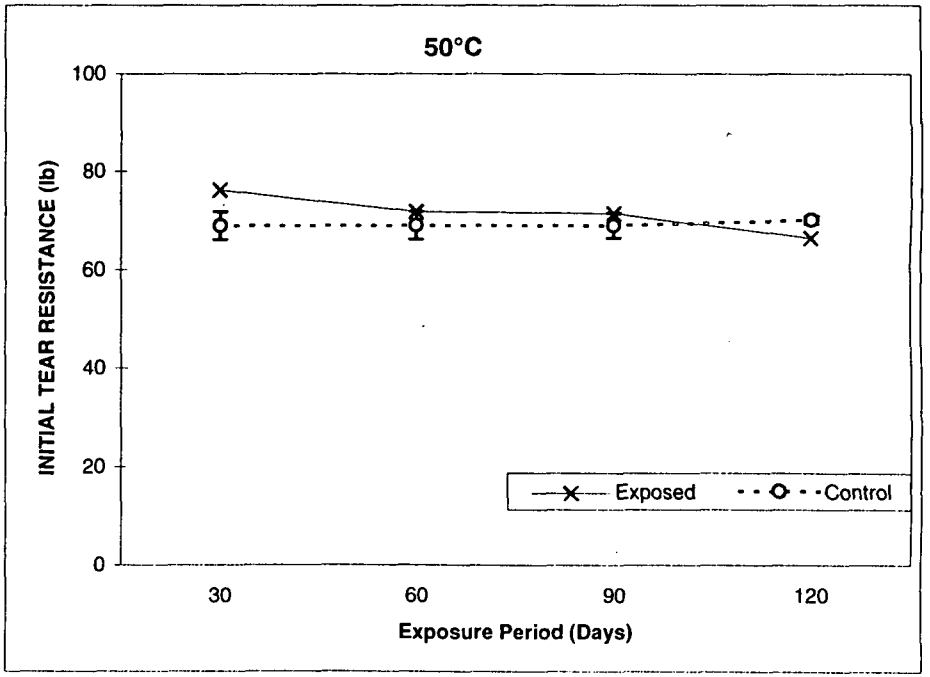
CLIENT: FERMCO
METHOD: ASTM D1004
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): INITIAL TEAR RESISTANCE (lb)
DIRECTION: CROSS-ROLL

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	66	66	71	72	70	69.0	2.8	0.000	66	66	71	72	70	69.0	2.8	0.000	VV
30	68	74	70	72	73	71.4	2.4	3.478	81	75	73	74	78	76.2	3.3	10.435	VV
Control	66	66	71	72	70	69.0	2.8	0.000	66	66	71	72	70	69.0	2.8	0.000	WM
60	77	74	78	78	78	77.0	1.7	11.594	71	75	70	73	70	71.8	2.2	4.058	VV
Control	70	69	65	72	69	69.0	2.5	0.000	70	69	65	72	69	69.0	2.5	0.000	WM
90	72	71	69	72	73	71.2	1.3	3.217	71	69	75	70	71	71.4	2.3	3.545	WM
Control	70	71	71	70	69	70.2	0.8	0.000	70	71	71	70	69	70.2	0.8	0.000	WM
120	67	67	67	70	70	68.2	1.6	-2.849	67	70	64	64	67	66.4	2.5	-5.413	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000331

1-387

E 387

2.11 Hardness

Rationale for Test

Hardness is a measure of the resistance of a material to indentation by a small diameter probe, called an indentor. When the surface of a sample softens, such as when the sample absorbs chemicals or undergoes a chemical reaction, it will have a lower hardness value. In the absence of oxygen, ultraviolet radiation and ionizing radiation (i.e., radioactivity) can cause polyethylene molecules on the surface of the geomembrane crosslink, which increases hardness.

Results and Discussion

Hardness of the geomembranes was generally constant during the 120 days of exposure to the leachate, showing consistency in the test results. In addition, most of the mean values of the exposed samples were within one standard deviation of the control value means. Finally, hardness results of the 23 °C (73°F) and 50°C (122°F) samples were nearly the same. These results are consistent with the physical properties, which were constant during exposure to the test leachate.

Conclusion

The hardness of the geomembranes was not measurably impacted by 120 days of exposure to the test leachate.

draft

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

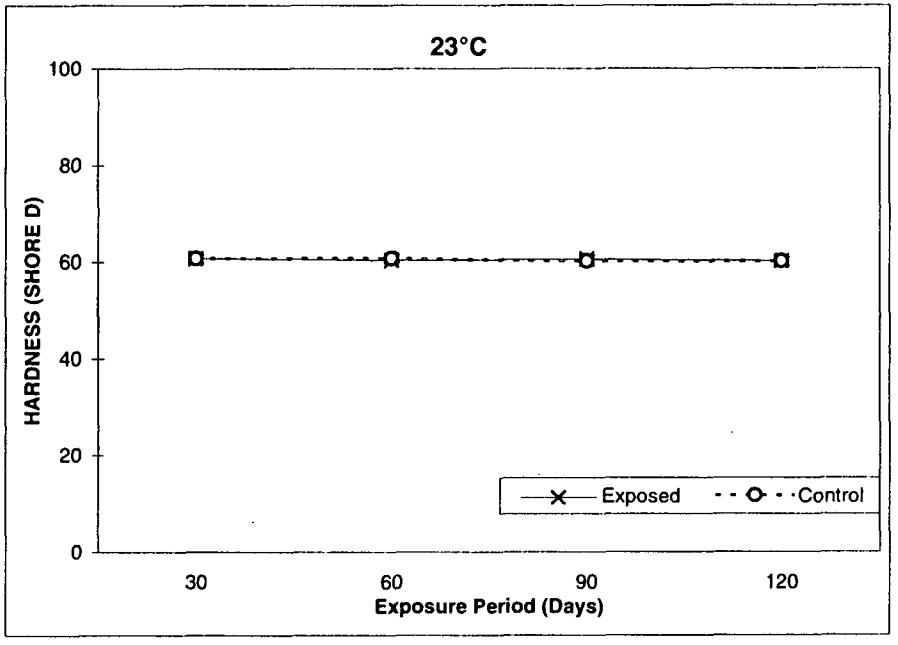
CHEMICAL COMPATIBILITY TEST RESULTS

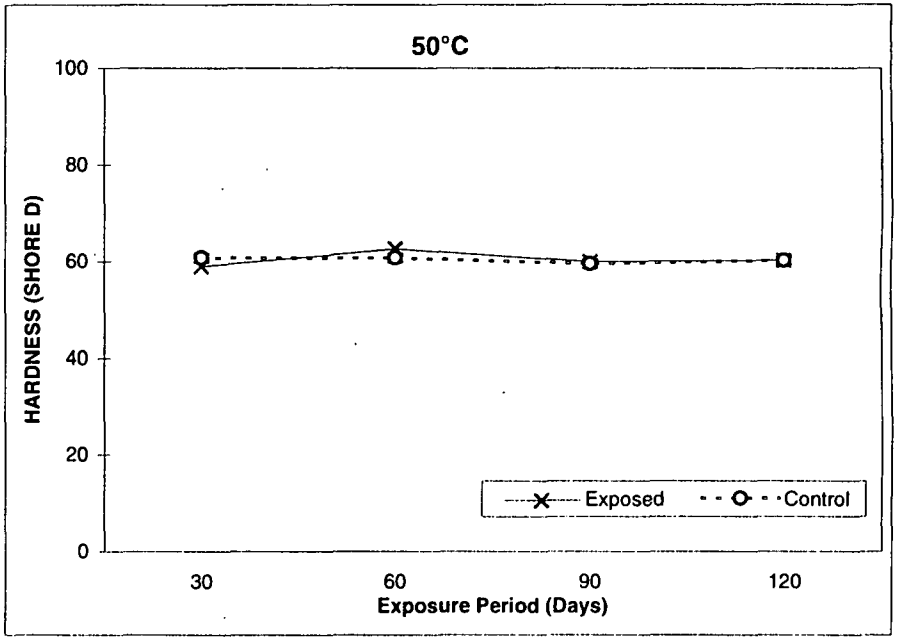
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): HARDNESS (SHORE D)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	61	60	62	61	60	61	1	0.000	60	61	62	61	60	61	1	0.000	CR
30	60	59	61	63	61	61	1	0.000	60	59	58	59	59	59	1	-2.961	CR
Control	61	60	62	61	60	61	1	0.000	60	61	62	61	60	61	1	0.000	CR
60	59	60	62	61	60	60	1	-0.658	61	62	62	63	65	63	2	2.961	CR
Control	60	61	59	61	60	60	1	0.000	61	59	59	60	59	60	1	0.000	CR
90	60	59	61	62	61	61	1	0.664	59	59	61	61	60	60	1	0.671	CR
Control	61	60	59	61	60	60	1	0.000	61	60	61	59	60	60	1	0.000	CR
120	61	60	60	59	61	60	1	0.000	61	60	59	60	61	60	1	0.000	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000333

382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

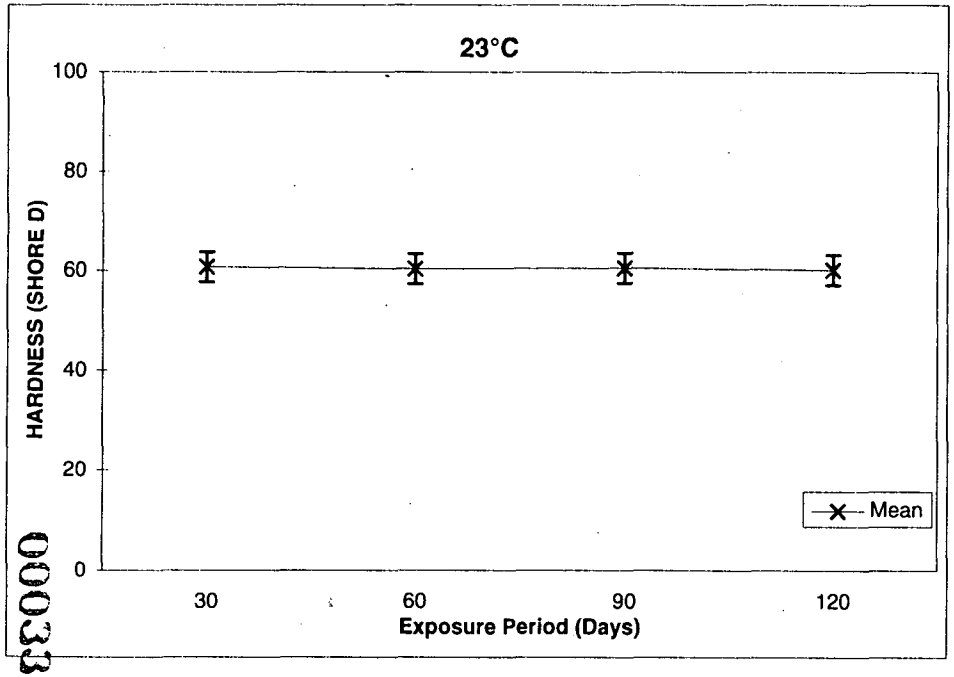
CHEMICAL COMPATIBILITY TEST RESULTS

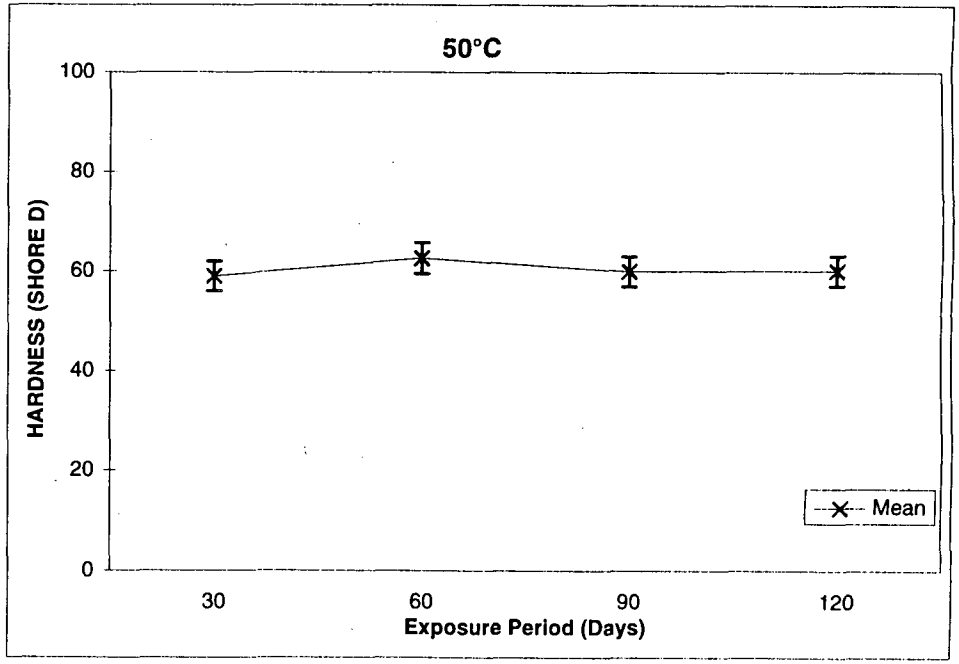
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): HARDNESS (SHORE D)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	61	60	62	61	60	61	1	0.0	60	61	62	61	60	61	1	0.0	CR
30	60	59	61	63	61	61	1	0.0	60	59	58	59	59	59	1	-3.0	CR
60	59	60	62	61	60	60	1	-0.7	61	62	62	63	65	63	2	3.0	CR
90	60	59	61	62	61	61	1	-0.3	59	59	61	61	60	60	1	-1.3	CR
120	61	60	60	59	61	60	1	-1.0	61	60	59	60	61	60	1	-1.0	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

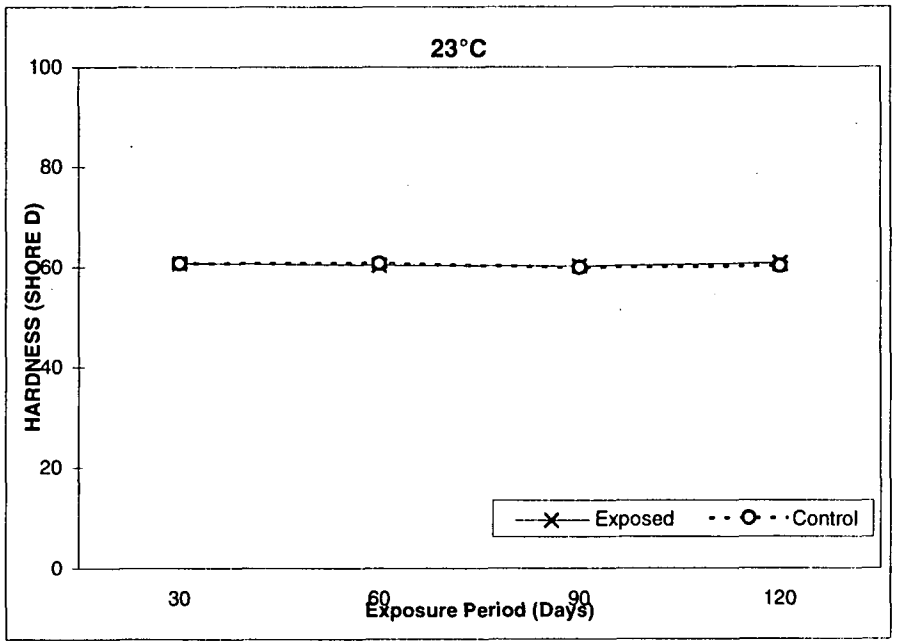
CHEMICAL COMPATIBILITY TEST RESULTS

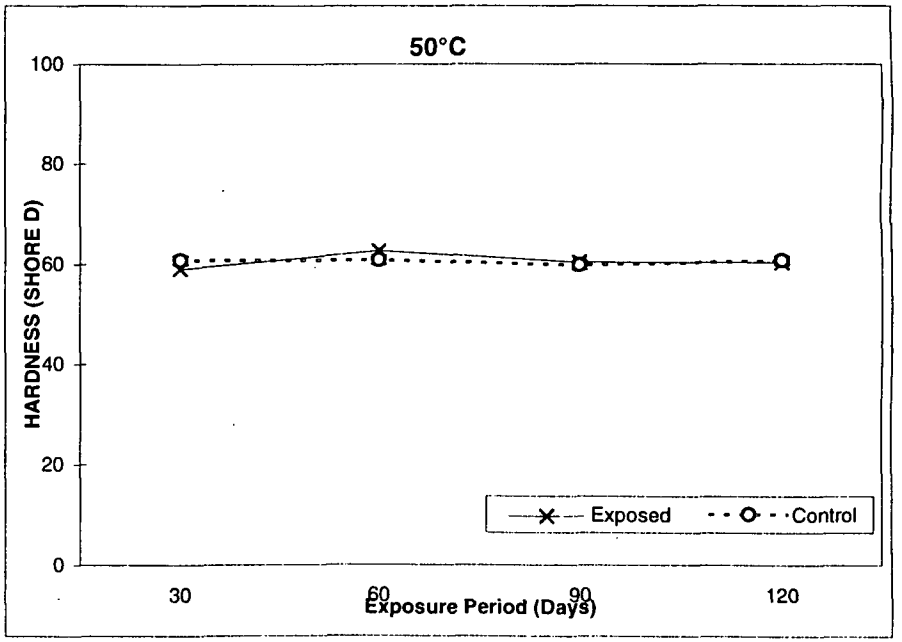
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): HARDNESS (SHORE D)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	61	60	62	61	60	61	1	0.000	60	61	62	61	60	61	1	0.000	CR
30	60	59	61	63	61	61	1	0.000	60	59	58	59	59	59	1	-2.961	CR
Control	61	60	62	61	60	61	1	0.000	60	61	62	61	60	61	1	0.000	CR
60	59	60	62	61	60	60	1	-0.658	61	62	62	63	65	63	2	2.961	CR
Control	59	60	61	60	60	60	1	0.000	59	61	60	59	60	60	1	0.000	CR
90	60	60	61	60	60	60	0	0.333	61	62	59	60	60	60	1	1.003	CR
Control	59	61	60	61	60	60	1	0.000	62	61	60	61	60	61	1	0.000	CR
120	63	59	61	60	61	61	1	0.997	61	60	61	60	60	60	1	-0.658	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000335

382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

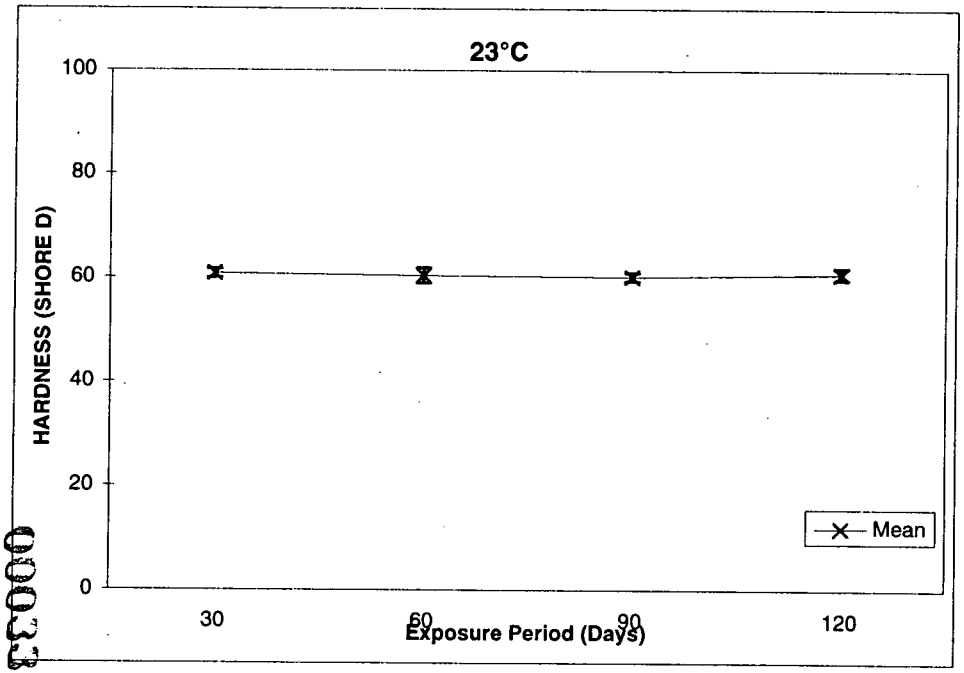
CHEMICAL COMPATIBILITY TEST RESULTS

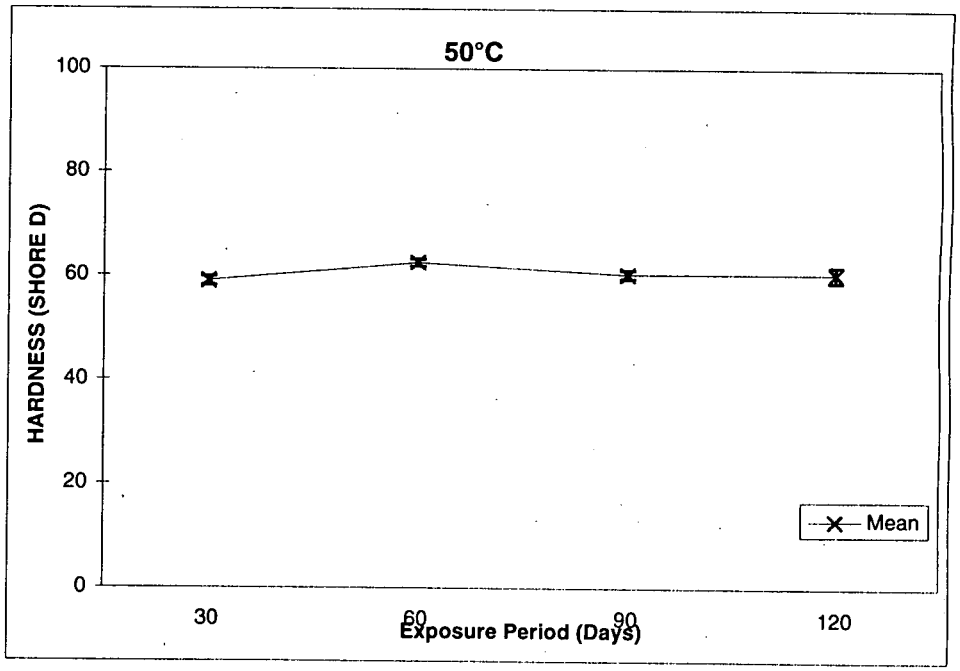
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): HARDNESS (SHORE D)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	61	60	62	61	60	61	1	0.0	60	61	62	61	60	61	1	0.0	CR
30	60	59	61	63	61	61	1	0.0	60	59	58	59	59	59	1	-3.0	CR
60	59	60	62	61	60	60	1	-0.7	61	62	62	63	65	63	2	3.0	CR
90	60	60	61	60	60	60	0	-1.0	61	62	59	60	60	60	1	-0.7	CR
120	63	59	61	60	61	61	1	0.0	61	60	61	60	60	60	1	-0.7	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

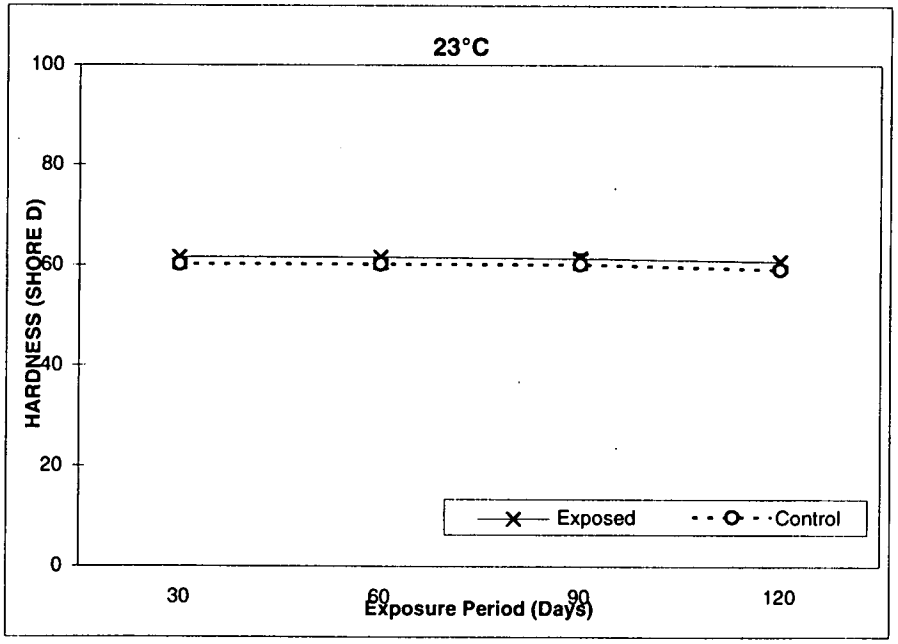
CHEMICAL COMPATIBILITY TEST RESULTS

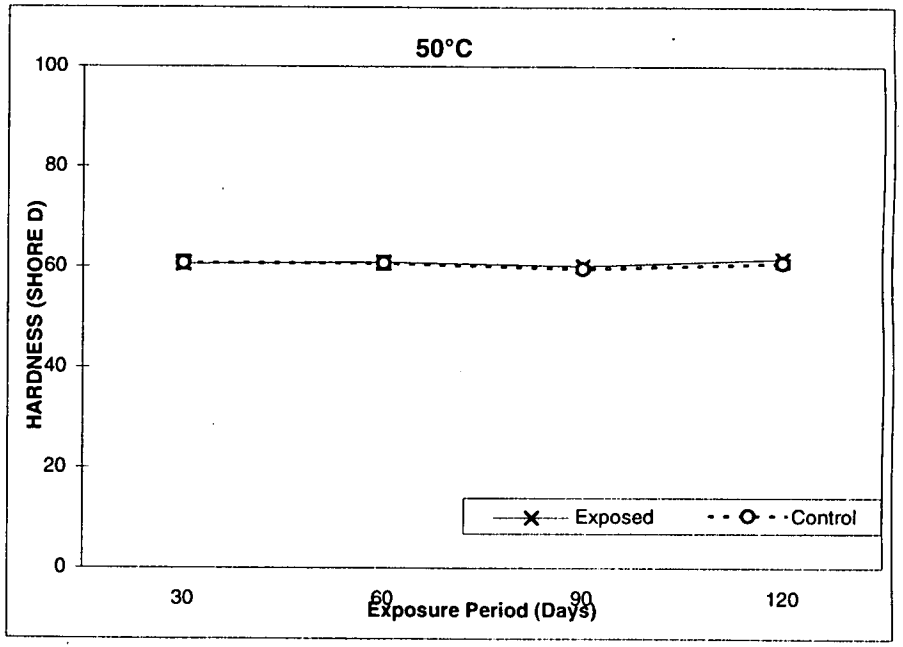
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): HARDNESS (SHORE D)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	61	60	61	59	60	60	1	0.000	62	59	62	60	61	61	1	0.000	CR
30	61	62	63	62	60	62	1	2.326	62	61	61	60	59	61	1	-0.329	CR
Control	61	60	61	59	60	60	1	0.000	62	59	62	60	61	61	1	0.000	CR
60	61	62	63	62	60	62	1	2.326	62	62	61	61	59	61	1	0.329	CR
Control	59	61	60	61	60	60	1	0.000	60	59	59	60	60	60	1	0.000	CR
90	63	60	59	64	61	61	2	1.993	61	61	60	60	59	60	1	1.007	CR
Control	59	59	59	60	59	59	0	0.000	61	60	62	61	60	61	1	0.000	CR
120	60	59	61	63	61	61	1	2.703	62	64	61	60	61	62	2	1.316	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000337

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

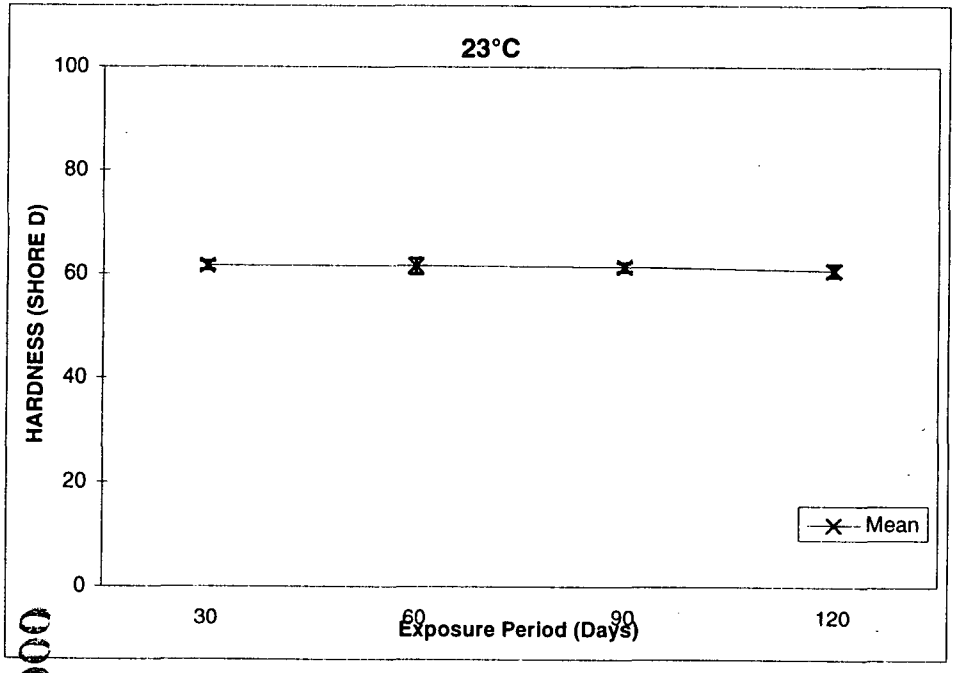
CHEMICAL COMPATIBILITY TEST RESULTS

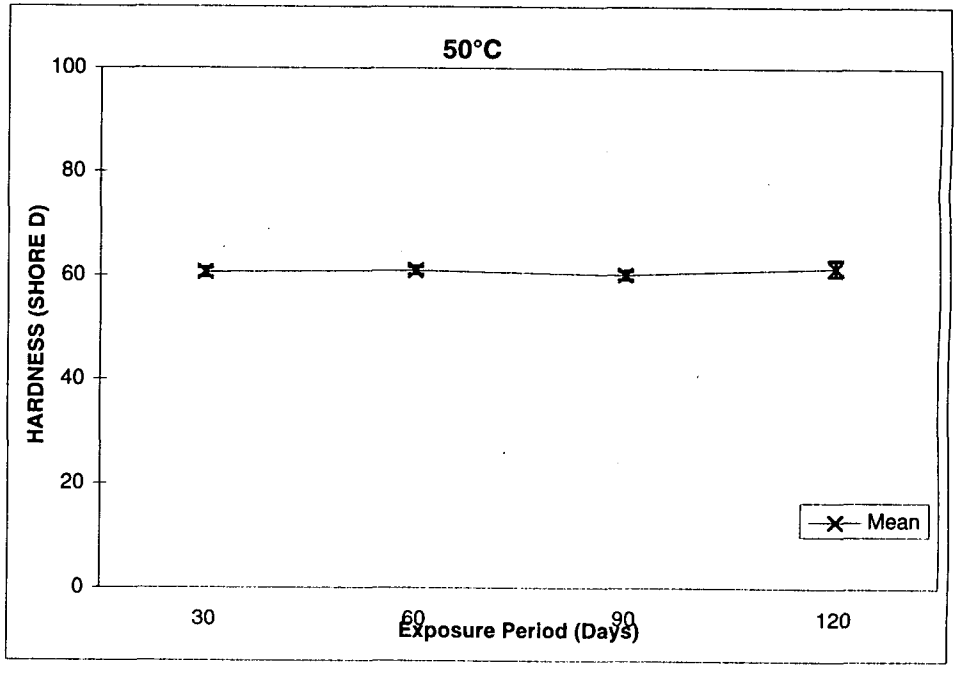
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): HARDNESS (SHORE D)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	61	60	61	59	60	60	1	0.0	62	59	62	60	61	61	1	0.0	CR
30	61	62	63	62	60	62	1	2.3	62	61	61	60	59	61	1	-0.3	CR
60	61	62	63	62	60	62	1	2.3	62	62	61	61	59	61	1	0.3	CR
90	63	60	59	64	61	61	2	2.0	61	61	60	60	59	60	1	-1.0	CR
120	60	59	61	63	61	61	1	1.0	62	64	61	60	61	62	2	1.3	CR





© 1996 GEOSYNTEC CONSULTANTS

000338

382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

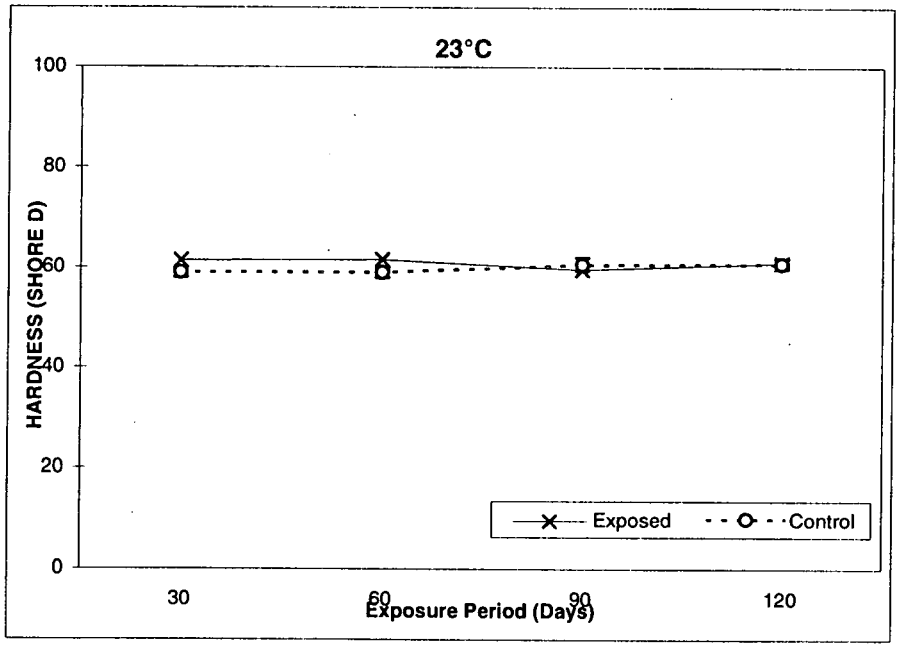
CHEMICAL COMPATIBILITY TEST RESULTS

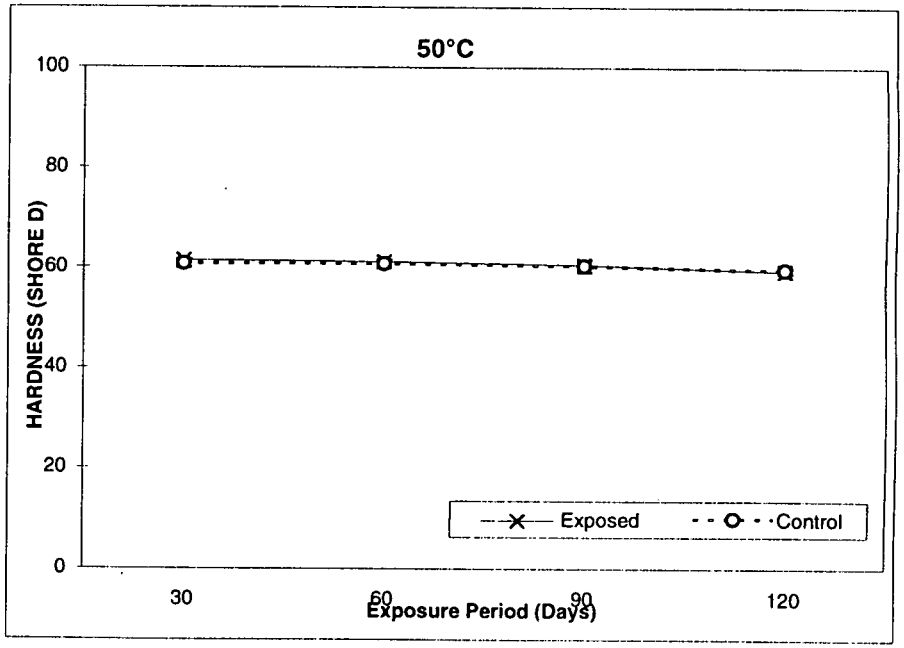
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): HARDNESS (SHORE D)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	60	59	58	60	58	59	1	0.000	60	61	62	61	60	61	1	0.000	CR
30	61	62	63	60	61	61	1	4.068	62	61	61	60	63	61	1	0.987	CR
Control	60	59	58	60	58	59	1	0.000	60	61	62	61	60	61	1	0.000	CR
60	61	62	63	62	60	62	1	4.407	62	62	61	60	61	61	1	0.658	CR
Control	62	61	59	61	60	61	1	0.000	62	60	61	59	60	60	1	0.000	CR
90	60	62	59	58	59	60	2	-1.650	59	62	61	61	60	61	1	0.331	CR
Control	61	60	61	61	61	61	0	0.000	60	59	59	60	60	60	1	0.000	CR
120	62	61	60	61	61	61	1	0.329	59	61	60	59	58	59	1	-0.336	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000339

382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

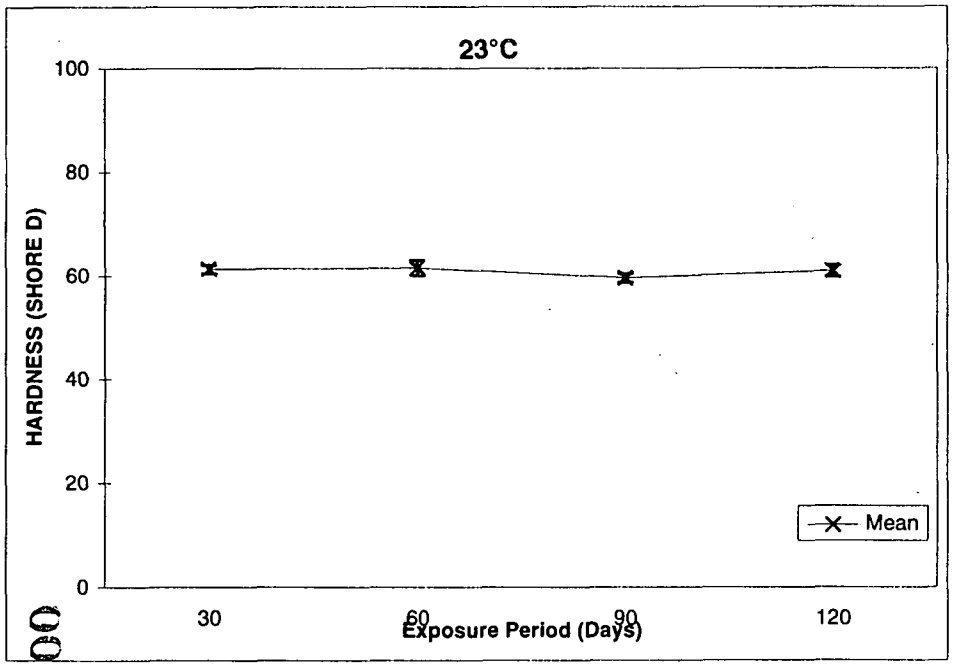
CHEMICAL COMPATIBILITY TEST RESULTS

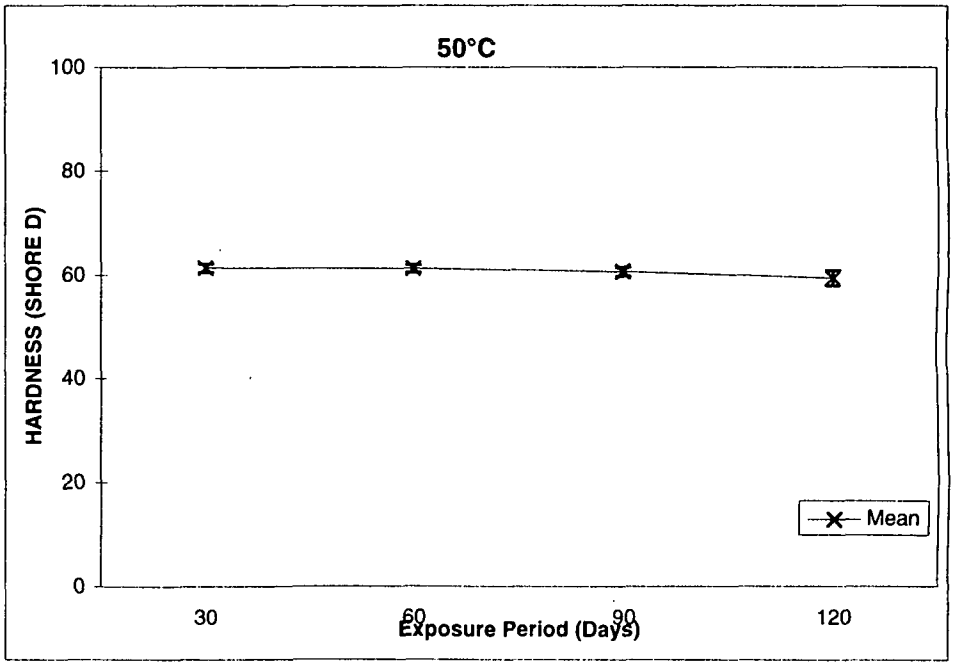
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): HARDNESS (SHORE D)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	60	59	58	60	58	59	1	0.0	60	61	62	61	60	61	1	0.0	CR
30	61	62	63	60	61	61	1	4.1	62	61	61	60	63	61	1	1.0	CR
60	61	62	63	62	60	62	1	4.4	62	62	61	60	61	61	1	0.7	CR
90	60	62	59	58	59	60	2	1.0	59	62	61	61	60	61	1	-0.3	CR
120	62	61	60	61	61	61	1	3.4	59	61	60	59	58	59	1	-2.3	CR





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

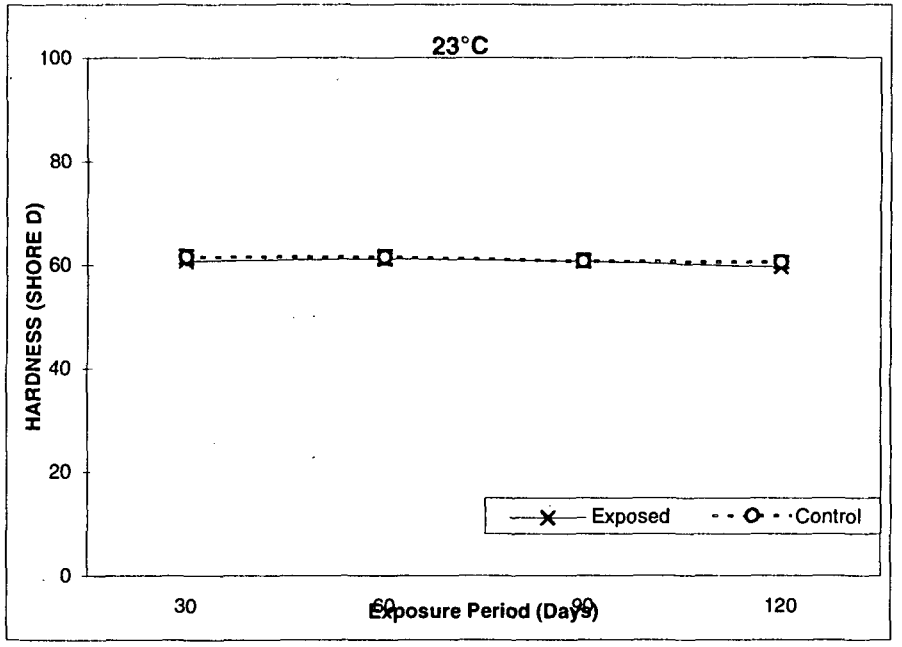
CHEMICAL COMPATIBILITY TEST RESULTS

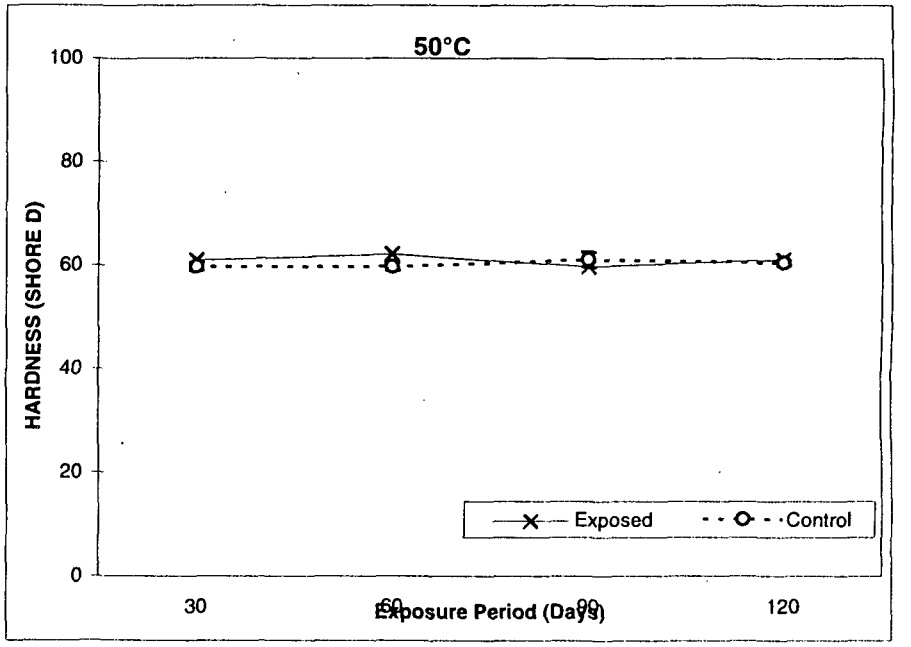
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): HARDNESS (SHORE D)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	61	61	63	60	63	62	1	0.000	61	59	60	60	59	60	1	0.000	CR
30	61	60	59	62	62	61	1	-1.299	63	61	62	60	59	61	2	2.007	CR
Control	61	61	63	60	63	62	1	0.000	61	59	60	60	59	60	1	0.000	CR
60	59	63	62	61	61	61	1	-0.649	62	63	61	62	63	62	1	4.013	CR
Control	61	59	61	62	61	61	1	0.000	59	61	63	62	61	61	1	0.000	CR
90	60	63	61	60	60	61	1	0.000	59	60	59	61	60	60	1	-2.288	CR
Control	60	59	62	61	61	61	1	0.000	61	61	61	60	60	61	1	0.000	CR
120	58	59	60	60	61	60	1	-1.650	61	62	59	62	62	61	1	0.990	CR





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

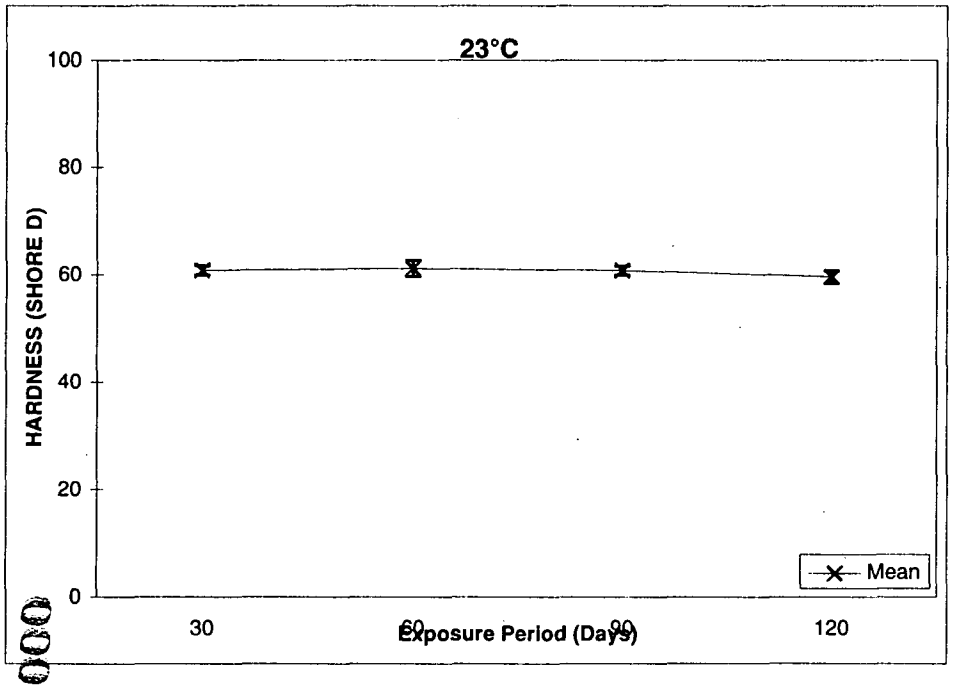
CHEMICAL COMPATIBILITY TEST RESULTS

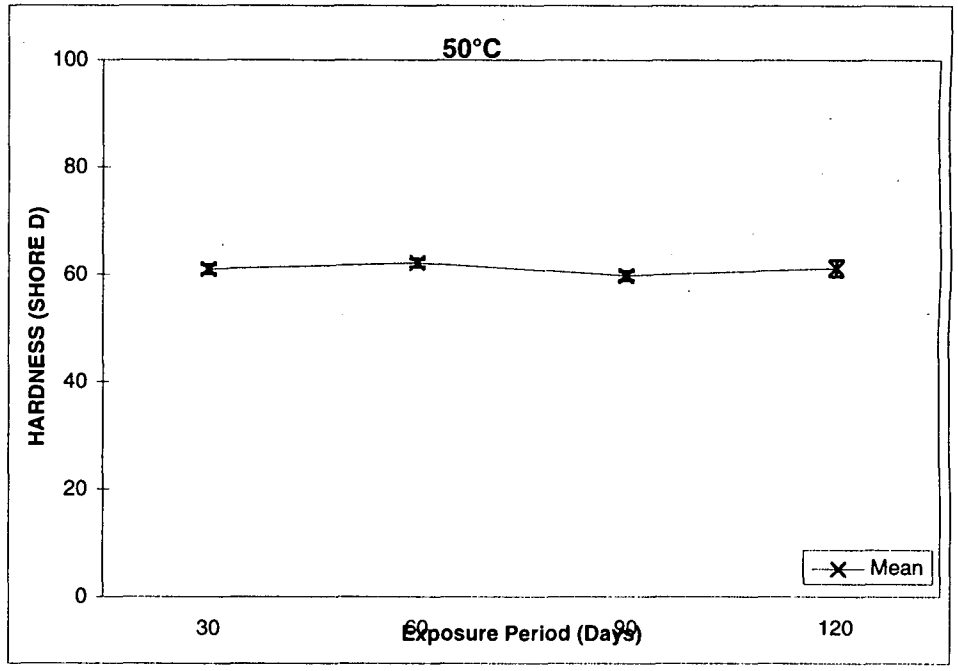
CLIENT: *FERMCO*
METHOD: *ASTM D2240*
DATE TESTED: *06/14/96*

GEOSYNTEC JOB NO.: *GE 3900*
MATERIAL TYPE: *SERROT*
CHARACTERISTICS: *80 mil HDPE Geomembrane*
IMMERSION MEDIUM: *Perched Ground Water*

PROPERTY (UNIT): HARDNESS (SHORE D)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	61	61	63	60	63	62	1	0.0	61	59	60	60	59	60	1	0.0	CR
30	61	60	59	62	62	61	1	-1.3	63	61	62	60	59	61	2	2.0	CR
60	59	63	62	61	61	61	1	-0.6	62	63	61	62	63	62	1	4.0	CR
90	60	63	61	60	60	61	1	-1.3	59	60	59	61	60	60	1	0.0	CR
120	58	59	60	60	61	60	1	-3.2	61	62	59	62	62	61	1	2.3	CR





© 1996 GEOSYNTEC CONSULTANTS

2.12 Puncture Resistance

Rationale for Test

Puncture resistance is a measure of the resistance of a material to being punctured by a small diameter probe. As with hardness, initial tear, modulus of elasticity, and stress at yield, puncture resistance is reduced when the material absorbs volatile constituents.

Results and Discussion

The following observations were made regarding the puncture resistance of the five geomembranes exposed to the FEMP leachate.

GSE-SLT, NSC, and Serrot Geomembranes. The puncture resistance results were generally constant. However, the values of the exposed samples were slightly greater than the control values, although there was no ascending trend. Consequently, the mean values of the exposed samples tended to fall outside of one standard deviation of the control value means. In addition, the 50°C (122°F) samples' values of the GSE-SLT geomembranes were slightly above the 23°C (73°F) values, while there was no appreciable difference between the 23°C (73°F) and 50°C (122°F) samples of the NSC and Serrot geomembranes.

GSE-Gundle and Polyflex Geomembranes. Puncture resistance values of the exposed samples were generally constant. In addition, most of the mean values of the exposed samples fell within one standard deviation of the mean values of the control samples. Moreover, there was no appreciable difference between the values of the 23°C (73°F) and 50°C (122°F) samples.

The puncture resistance values of the exposed samples were generally constant. However, some anomalous results were observed, such as those of the GSE-SLT, NSC, and Serrot geomembranes, which tended to have puncture resistance values that were higher than the control values. The increased puncture resistance values are most likely due to experimental and material variability because: (i) the tensile strength did not

Draft

increase; (ii) hardness did not increase; and (iii) the measured physical properties were constant. Therefore, any changes occurring in the puncture resistance of the exposed samples are most likely attributable to material and experimental variability.

Conclusion

The test leachate did not measurably impact the puncture resistance of the geomembranes during the 120 days of exposure.

draft

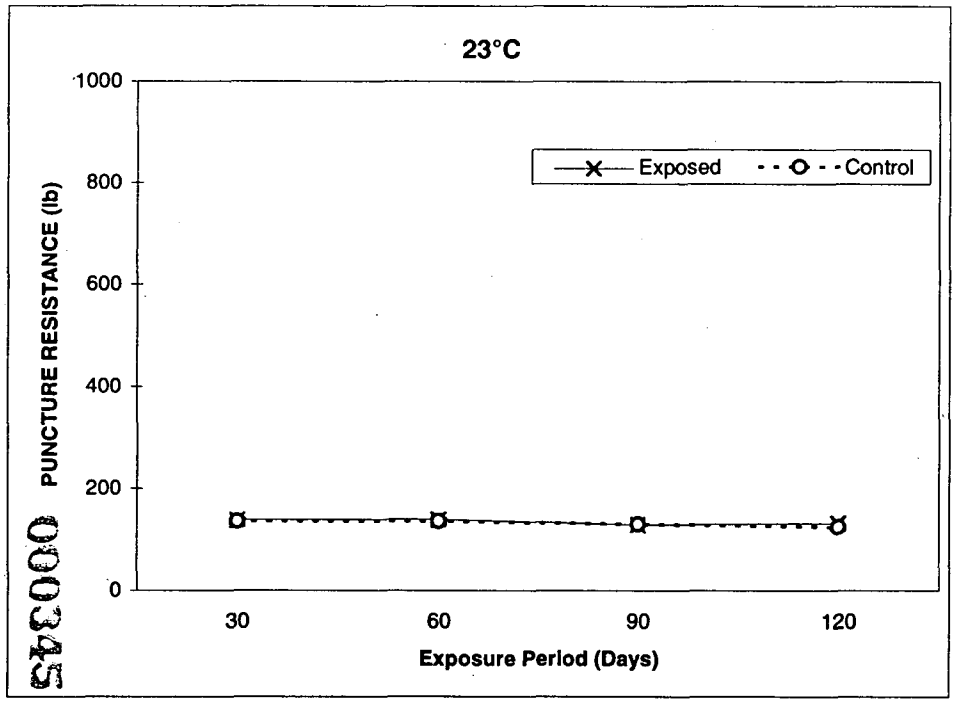
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

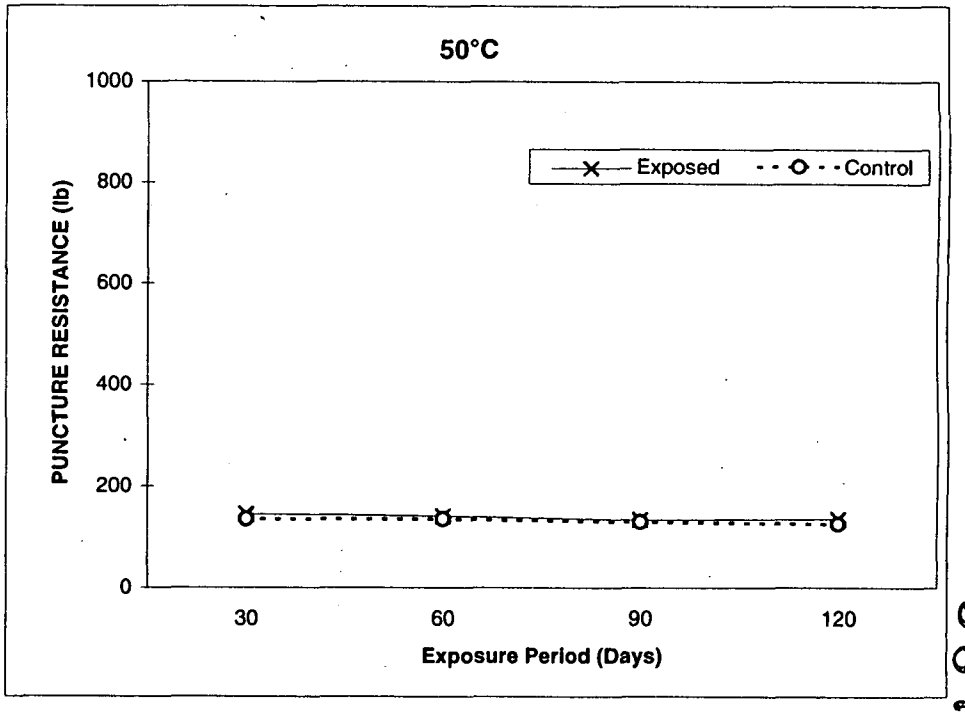
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*FTMS 101C (METHOD 2065)*	*MATERIAL TYPE:*	*GSE - SLT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): PUNCTURE RESISTANCE (lb)
DIRECTION: N/A

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	138.4	139.5	127.4	139.0	136.9	136.2	5.0	0.000	138.4	139.5	127.4	139.0	136.9	136.2	5.0	0.000	VV
30	136.0	143.3	143.6	130.8	142.6	139.3	5.7	2.217	149.9	150.3	147.3	138.5	142.9	145.8	5.0	7.002	VV
Control	138.4	139.5	127.4	139.0	136.9	136.2	5.0	0.000	138.4	139.5	127.4	139.0	136.9	136.2	5.0	0.000	DL
60	138.3	141.7	139.9	137.1	139.5	139.3	1.7	2.246	141.8	136.7	139.5	144.6	145.0	141.5	3.5	3.876	VV
Control	131.0	134.8	130.6	128.3	128.0	130.5	2.7	0.000	131.0	134.8	130.6	128.3	128.0	130.5	2.7	0.000	DL
90	128.0	131.0	129.7	131.2	127.3	129.4	1.8	-0.843	133.0	128.2	138.5	139.3	131.8	134.2	4.7	2.773	DL
Control	119.5	127.4	125.1	124.9	131.3	125.6	4.3	0.000	119.5	127.4	125.1	124.9	131.3	125.6	4.3	0.000	DL
120	128.6	126.0	136.4	133.4	138.1	132.5	5.1	5.460	135.9	133.4	134.1	136.1	136.9	135.3	1.5	7.673	DL





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000345

38

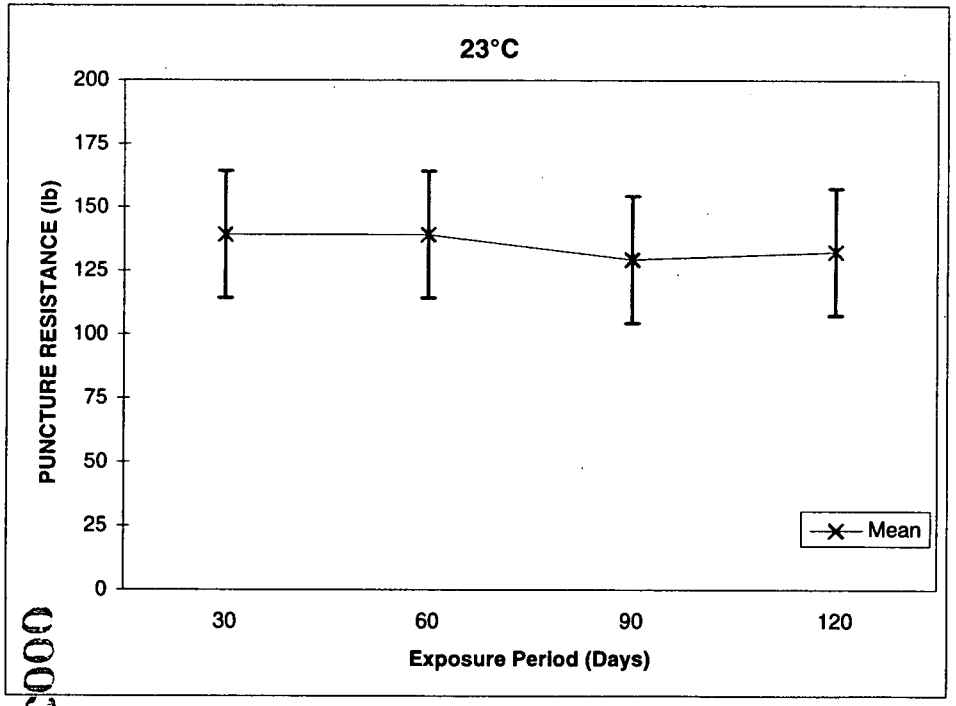
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

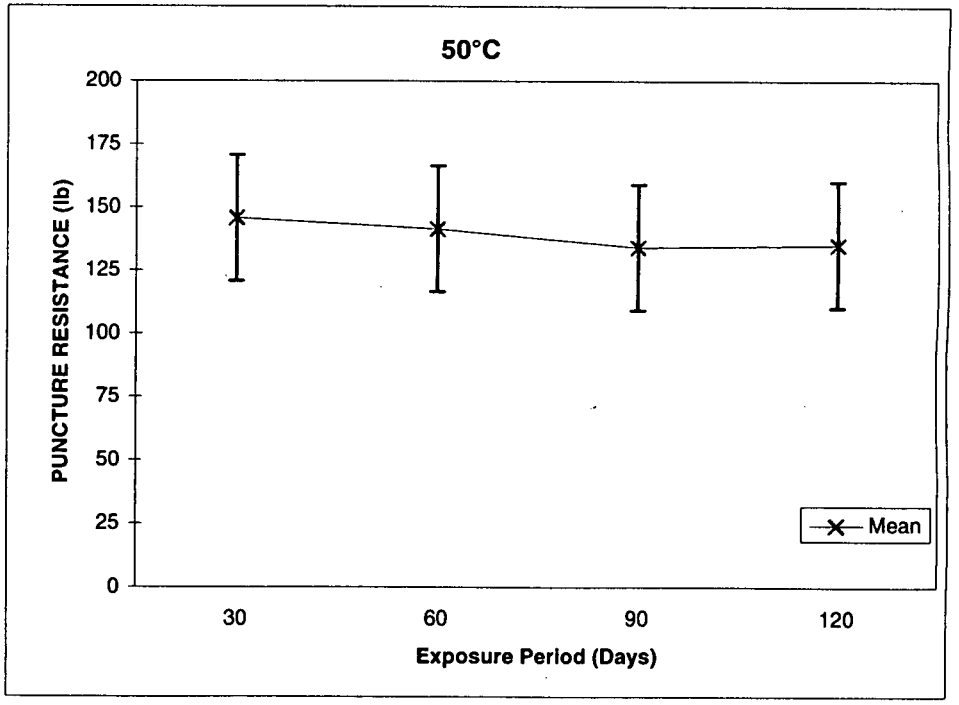
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*FTMS 101C (METHOD 2065)*	*MATERIAL TYPE:*	*GSE - SLT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): PUNCTURE RESISTANCE (lb)
DIRECTION: N/A

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	138.4	139.5	127.4	139.0	136.9	136.2	5.0	0.0	138.4	139.5	127.4	139.0	136.9	136.2	5.0	0.0	VV
30	136.0	143.3	143.6	130.8	142.6	139.3	5.7	2.2	149.9	150.3	147.3	138.5	142.9	145.8	5.0	7.0	VV
60	138.3	141.7	139.9	137.1	139.5	139.3	1.7	2.2	141.8	136.7	139.5	144.6	145.0	141.5	3.5	3.9	VV
90	128.0	131.0	129.7	131.2	127.3	129.4	1.8	-5.0	133.0	128.2	138.5	139.3	131.8	134.2	4.7	-1.5	DL
120	128.6	126.0	136.4	133.4	138.1	132.5	5.1	-2.7	135.9	133.4	134.1	136.1	136.9	135.3	1.5	-0.7	DL





© 1996 GEOSYNTEC CONSULTANTS

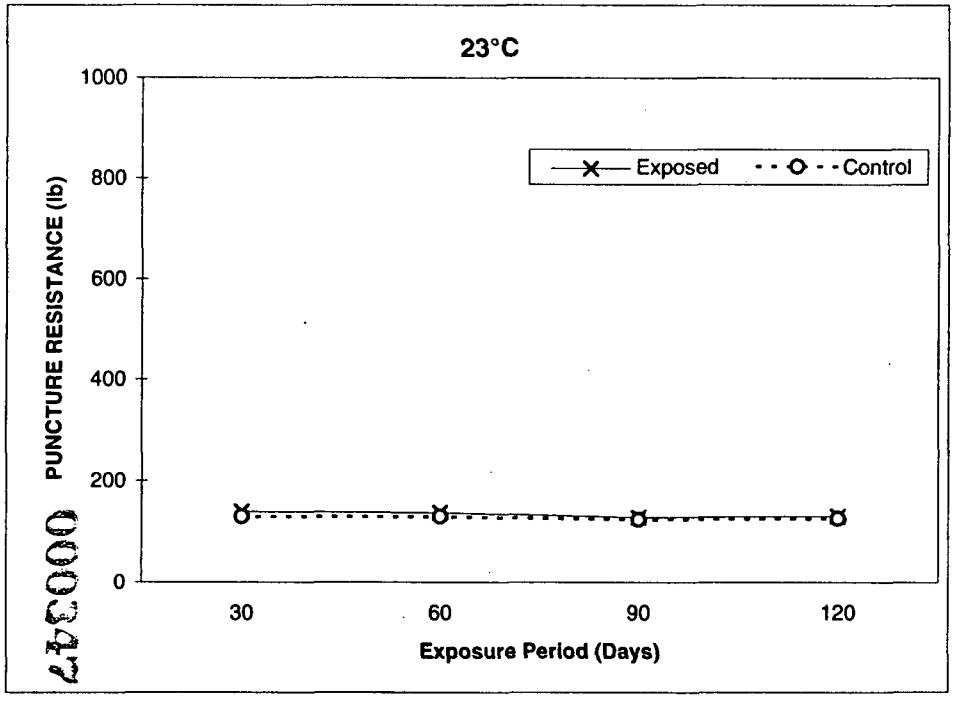
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

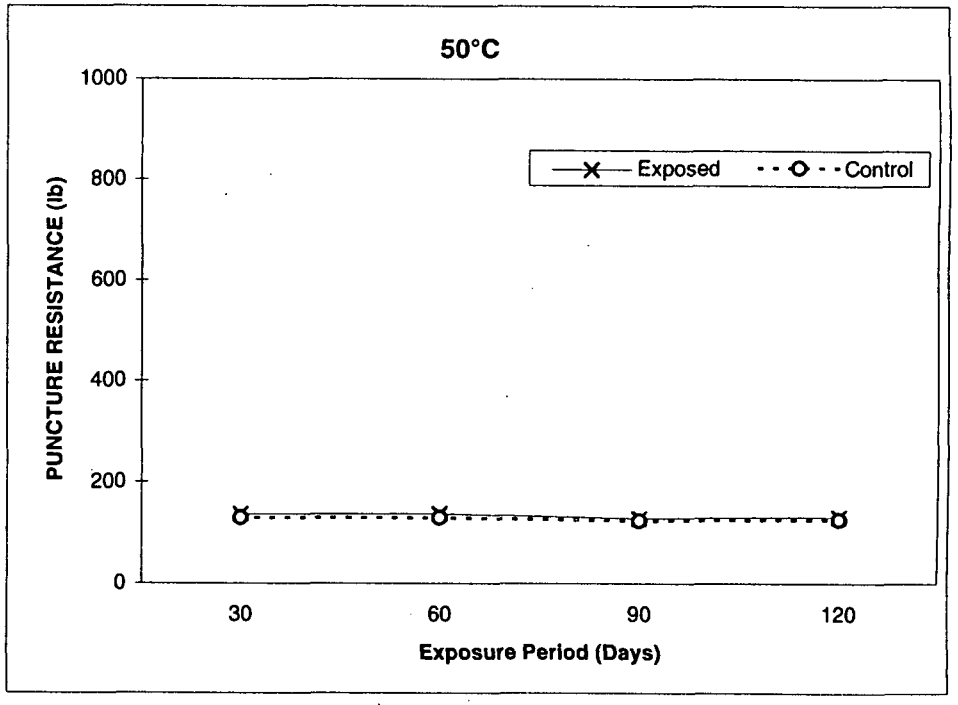
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*FTMS 101C (METHOD 2065)*	*MATERIAL TYPE:*	*NSC*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): PUNCTURE RESISTANCE (lb)
DIRECTION: N/A

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	130.4	125.3	132.1	133.5	126.9	129.6	3.5	0.000	130.4	125.3	132.1	133.5	126.9	129.6	3.5	0.000	VV
30	137.7	137.1	139.3	139.4	139.7	138.6	1.2	6.942	138.5	136.2	135.1	136.3	136.3	136.5	1.2	5.276	VV
Control	130.4	125.3	132.1	133.5	126.9	129.6	3.5	0.000	130.4	125.3	132.1	133.5	126.9	129.6	3.5	0.000	DL
60	139.4	136.1	139.2	135.0	134.1	136.8	2.4	5.492	135.7	139.3	136.3	137.3	137.1	137.1	1.4	5.785	VV
Control	122.0	124.3	124.7	125.1	123.3	123.9	1.2	0.000	122.0	124.3	124.7	125.1	123.3	123.9	1.2	0.000	DL
90	130.6	128.5	129.6	126.0	127.0	128.3	1.9	3.600	126.7	128.3	129.3	127.7	127.1	127.8	1.0	3.180	DL
Control	130.0	122.0	127.3	123.2	129.0	126.3	3.5	0.000	130.0	122.0	127.3	123.2	129.0	126.3	3.5	0.000	DL
120	132.3	129.0	130.0	129.7	131.2	130.4	1.3	3.278	125.8	131.7	134.3	133.2	132.9	131.6	3.4	4.181	DL





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000347

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

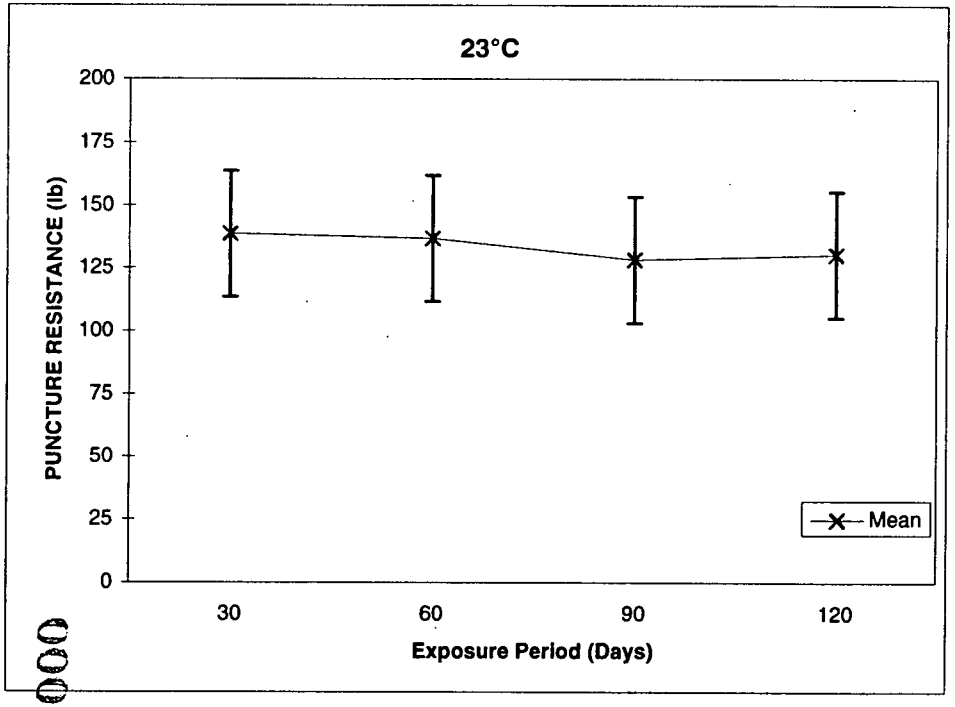
CHEMICAL COMPATIBILITY TEST RESULTS

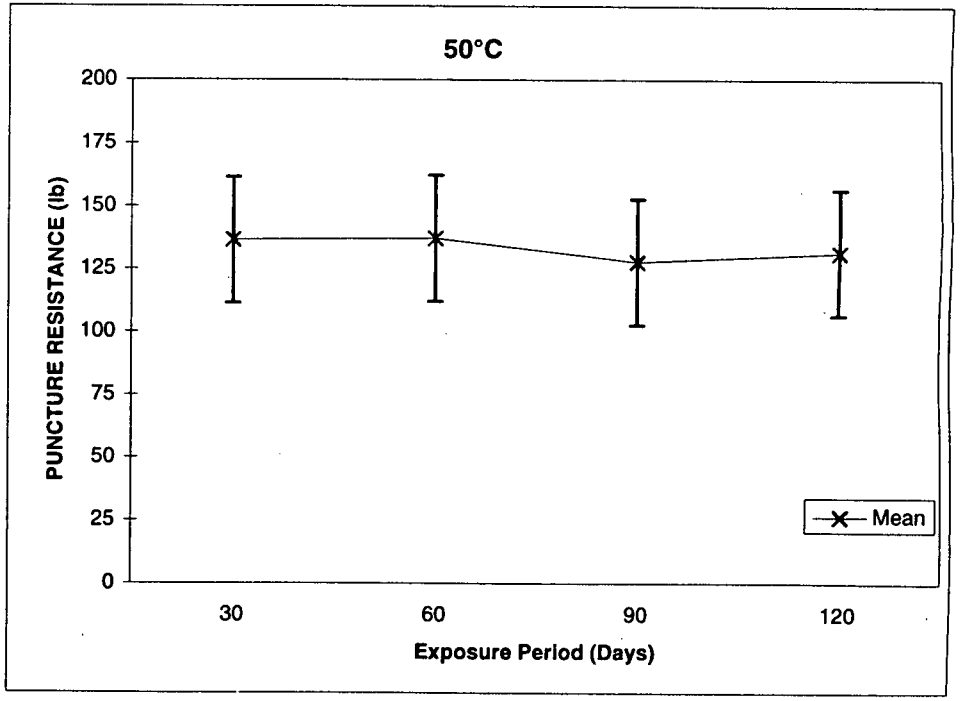
CLIENT: FERMCO
METHOD: FTMS 101C (METHOD 2065)
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): PUNCTURE RESISTANCE (lb)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	130.4	125.3	132.1	133.5	126.9	129.6	3.5	0.0	130.4	125.3	132.1	133.5	126.9	129.6	3.5	0.0	VV
30	137.7	137.1	139.3	139.4	139.7	138.6	1.2	6.9	138.5	136.2	135.1	136.3	136.3	136.5	1.2	5.3	VV
60	139.4	136.1	139.2	135.0	134.1	136.8	2.4	5.5	135.7	139.3	136.3	137.3	137.1	137.1	1.4	5.8	VV
90	130.6	128.5	129.6	126.0	127.0	128.3	1.9	-1.0	126.7	128.3	129.3	127.7	127.1	127.8	1.0	-1.4	DL
120	132.3	129.0	130.0	129.7	131.2	130.4	1.3	0.6	125.8	131.7	134.3	133.2	132.9	131.6	3.4	1.5	DL





© 1996 GEOSYNTEC CONSULTANTS

000348

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

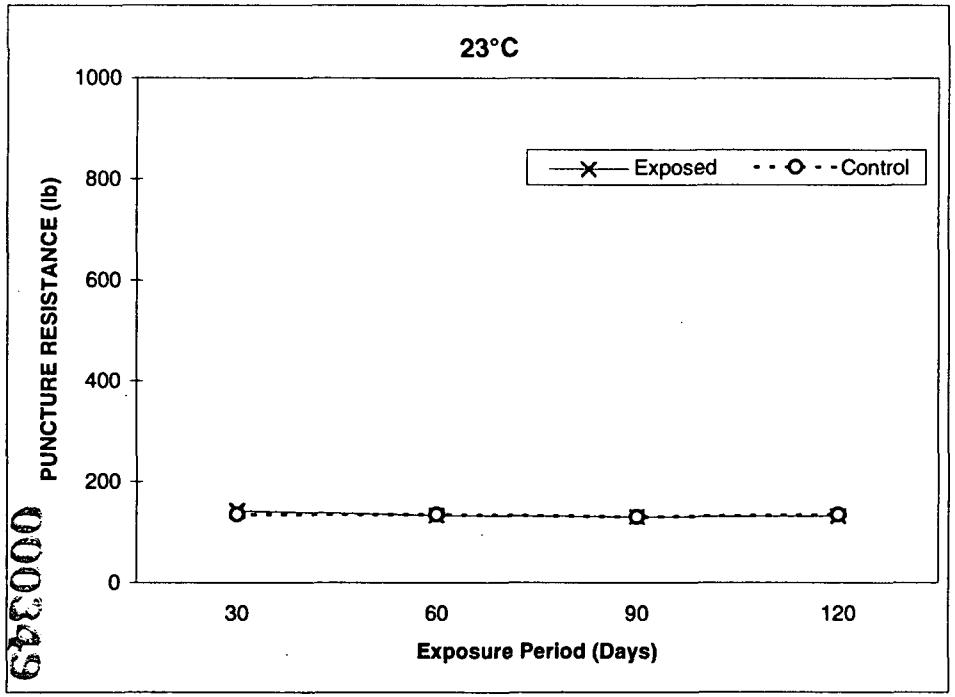
CHEMICAL COMPATIBILITY TEST RESULTS

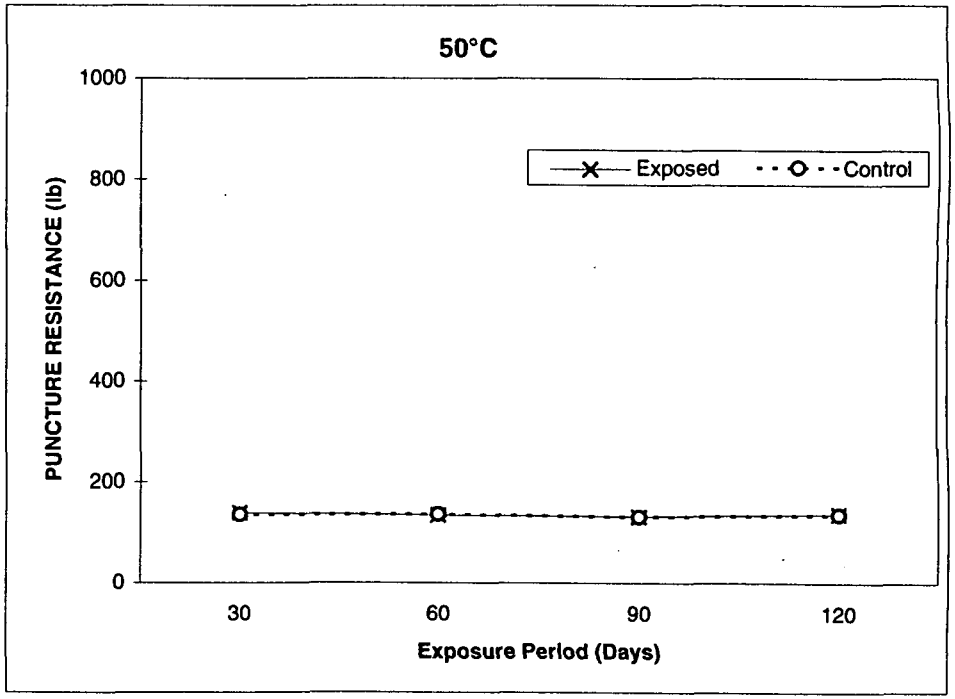
CLIENT: FERMCO
METHOD: FTMS 101C (METHOD 2065)
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): PUNCTURE RESISTANCE (lb)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	132.8	139.2	129.7	136.5	137.4	135.1	3.8	0.000	132.8	139.2	129.7	136.5	137.4	135.1	3.8	0.000	VV
30	143.3	139.9	143.4	142.5	140.8	142.0	1.6	5.077	136.6	140.5	137.4	136.4	140.7	138.3	2.1	2.368	VV
Control	132.8	139.2	129.7	136.5	137.4	135.1	3.8	0.000	132.8	139.2	129.7	136.5	137.4	135.1	3.8	0.000	DL
60	133.4	129.3	141.8	130.6	132.4	133.5	4.9	-1.199	131.8	132.7	134.2	134.6	133.8	133.4	1.1	-1.258	VV
Control	130.0	127.3	132.2	132.7	129.3	130.3	2.2	0.000	130.0	127.3	132.2	132.7	129.3	130.3	2.2	0.000	DL
90	135.5	129.5	126.8	128.5	129.0	129.9	3.3	-0.338	134.0	131.1	131.0	128.1	129.5	130.7	2.2	0.338	DL
Control	135.5	136.6	130.1	135.3	137.9	135.1	3.0	0.000	135.5	136.6	130.1	135.3	137.9	135.1	3.0	0.000	DL
120	132.6	129.4	132.7	132.7	132.8	132.0	1.5	-2.251	136.1	137.5	135.6	136.9	136.4	136.5	0.7	1.051	DL





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

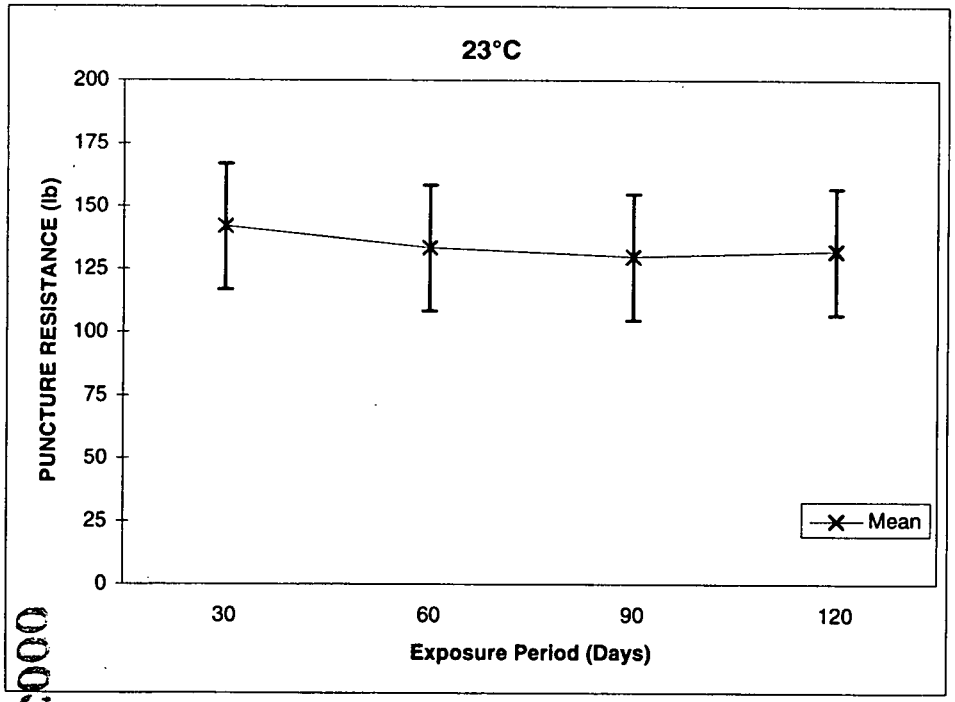
CHEMICAL COMPATIBILITY TEST RESULTS

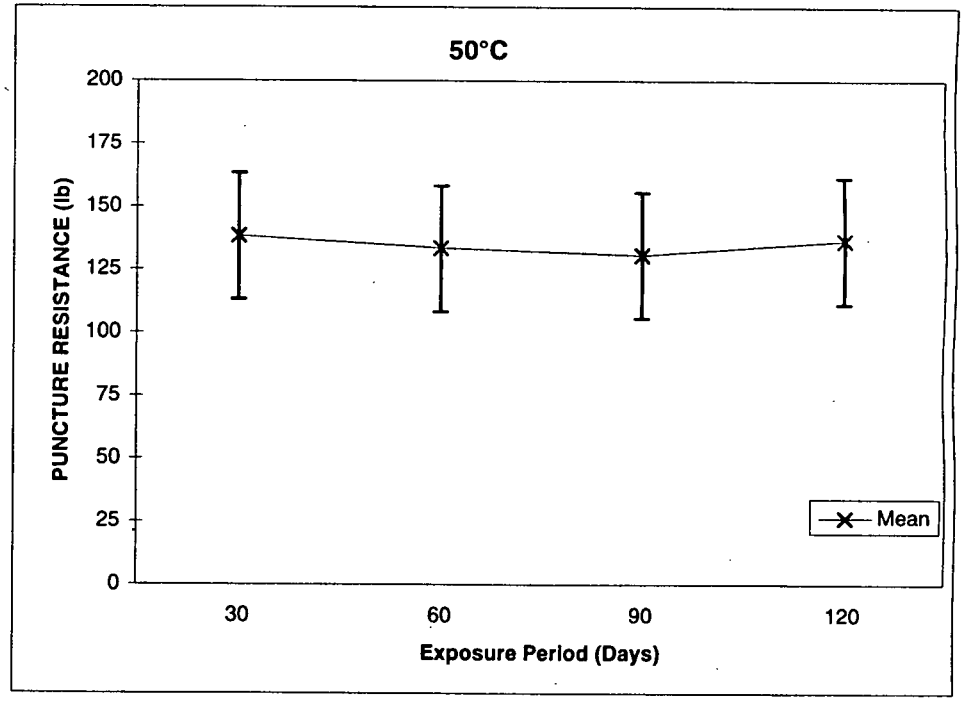
CLIENT: FERMCO
METHOD: FTMS 101C (METHOD 2065)
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): PUNCTURE RESISTANCE (lb)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	132.8	139.2	129.7	136.5	137.4	135.1	3.8	0.0	132.8	139.2	129.7	136.5	137.4	135.1	3.8	0.0	VV
30	143.3	139.9	143.4	142.5	140.8	142.0	1.6	5.1	136.6	140.5	137.4	136.4	140.7	138.3	2.1	2.4	VV
60	133.4	129.3	141.8	130.6	132.4	133.5	4.9	-1.2	131.8	132.7	134.2	134.6	133.8	133.4	1.1	-1.3	VV
90	135.5	129.5	126.8	128.5	129.0	129.9	3.3	-3.9	134.0	131.1	131.0	128.1	129.5	130.7	2.2	-3.2	DL
120	132.6	129.4	132.7	132.7	132.8	132.0	1.5	-2.3	136.1	137.5	135.6	136.9	136.4	136.5	0.7	1.0	DL





© 1996 GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

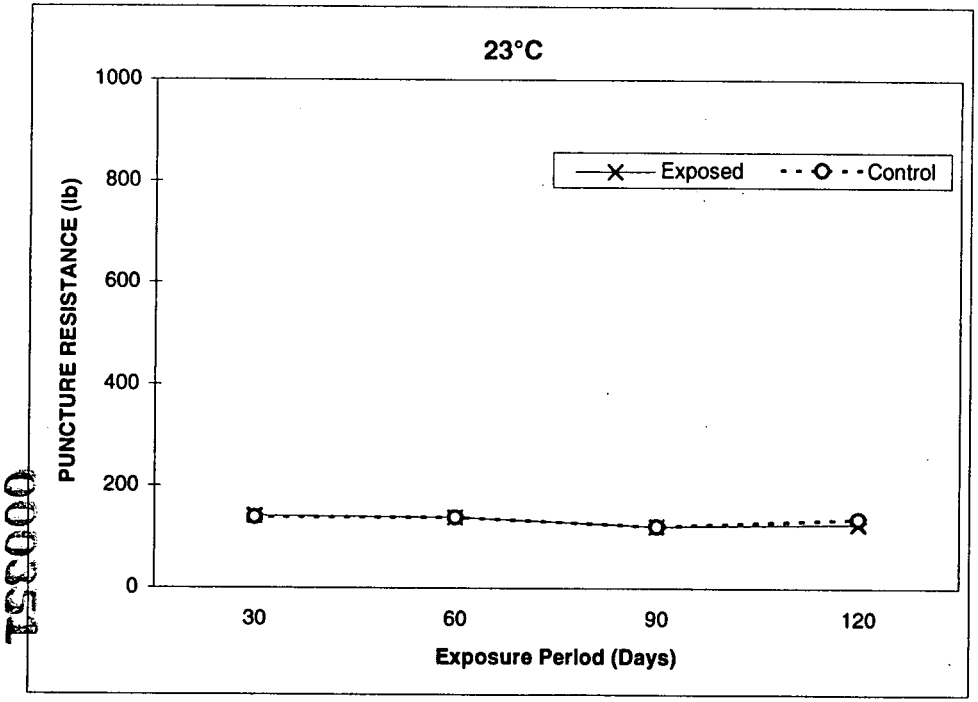
CHEMICAL COMPATIBILITY TEST RESULTS

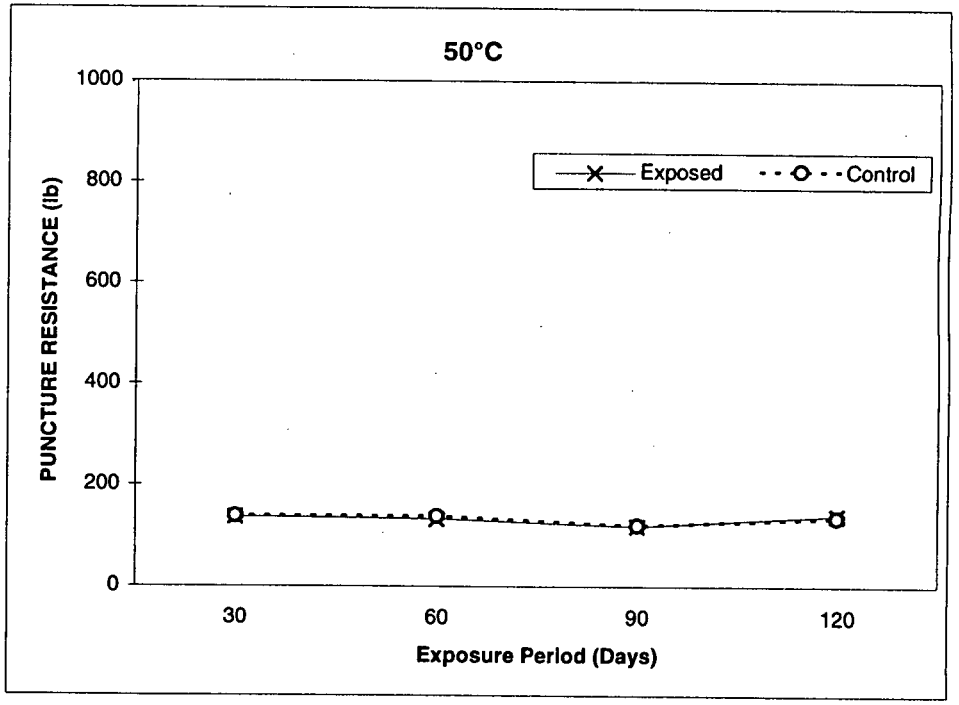
CLIENT: FERMCO
METHOD: FTMS 101C (METHOD 2065)
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): PUNCTURE RESISTANCE (lb)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	142.4	142.0	140.0	137.5	132.0	138.8	4.3	0.000	142.4	142.0	140.0	137.5	132.0	138.8	4.3	0.000	VV
30	137.5	140.2	146.6	145.6	135.9	141.2	4.8	1.715	133.1	132.1	140.3	140.5	137.7	136.7	4.0	-1.469	VV
Control	142.4	142.0	140.0	137.5	132.0	138.8	4.3	0.000	142.4	142.0	140.0	137.5	132.0	138.8	4.3	0.000	DL
60	136.3	145.4	134.6	134.9	142.8	138.8	5.0	0.014	137.8	134.5	131.5	128.4	132.8	133.0	3.5	-4.165	VV
Control	124.1	118.1	121.6	122.6	118.6	121.0	2.6	0.000	124.1	118.1	121.6	122.6	118.6	121.0	2.6	0.000	DL
90	113.8	125.0	123.8	125.1	118.7	121.3	4.9	0.231	127.5	116.5	116.0	117.0	117.8	119.0	4.8	-1.686	DL
Control	136.8	142.6	138.1	127.3	136.7	136.3	5.6	0.000	136.8	142.6	138.1	127.3	136.7	136.3	5.6	0.000	DL
120	127.0	125.5	125.3	125.5	126.1	125.9	0.7	-7.645	135.0	138.1	142.1	141.8	146.4	140.7	4.3	3.213	DL





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

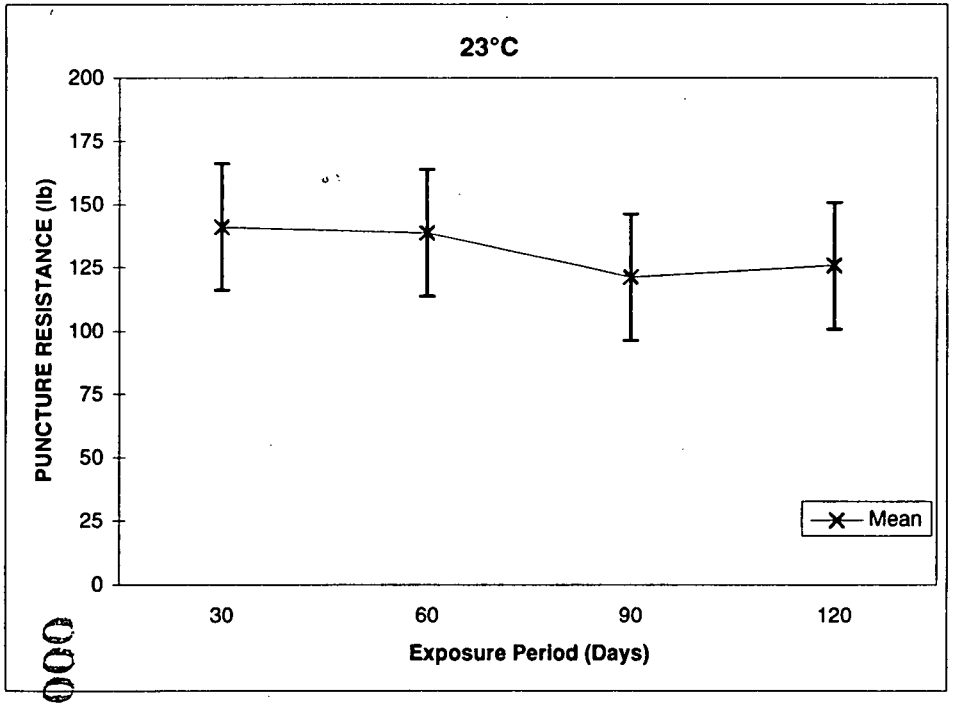
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

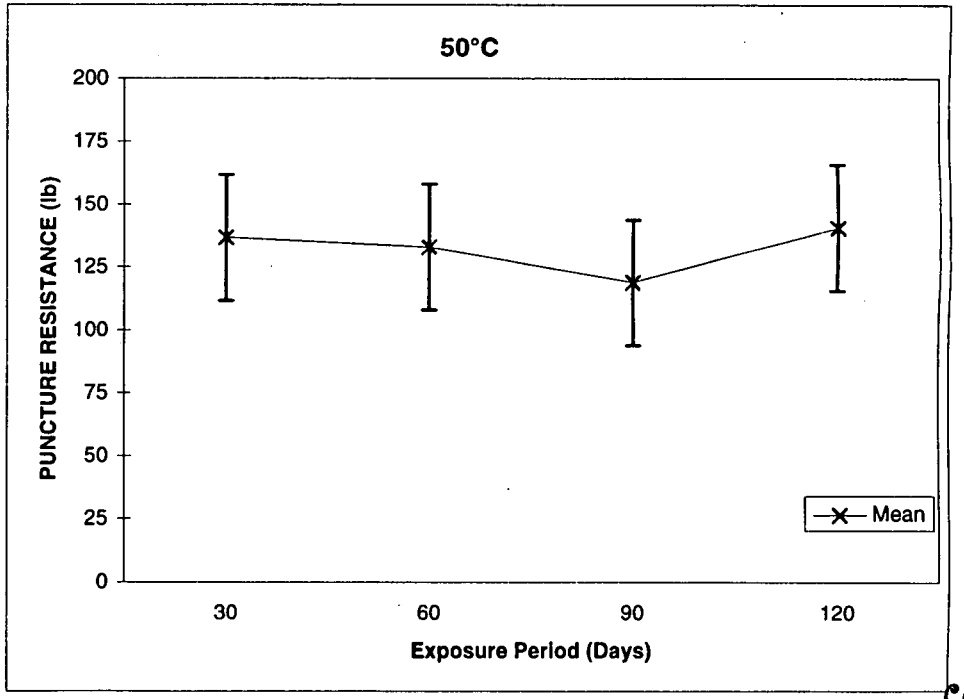
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*FTMS 101C (METHOD 2065)*	*MATERIAL TYPE:*	*POLYFLEX*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): PUNCTURE RESISTANCE (lb)
DIRECTION: N/A

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	142.4	142.0	140.0	137.5	132.0	138.8	4.3	0.0	142.4	142.0	140.0	137.5	132.0	138.8	4.3	0.0	VV
30	137.5	140.2	146.6	145.6	135.9	141.2	4.8	1.7	133.1	132.1	140.3	140.5	137.7	136.7	4.0	-1.5	VV
60	136.3	145.4	134.6	134.9	142.8	138.8	5.0	0.0	137.8	134.5	131.5	128.4	132.8	133.0	3.5	-4.2	VV
90	113.8	125.0	123.8	125.1	118.7	121.3	4.9	-12.6	127.5	116.5	116.0	117.0	117.8	119.0	4.8	-14.3	DL
120	127.0	125.5	125.3	125.5	126.1	125.9	0.7	-9.3	135.0	138.1	142.1	141.8	146.4	140.7	4.3	1.4	DL





© 1996 GEOSYNTEC CONSULTANTS

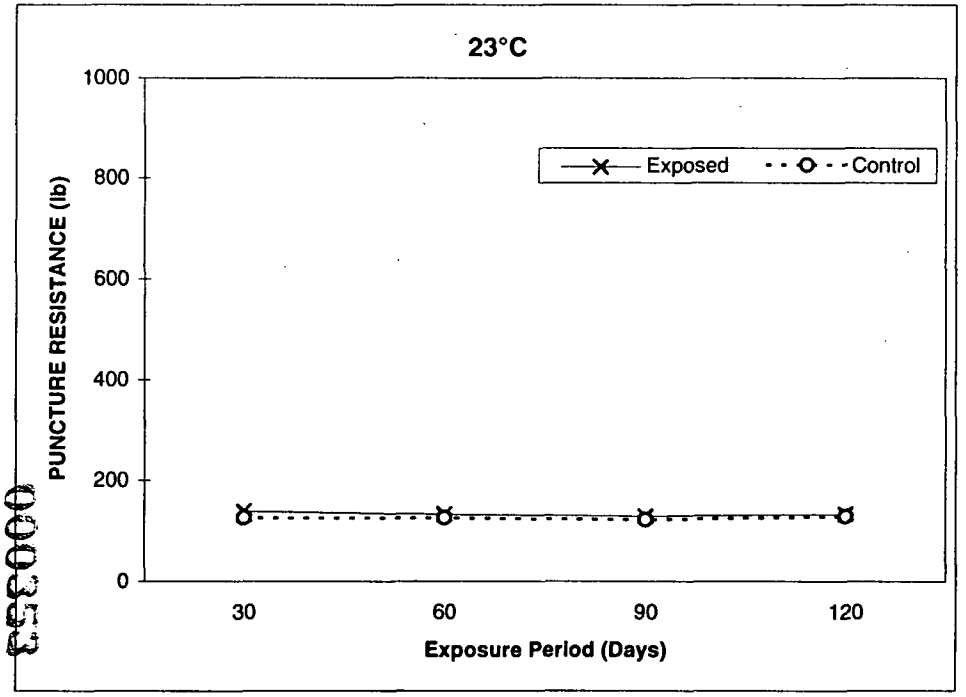
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

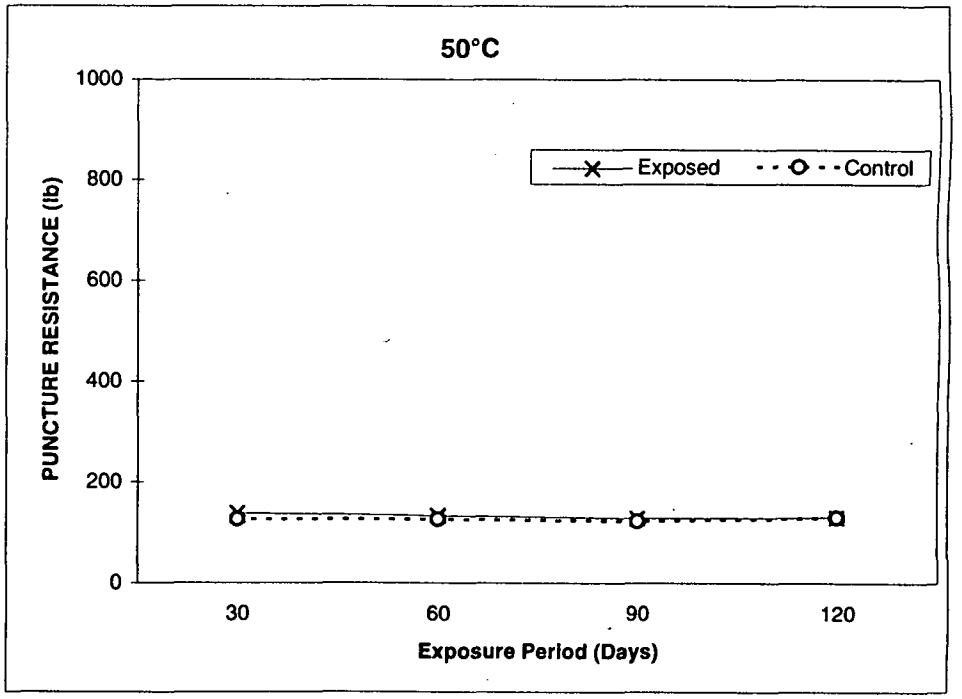
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*FTMS 101C (METHOD 2065)*	*MATERIAL TYPE:*	*SERROT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): PUNCTURE RESISTANCE (lb)
DIRECTION: N/A

Exposure Period (Days)	*23°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*50°C* Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	*Technician*
Control	120.7	129.7	117.7	129.3	132.7	126.0	6.5	0.000	120.7	129.7	117.7	129.3	132.7	126.0	6.5	0.000	VV
30	136.2	140.2	140.5	138.6	136.4	138.4	2.0	9.808	139.2	138.2	140.1	134.9	136.2	137.7	2.1	9.284	VV
Control	120.7	129.7	117.7	129.3	132.7	126.0	6.5	0.000	120.7	129.7	117.7	129.3	132.7	126.0	6.5	0.000	DL
60	130.8	133.8	133.4	132.5	134.0	132.9	1.3	5.459	134.1	133.6	131.1	133.2	133.0	133.0	1.1	5.539	VV
Control	126.3	125.7	118.2	116.3	122.2	121.7	4.4	0.000	126.3	125.7	118.2	116.3	122.2	121.7	4.4	0.000	DL
90	130.0	129.5	127.3	129.6	127.3	128.7	1.3	5.750	129.8	128.5	128.8	127.7	125.3	128.0	1.7	5.159	DL
Control	129.6	122.4	124.4	135.8	131.8	128.8	5.5	0.000	129.6	122.4	124.4	135.8	131.8	128.8	5.5	0.000	DL
120	135.0	134.0	135.5	131.1	130.3	133.2	2.3	3.401	129.2	130.0	129.7	127.8	127.9	128.9	1.0	0.093	DL





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000353

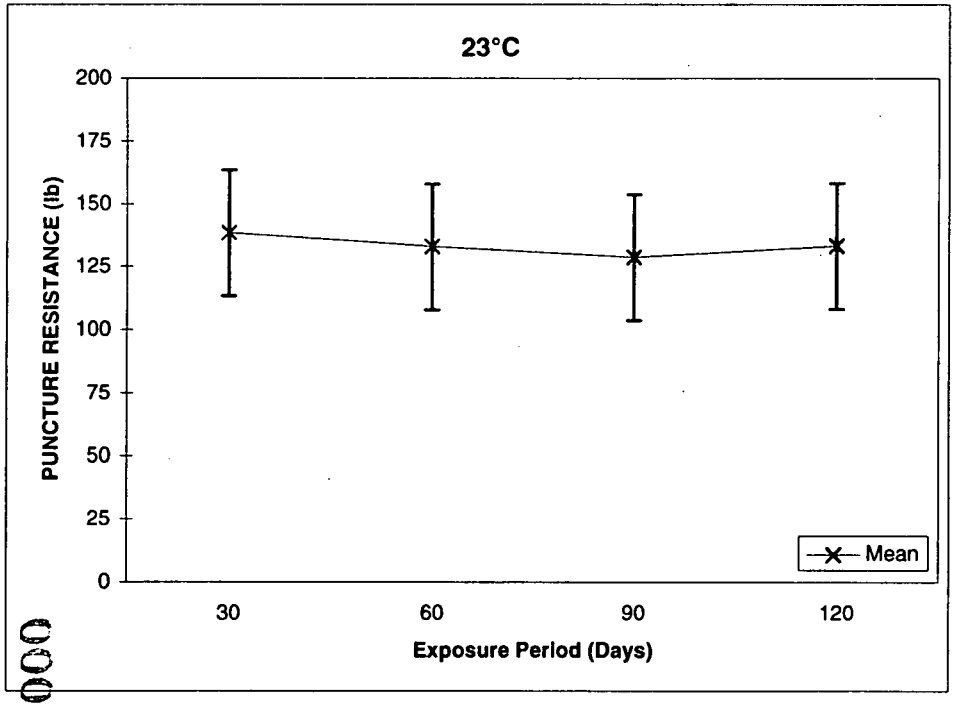
GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

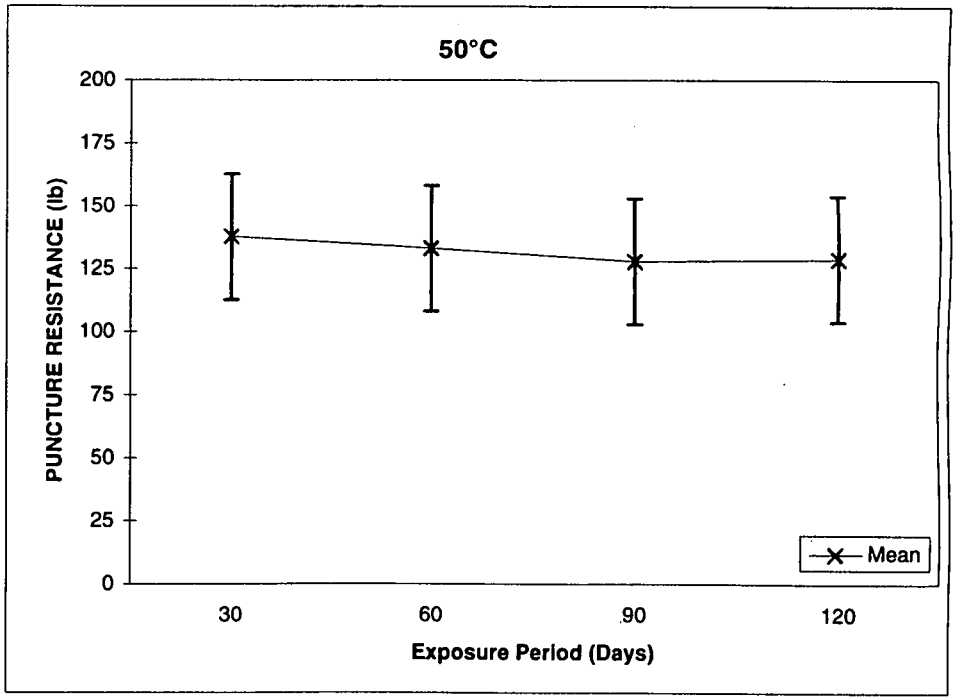
CHEMICAL COMPATIBILITY TEST RESULTS

CLIENT:	*FERMCO*	*GEOSYNTEC JOB NO.:*	*GE 3900*
METHOD:	*FTMS 101C (METHOD 2065)*	*MATERIAL TYPE:*	*SERROT*
DATE TESTED:	*06/14/96*	*CHARACTERISTICS:*	*80 mil HDPE Geomembrane*
		IMMERSION MEDIUM:	*Perched Ground Water*

PROPERTY (UNIT): PUNCTURE RESISTANCE (lb)
DIRECTION: N/A

Exposure Period (Days)	*23°C*								*50°C*								*Technician*
	Specimens					*Mean*	*Standard Deviation*	*Percent Change*	*Specimens*					*Mean*	*Standard Deviation*	*Percent Change*	
	1	*2*	*3*	*4*	*5*				*1*	*2*	*3*	*4*	*5*				
Control	120.7	129.7	117.7	129.3	132.7	126.0	6.5	0.0	120.7	129.7	117.7	129.3	132.7	126.0	6.5	0.0	VV
30	136.2	140.2	140.5	138.6	136.4	138.4	2.0	9.8	139.2	138.2	140.1	134.9	136.2	137.7	2.1	9.3	VV
60	130.8	133.8	133.4	132.5	134.0	132.9	1.3	5.5	134.1	133.6	131.1	133.2	133.0	133.0	1.1	5.5	VV
90	130.0	129.5	127.3	129.6	127.3	128.7	1.3	2.2	129.8	128.5	128.8	127.7	125.3	128.0	1.7	1.6	DL
120	135.0	134.0	135.5	131.1	130.3	133.2	2.3	5.7	129.2	130.0	129.7	127.8	127.9	128.9	1.0	2.3	DL





© 1996 GEOSYNTEC CONSULTANTS

2.13 Mullen Burst Strength (Hydrostatic Resistance)

Rationale for Test

Mullen burst strength is a measure of the resistance of a material to being burst by a hemispherical rubber diaphragm. As with initial tear, modulus of elasticity, stress at yield, and puncture resistance, Mullen burst strength is reduced when a material absorbs volatile constituents.

Results and Discussion

The five exposed geomembranes generally underwent parallel changes in their Mullen burst strength, although the magnitude of percent change varied among the different geomembranes. The results displayed some variability (i.e., no trends were observed, and the exposed sample values varied from the control values). Moreover, many of the mean values of the exposed samples were outside of one standard deviation of the control value means. In addition, there were no appreciable differences between the 23°C (73°F) and 50°C (122°F) data sets. Finally, these results, which were slightly inconsistent, show variability which is similar to that observed in the tensile properties and the initial tear resistance results. Therefore, the changes in Mullen burst strength of the exposed samples are probably due to material and experimental variability.

Conclusion

Mullen burst strengths of the five geomembranes were not measurably impacted by 120 days of exposure to the test leachate.

Draft

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

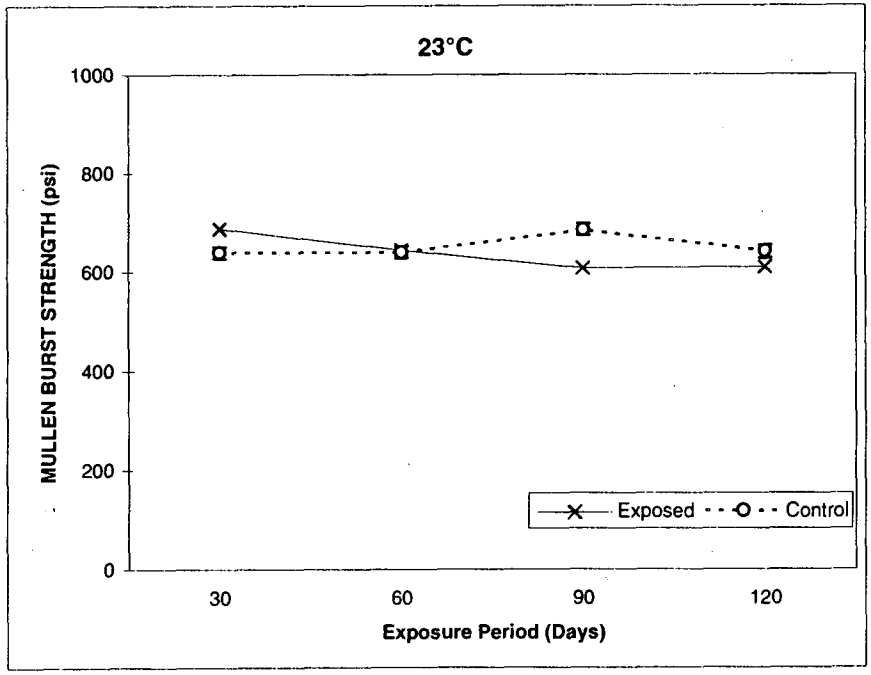
CHEMICAL COMPATIBILITY TEST RESULTS

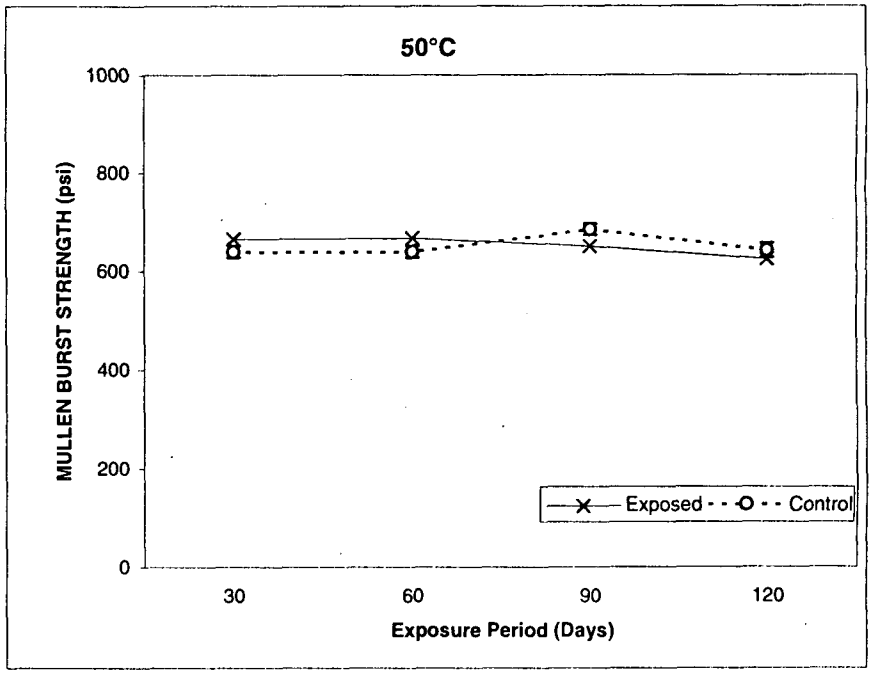
CLIENT: FERMCO
METHOD: ASTM D3786
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE - SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MULLEN BURST STRENGTH (psi)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	660	640	630	640	630	640	12	0.000	660	640	630	640	630	640	12	0.000	VV
30	680	680	700	680	700	688	11	7.500	670	650	670	670	670	666	9	4.063	VV
Control	660	640	630	640	630	640	12	0.000	660	640	630	640	630	640	12	0.000	WM
60	640	650	640	640	650	644	5	0.625	660	680	670	670	660	668	8	4.375	VV
Control	700	690	680	670	690	686	11	0.000	700	690	680	670	690	686	11	0.000	WM
90	610	615	620	600	590	607	12	-11.516	660	660	645	650	640	651	9	-5.102	WM
Control	660	635	630	630	655	642	14	0.000	660	635	630	630	655	642	14	0.000	WM
120	620	580	590	630	625	609	22	-5.140	630	640	620	610	620	624	11	-2.804	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000356

382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

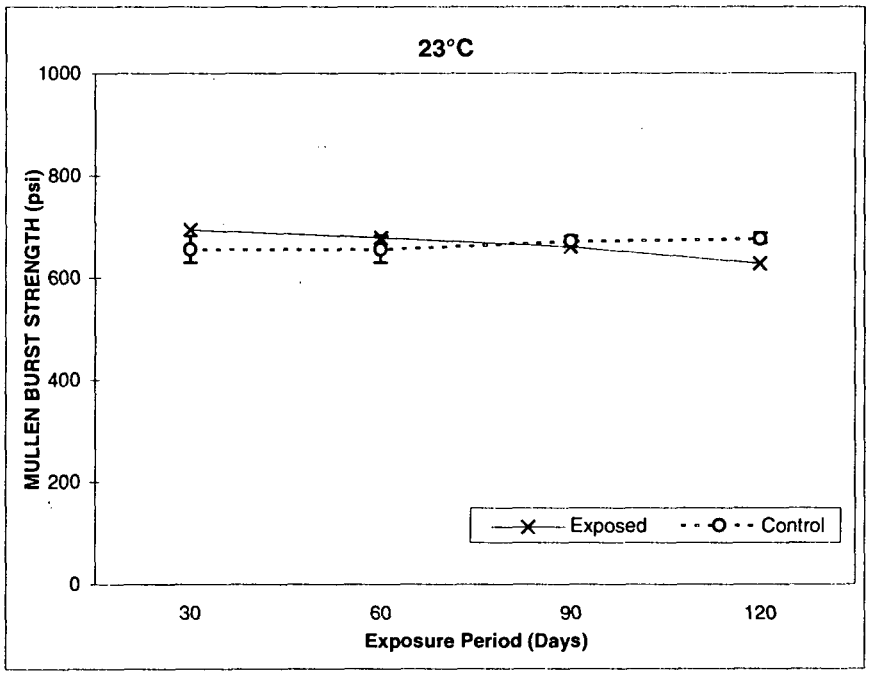
CHEMICAL COMPATIBILITY TEST RESULTS

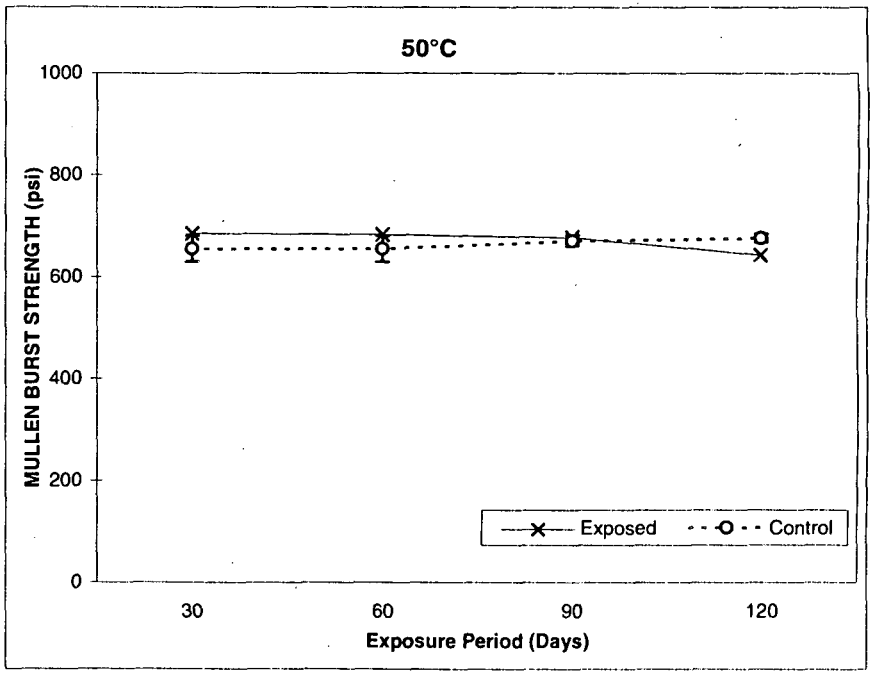
CLIENT: FERMCO
METHOD: ASTM D3786
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MULLEN BURST STRENGTH (psi)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	650	700	650	630	650	656	26	0.000	650	700	650	630	650	656	26	0.000	VV
30	690	690	690	700	700	694	5	5.793	690	670	690	690	690	686	9	4.573	VV
Control	650	700	650	630	650	656	26	0.000	650	700	650	630	650	656	26	0.000	WM
60	690	680	670	680	670	678	8	3.354	680	680	680	690	690	684	5	4.268	VV
Control	670	660	670	690	670	672	11	0.000	670	660	670	690	670	672	11	0.000	WM
90	670	645	670	660	660	661	10	-1.637	690	680	665	665	690	678	13	0.893	WM
Control	675	670	670	690	680	677	8	0.000	675	670	670	690	680	677	8	0.000	WM
120	650	610	625	610	645	628	19	-7.238	660	645	640	620	650	643	15	-5.022	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000357

382

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

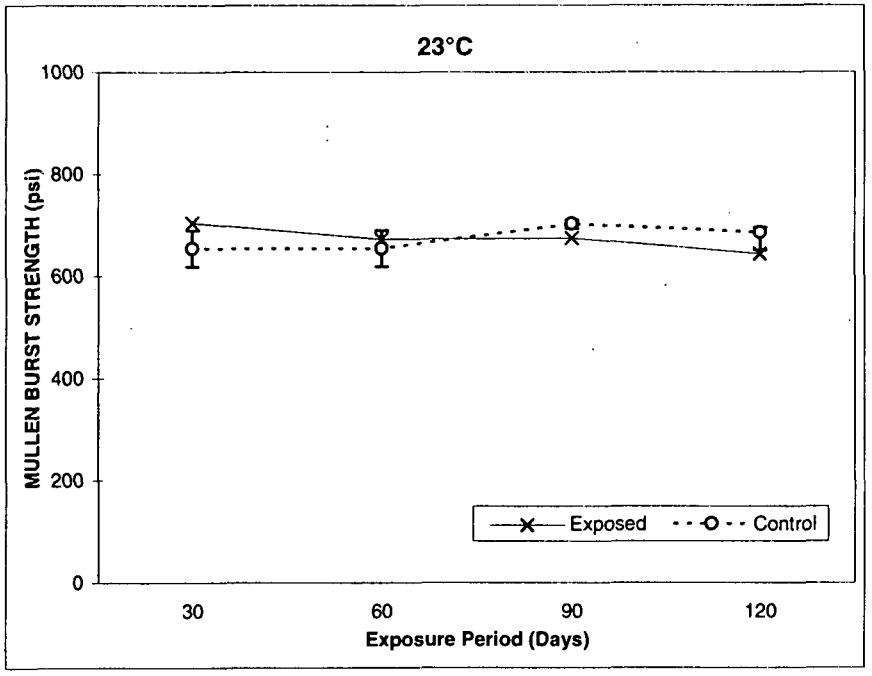
CHEMICAL COMPATIBILITY TEST RESULTS

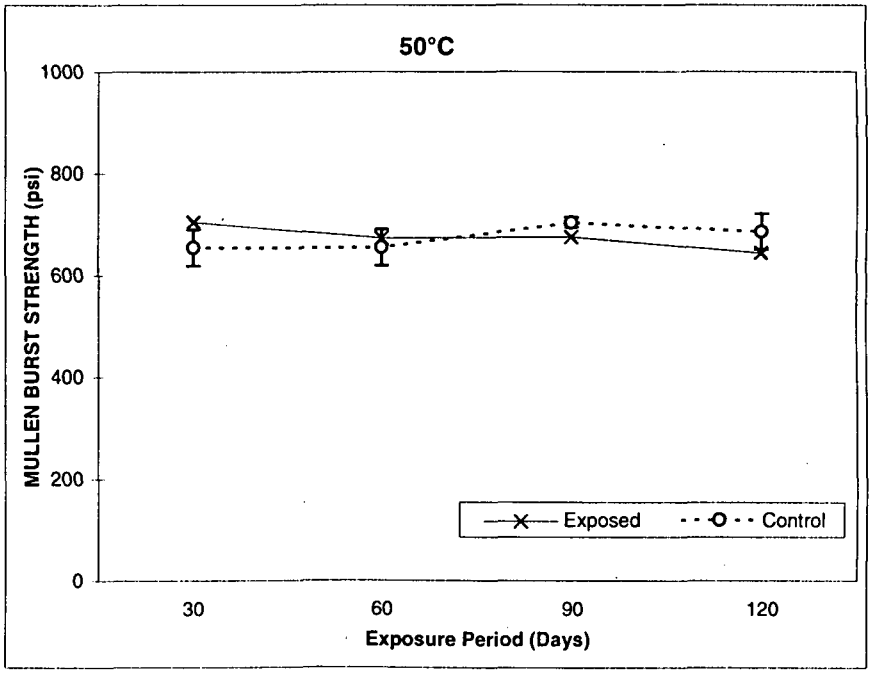
CLIENT: FERMCO
METHOD: ASTM D3786
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MULLEN BURST STRENGTH (psi)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	600	690	640	680	660	654	36	0.000	600	690	640	680	660	654	36	0.000	VV
30	700	700	710	710	700	704	5	7.645	720	710	720	730	710	718	8	9.786	VV
Control	600	690	640	680	660	654	36	0.000	600	690	640	680	660	654	36	0.000	WM
60	650	680	690	680	660	672	16	2.752	680	690	690	690	690	688	4	5.199	VV
Control	715	700	710	690	700	703	10	0.000	715	700	710	690	700	703	10	0.000	WM
90	680	675	665	680	670	674	7	-4.125	655	690	690	665	670	674	16	-4.125	WM
Control	740	660	695	650	680	685	35	0.000	740	660	695	650	680	685	35	0.000	WM
120	665	650	635	630	635	643	14	-6.131	660	660	670	680	690	672	13	-1.898	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000358

387

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

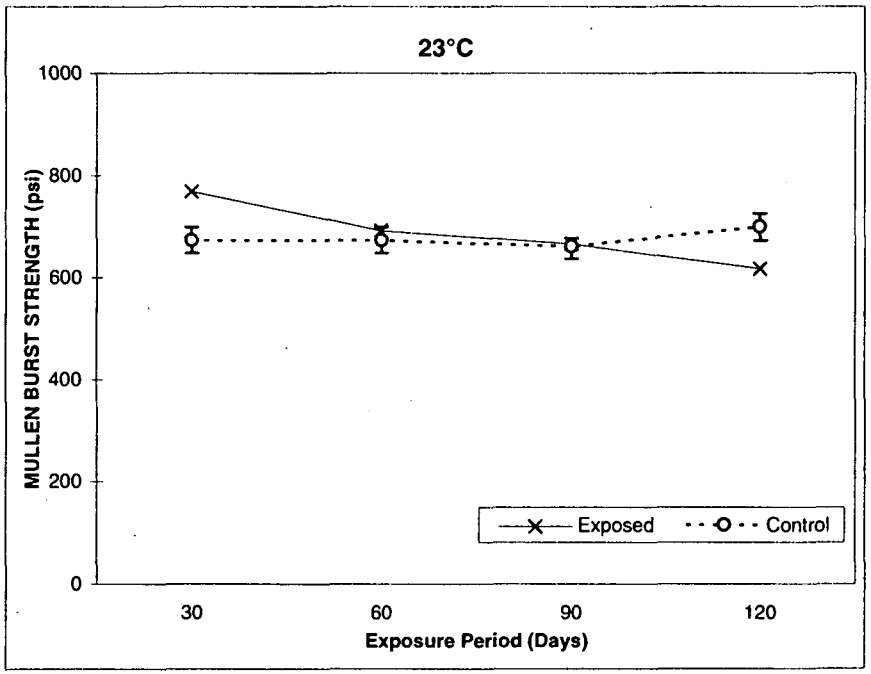
CHEMICAL COMPATIBILITY TEST RESULTS

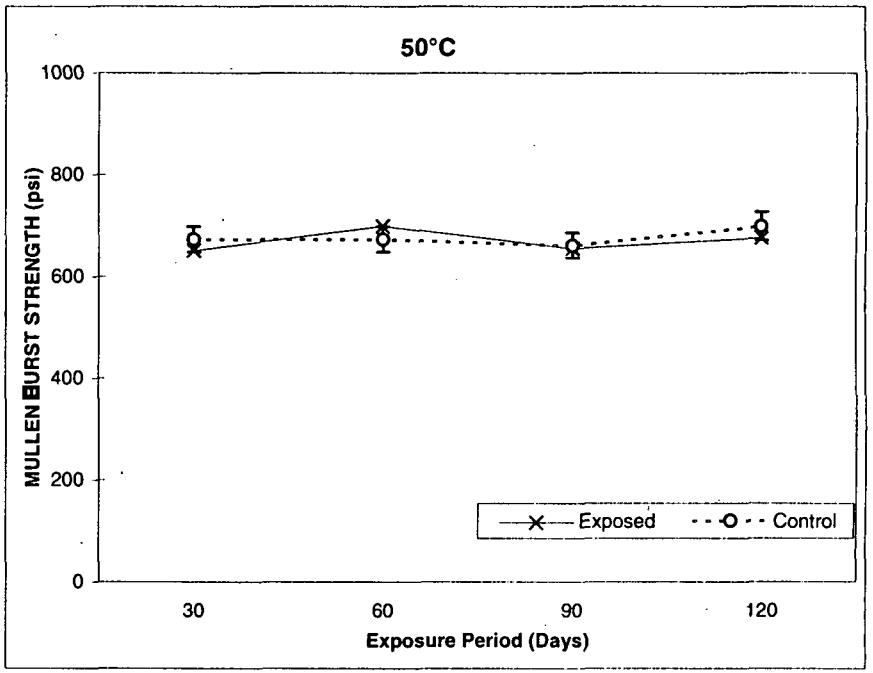
CLIENT: FERMCO
METHOD: ASTM D3786
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MULLEN BURST STRENGTH (psi)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	710	660	690	660	650	674	25	0.000	710	660	690	660	650	674	25	0.000	VV
30	760	750	790	770	770	768	15	13.947	650	670	660	640	640	652	13	-3.264	VV
Control	710	660	690	660	650	674	25	0.000	710	660	690	660	650	674	25	0.000	WM
60	700	690	680	690	700	692	8	2.671	700	680	680	690	750	700	29	3.858	VV
Control	630	680	640	680	680	662	25	0.000	630	680	640	680	680	662	25	0.000	WM
90	670	660	690	660	650	666	15	0.604	700	650	600	650	680	656	38	-0.906	WM
Control	690	700	730	720	660	700	27	0.000	690	700	730	720	660	700	27	0.000	WM
120	615	610	610	620	630	617	8	-11.857	645	665	700	720	655	677	32	-3.286	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000359

23 00

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

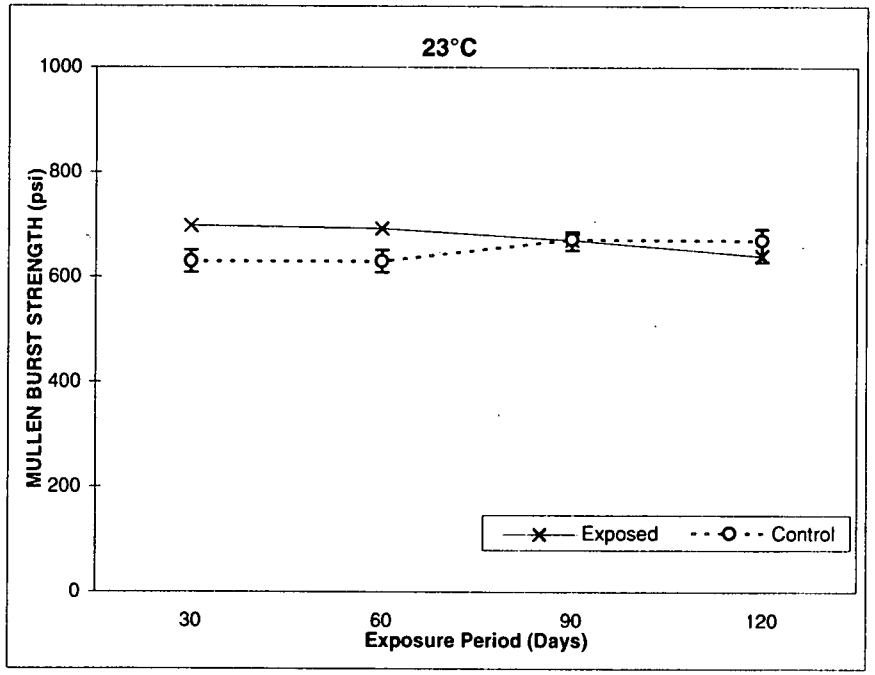
CHEMICAL COMPATIBILITY TEST RESULTS

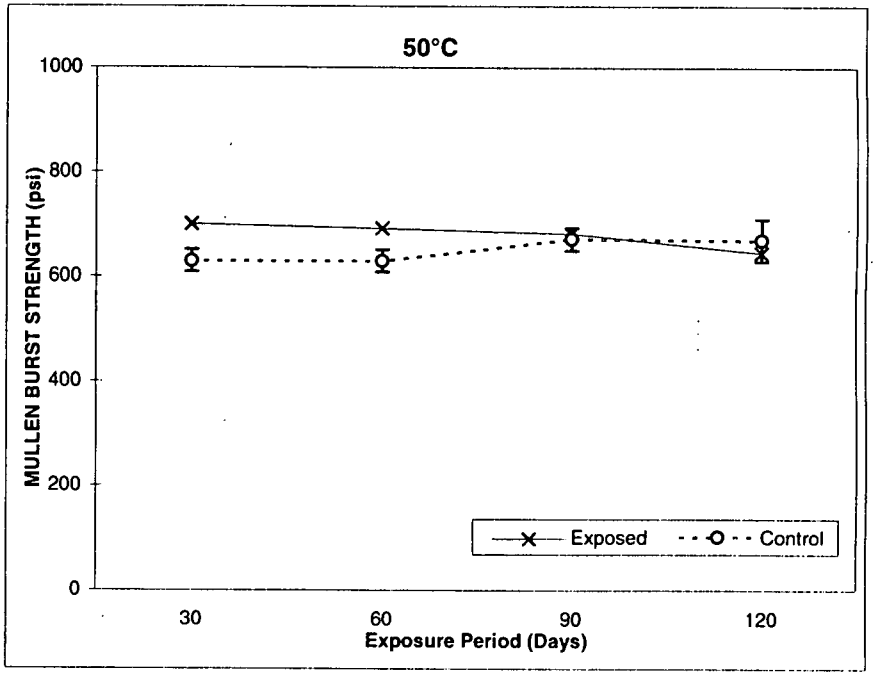
CLIENT: FERMCO
METHOD: ASTM D3786
DATE TESTED: 06/14/96

GEOSYNTEC JOB NO.: GE 3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

PROPERTY (UNIT): MULLEN BURST STRENGTH (psi)
DIRECTION: N/A

Exposure Period (Days)	23°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	50°C Specimens 1	2	3	4	5	Mean	Standard Deviation	Percent Change	Technician
Control	640	630	610	610	660	630	21	0.000	640	630	610	610	660	630	21	0.000	VV
30	700	690	700	710	690	698	8	10.794	700	710	700	700	690	700	7	11.111	VV
Control	640	630	610	610	660	630	21	0.000	640	630	610	610	660	630	21	0.000	WM
60	690	690	690	700	690	692	4	9.841	690	690	690	700	690	692	4	9.841	VV
Control	680	650	680	650	700	672	22	0.000	680	650	680	650	700	672	22	0.000	WM
90	660	650	680	680	680	670	14	-0.298	690	680	680	670	690	682	8	1.488	WM
Control	610	700	710	650	680	670	41	0.000	610	700	710	650	680	670	41	0.000	WM
120	640	645	640	640	635	640	4	-4.478	640	645	655	655	635	646	9	-3.582	WM





Note: Error bars represent one standard deviation at mean sample value.

© 1996 GEOSYNTEC CONSULTANTS

000360

387

2.14 Conclusions

2.14.1 Conclusions on Physical Properties

The mass, thickness, dimensions, and specific gravity results are consistent, show good inter-test correlation, have mean values for exposed samples which are generally within one standard deviation of the control samples, and the 23°C (73°F) and the 50°C (122°F) data sets are similar to one another. The mass, thickness, dimensions, and specific gravity results indicate that the leachate did not measurably impact the geomembranes.

The volatiles loss and extractables content results were variable (such variability is often observed in volatiles loss and extractables content in USEPA Method 9090 testing programs). Although, all of the post-exposure values were greater than that of the control, no other trends in the data were observed. Moreover, these data did not correlate with mass, thickness, specific gravity, and dimension results. Therefore, the changes in volatiles loss and extractables content are not attributed to the action of the test leachate. Other sources, such as surface moisture (in the case of volatiles loss) and ultrasonic cleaning (in the case of extractable content) are mechanisms that much more likely explain the test result variabilities.

In conclusion, these results indicate that the physical properties of the geomembranes were not measurably impacted by 120 days of exposure to the test leachate.

2.14.2 Conclusions on the Mechanical Properties of the Geomembranes

The mechanical properties of the five geomembranes did not undergo changes that were consistent with a mechanism of interaction with the test leachate. The observed changes were variable; however, many of the exposed sample values were within one standard deviation of the control value means. In some instances, the tensile properties did not correlate with other measured properties (i.e., the inverse relationship of stress and strain was not observed). Moreover, the action of leachate on a material is

draft

probably not selective, and would, thus, adversely impact all properties. Therefore, it is concluded that the mechanical properties of the geomembranes were not measurably impacted by the test leachate during the 120 day exposure period. Changes observed in the mechanical properties of the geomembranes are attributed to material and experimental variability.

2.14.3 Comparison of Results of the Geomembrane Sample Types

As shown by the results of the USEPA Method 9090 tests, the performance of each of the five geomembranes was equivalent. However, each exhibited a different amount of variability. Therefore, the results of the USEPA Method 9090 tests may be ranked in terms of the coefficients of variation for each geomembrane. The coefficient of variation, in which the standard deviation is expressed as a percentage of the mean, is often used for comparing variability in two sets of measurements having different mean values. The ranking was calculated using only the results of the mechanical properties tests. Mass, thickness, dimensions, and specific gravity were not included in this calculation because the standard deviation values were, in most cases, nearly zero. In addition, volatiles and extractables were not included because standard deviation values were extremely high, in some cases higher than the mean values.

The geomembranes are ranked below in order of increasing coefficient of variation.

Geomembrane	Coefficient of Variation
NSC	2.9
GSE-Gundle	4.1
Serrot	5.2
GSE-SLT	5.3
Polyflex	5.4

As shown above, the NSC geomembrane has the lowest coefficient of variation, followed by GSE-Gundle, and Serrot, GSE-SLT, and Polyflex, which have nearly the same level of variability.

draft

APPENDIX C

APPENDIX C

RESIN AND ROLL CERTIFICATIONS

draft

CERTIFICATION SHEET

POLY-FLEX, INC.
2000 W. Marshall Drive
Grand Prairie, Texas 75051

PROJECT NO: B DATE: 1/9/96
TRIP NO: CERTIFIED BY: J. D. Green

TEST DESCRIPTION		THICKNESS	CARBON BLACK	C-TEAR	PUNCTURE 2065	TENSILE YIELD	ELONG @ YIELD	TENSILE BREAK	ELONG @ BREAK	ELASTIC MODULUS	DIMENSION STABILITY	CAR. BLK. DISPERSION	MELT INDEX	DENSITY	LOW TEMP IMPACT	ESCR (cond. B)
ASTM METHOD		D1593	D1603	D1004	FTMS 101	D638	D638	D638	D638	D638	D1204	D3015	D1238	D1505	D746	D1693
(modifications)		min/avg			2065										-70° C	2000 hrs
FREQUENCY																
UNITS		mils	%	lb	lb	ppi	%	ppi	%	psi	%		g/10 min	gm/cc	PASS	PASS
HDPE SPECIFICATION		72/80	2-3	56	120	184	13	320	750	80,000	±1	A1,A2,B1	0.4	0.940	<-94°F	2,000
ROLL NUMBER	BLEND												MAX			
N9-8-95- 7 -3	164509	75 / 86	2.6	67	135	214	18	379	957	96000	-0.2	A1	0.18	0.949	Pass	Pass
		/														
		/														
		/														
		/														
		/														
		/														
		/														
		/														
		/														
		/														
		/														
		/														
		/														
		/														
		/														

000365

2 of 3

387

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 17, 1995

JHV# 15394-95

FAX: 214-647-0829

Poly America, Inc.
2000 West Marshall Drive
Grand Prairie, TX 75051

ATTN: Dee Averitte

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-400G
Lot Number:	7151197
P.O. Number:	5247
Date Shipped:	10/16/95
Package:	PSPX 2262
Quantity:	177700 LBS.
HLMI (Flow Rate):	11.4 G/10 MIN
Melt Index:	.090 G/10 MIN
Density:	.937 G/CC

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.

cc: QA-File-RC

Mr. Jim Nobert
Poly America, Inc.
2000 West Marschall Drive
Grand Prairie, TX 75051

UNION CARBIDE
UNION CARBIDE CORPORATION
P.O. Box 186, Port Lavaca, TX 77979

Fax: 1214-647-0829

Poly America Inc.
2000 West Marshall
Grand Prairie, TX 75051-2795
Attn: A. Bertrand

PRODUCT QUALITY REPORT

01/23/95

Product Name: DHDB-1525 NT

Shipped To: Poly America Inc.
2000 W. Marshall
Grand Prairie, TX 75051-2795

Customer Order No.: 2549-4
Internal Order No.: 178455

Blend	Quantity	Container Id	Ship Date
164509	193213	UNPX123466	01/20/95

The following test data was obtained :

Blend : 164509
Sample Id : PE240894
Date of Manufacture : 01/17/95

Test Description	Unit	Results
Melt Index	g/10min	.16
Density	g/cu cm	.9397

Wayne Daggs

Wayne Daggs

Quality Assurance Department

GSE

Roll Test Data Report

387

ROLL NO. AF-9750

ROLL DIMENSIONS ≈ ± 1%

ROLL NUMBER:	AF-9750	
PROD DATE:	01/08/96	
SHEET AREA:	117	sq.ft.
	11	sq. meters
LENGTH:	5	feet
	2	meters
WIDTH:	23.33	feet
	7.1	meters
WEIGHT:	62	pounds
	28	kilograms

RESIN LOT INFORMATION

LOT NUMBER	U-45921
RESIN TYPE	600 SERIES

PROPERTY	UNITS	METHOD	RESULT
DENSITY	g/cc	D1505	0.935
MOISTURE	%	D570	< 0.09
BRITTLENESS	°C	D746	<-70
MELT INDEX	g/10 min.	D1238	0.540

PROPERTY	ASTM METHOD	GSE MINIMUMS ENGLISH	GSE MINIMUMS METRIC	ACTUAL TEST VALUES ENGLISH	ACTUAL TEST VALUES METRIC
TENSILE YIELD STRENGTH	D638				
CD -		173 lb/in	31 kg/cm	185 lb/in	33 kg/cm
MD -		173	31	184	33
YIELD ELONGATION	D638				
CD -		13 %		20 %	
MD -		13		21	
TENSILE BREAK STRENGTH	D638				
CD -		324 lb/in	59 kg/cm	412 lb/in	74 kg/cm
MD -		324	59	412	74
[illegible]K ELONGATION	D638				
CD -		560 %		724 %	
MD -		560		727	
INITIAL TEARING STRENGTH	D1004				
CD -		60 lb	27 kg	76 lb	34 kg
MD -		60	27	66	30
PUNCTURE STRENGTH	FTMS 101C/2065	98 lb	44 kg	125 lb	57 kg
SHRINKAGE	D1204				
CD -	(1 HR @ 100C)	+/-2.00 %		0.5 %	
MD -		+/-2.00		0.2	
CARBON BLACK DISPERSION	D3015	A2		A2	
CARBON BLACK CONTENT	D1603	2.00 %		2.27 %	
GEOMEMBRANE DENSITY	D792		0.940 g/cc		0.944 g/cc
ESCR	D1693-B	1500 hours		Start 1/12/96	
THICKNESS	D1593/D751				
NOMINAL		80 mil	2.03 mm	80 mil	2.03 mm
MINIMUM		72	1.83	72	1.82
AVG. THICKNESS				80	2.03

TEST NOTES: MD=MACHINE DIRECTION CD=CROSS DIRECTION ESCR START DATE IS GIVEN
-FOR TENSILE ELONGATION TEST GAUGE LENGTH=1.3 ON YIELD, 2.5 ON BREAK
ALL STRENGTH VALUES BASED ON NOMINAL THICKNESS

APPROVED 11/10/96 #8 QA

CUSTOMER:
JOB NO.
COMMENTS

DATE SHIPPED

20061118

000368

STAR... Safety Through Accountability and Recognition

Mobil Polyethylene

Certificate of Analysis

"QUALITY PEOPLE MAKING QUALITY PRODUCTS"

Bill Walling
GSE
19103 Gundle Road
Houston, TX 77073-3515

January 4, 1996

Mobil Chemical, a major supplier of quality polyethylene, has shipped a lot of Material to your facility. The lot identification and analysis are listed below. This data has been supplied by our Quality Control Laboratory located here in Beaumont. If you should need further information or another copy of this report please call your sales office in Irving, TX 214-580-1040.

Resin Identification		Resin Analysis Test	Lot Data
Product Type	HDA-611	Melt Index (gms/10 min) I_2	0.54
Lot Number	U-45921	Density (gms/cc)	0.935
Hopper Car Number	MOBX-52870		
Quantity Shipped	180,700		
Date of Manufacture	23-Oct-95		
P.O. Number	S 046938		
Location Shipped to Aldine, TX			

Thank you for your business. If you need additional assistance, please do not hesitate to contact our Sales Representative in your area.

Sincerely,

C. A. Winney
Quality Assurance Specialist

MP-DALLAS

FAX to 713/847-3885 D. Camp

GSE™

Quality Control Certificate

RAILCAR : PSPX2445
MATERIAL : HDPE 080 MIL
BATCH # : 122395
ROLL # : 04026120

MANF. DATE : 12/23/1995
PROJECT NAME : SAMPLES
MR NUMBER : 8900-01 PROJECT # : SAMPLE
LOCATION : HOUSTON TX 01

TEST PARAMETER	TESTING FREQUENCY	TYPICAL SPECIFICATIONS	TEST RESULTS	ASTM METHOD
Minimum Thickness (mils)	EVERY ROLL	72.0 min	76.0	D 751 NSF Mod.
Carbon Black (%)	5TH ROLL	2.0 to 3.0	2.6	D 1603
Carbon Black Dispersion	5TH ROLL	A-1/A-2/B-1	A-2	D 3015
Density (g/cc)	5TH ROLL	0.940 min	0.943	D 1505 (Meth.A)
Tensile Properties:				
T.S. @ Yield (ppi)	EVERY ROLL	173	213	
T.S. @ Break (ppi)	EVERY ROLL	320	390	D 638 Type IV
Elong. @ Yield (%)	EVERY ROLL	13	17	
Elong. @ Break (%)	EVERY ROLL	560	708	2 ipm
Puncture Resistance (lb.)	EVERY ROLL	105	140	FTMS 101, Meth. 2065
Tear Resistance (lb.)	EVERY ROLL	60	69	D 1004, Die C
Dimensional Stability (%)	EVERY ROLL	-2.00 to 2.00	Pending	D 1204 (1 hr, 100C)
ESCR (hrs)	EVERY ROLL	1500 min	Pending	D 1693 NSF MOD.

APPROVED #22 1/10/96 QA

387

PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

December 11, 1995

JHV# 18498-95

FAX: 713-443-4627

Gundle Lining Systems Inc.
1340 East Richey Road
Houston, TX 77073

ATTN: Rick Schaefer

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-400G
Lot Number:	7151468
P.O. Number:	S046063
Date Shipped:	12/08/95
Package:	PSPX 2445
Quantity:	177250 LBS.
Melt Index, ASTM D1238:	.100 G/10 MIN
HLMI Flow Rate,ASTM D1238	11.4 G/10 MIN
Density, ASTM 1505:	.937 G/CC
ESCR, F/50, Cond. B:	1500 HOURS **
HLMI/MI Ratio:	114. GM/10 MIN
Production Date:	11/30/95

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

* Reg. U.S. Pat. Off.
** Nominal Value (not tested on each lot)

cc: QA-File-RC

SERROT
CORPORATION
GEOMEMBRANE LINING SYSTEMS

CERTIFICATE OF QUALITY ASSURANCE

ROLL#:	1505831	**PROJECT NAME:**	Geosyntec Test
MATERIAL:	HDPE SMOOTH 80 MIL	**LOCATION:**	Boca Raton Fld
LOT/BLEND:	C51014L17A	**SALES ORDER #:**	6202
MANUFAC. DATE:	12/8/95		

TEST	FREQUENCY	SPECIFICATIONS	TEST RESULTS	TEST METHOD
Average Thickness:	Every Roll	76 mils	81.5	ASTM D751
Tensile Strength at Yield:	25,000 SqFt	168 ppi	199.6	ASTM D638
Tensile Strength at Break:	25,000 SqFt	304 ppi	348.3	ASTM D638
Elongation at Yield:	25,000 SqFt	12%	18.2	ASTM D638
Elongation at Break: (2.0" gauge length) NSF 54 MODIFIED	25,000 SqFt	560%	703.3	ASTM D638
Tear Resistance:	50,000 SqFt	52 lbs	63.2	ASTM D1004
Puncture Resistance:	50,000 SqFt	72 lbs	121.2	FTMS 101,(2065)
Puncture Resistance:	50,000 SqFt	96 lbs	163.6	FTMS 101,(2065)
Carbon Black Content:	100,000 SqFt	2.0- 3.0%	2.65	ASTM D1603
Carbon Dispersion:	100,000 SqFt	A1, A2 or B1	A1	ASTM D3015
Density (min):	100,000 SqFt	0.940 g/cm³	0.949	ASTM D792
Melt Flow Index:	Resin Batch	< 0.4 g/10 min.	0.235	ASTM D1238
Dimensional Stability:	Resin Batch	+/- 2.0%	0.12	ASTM D1204
Low Temp. Brittleness:	Certified	-60° C	-80° C	ASTM D746
Environ. Stress Crack:	Certified	1,500 hours	> 1,500	ASTM D638

CERTIFIED BY:

ERIC MAKI DATE: 6/19/96
QUALITY CONTROL LABORATORY SUPERVISOR

SOLVAY POLYMERS

Quality Polymers Through Technology and People

November 10, 1995

Surrot Corporation
James Long
8383 Cassia Way
Henderson, NV 89015
702-566-4745

Listed below are the data on G36-24-150 shipments:

Solvay Order Number:	0C4869
Customer PO:	21220
Date Shipped:	11/09/95
Shipped To:	HENDERSON, NV
Lot Number:	C51014L17A
Hopper Car Number:	ACFX 98069
Weight, Lbs.:	67,050

TEST	METHOD	RESULT	UNITS
MELT INDEX	D 1238-90b	0.25	G/10M
DENSITY (NATURAL RESIN)	D 4883-89	0.9374	G/CC

Compartments A and CA

Sincerely,

Sam J. Valenti III

Sam J. Valenti III
Regulatory Coordinator
Phone: (713) 307-3774

sab

THIS REPORT CANNOT BE COPIED OR REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE SOLVAY POLYMERS ANALYTICAL AND QUALITY SERVICES DEPARTMENT

Solvay Polymers Inc. Technical Center
1000 Sandersland Road, Deer Park, Texas 77536 Mailing Address: P.O. Box 1000, Deer Park, Texas 77536-1000 1-800-[illegible] Fax: 713 676 3521

NSC

GEOMEMBRANE CERTIFICATE OF ANALYSIS

Customer: GEOSYNTEC

Number of Rolls Shipped: 1

Project Name: 9090

Nominal Thickness: 80 mil

Project Number: SAMPLE

We hereby certify that the polyethylene geomembrane for the above identified shipment meets or exceeds National Seal Company's specifications, below. Testing was performed at the frequency indicated.

The raw polymeric material is first quality polyethylene resin containing no more than two percent clean re-worked plastic by weight. Thickness was measured according to ASTM D 5199. Tensile properties were determined in accordance with ASTM D 638, NSF modified, using Type IV dumbell specimens, a strain rate of two inches per per minute, and grip movement for strain determinations. Carbon black dispersion slides were prepared according to ASTM D 3015, NSF modified, and rated according to the ASTM D 2663 dispersion classification chart under 100X magnification. Where appropriate, carbon black content was determined according to ASTM D 1603. Dimensional stability was determined according to ASTM D 1204 at 100°C for one hour.

A database listing of all test values follows.

GEOMEMBRANE SPECIFICATIONS

Thickness	80 mil Minimum	at least every 50,000 ft^2
Stress at Yield	2200 psi Minimum	at least every 50,000 ft^2
Stress at Break	3800 psi Minimum	at least every 50,000 ft^2
Strain at Yield	13% Minimum	at least every 50,000 ft^2
Strain at Break	700% Minimum	at least every 50,000 ft^2
Carbon Black Dispersion	A1 or A2	at least every 50,000 ft^2
Carbon Black Content	2% to 3%	at least every 50,000 ft^2
Dimensional Stability	+/- 2%	at least once per shift

NATIONAL SEAL COMPANY

Jane Allen

Jane Allen
Quality Control Manager

1-23-96
Date

NSC

GEOMEMBRANE STANDARD TESTING

Date: 01/23/96

Page: 1

Bill(s) of Lading:

ROLL NUMBER	THICK (mil)	STRESS AT YIELD (psi) MD	STRESS AT YIELD (psi) TD	STRESS AT BREAK (psi) MD	STRESS AT BREAK (psi) TD	STRAIN AT YIELD (%) MD	STRAIN AT YIELD (%) TD	STRAIN AT BREAK (%) MD	STRAIN AT BREAK (%) TD	FABR DISP	FABR CONT (%)	DIMENSIONAL STABILITY MD	DIMENSIONAL STABILITY TD
C08L9757-5A0900021	82.8	2410	2500	4450	4440	17.7	16.8	832	902	A1	2.52	-0.8	0.4
C08L9757-5A0900061	83.6									A1	2.54		
C08L9757-5A1000041	82.5	2480	2540	5130	5270	18.3	17.6	935	1040	A1	2.54	0.0	0.6
C08L9757-5A1000081	82.1	2410	2610	4970	5170	18.4	17.2	929	1010	A1	2.59	0.0	0.4
C08L9757-5A1000121	81.7									A1	2.54		

Jane Allen

Jane Allen
Quality Control Manager

1-23-96
Date

01/23/96

NSC

POLYETHYLENE CERTIFICATE OF ANALYSIS

Customer: GEOSYNTEC

Resin Type: U.C.1527

Project Name: 9090

Project Number: SAMPLE

We hereby certify that the polyethylene resin for the above identified shipment, meets or exceeds the project specifications, below. Testing was performed on each resin blend.

Melt flow index was determined according to ASTM D 1238. Density was determined according to ASTM D 1505. Where appropriate, carbon black content was determined according to ASTM D 1603. The average test results are listed in the table below.

RESIN SPECIFICATIONS

Melt Flow Index	0.4 gram/10 minutes	Maximum
Density (with carbon black)	0.94 grams/cm^3	Minimum
Carbon Black Content	2% to 3%	Range

BLEND NUMBER	MELT FLOW INDEX	DENSITY	CARBON BLACK CONTENT
9757	0.16	0.936	

Jane Allen

Jane Allen
Quality Control Manager

1-23-96
Date:

Note: When no carbon black content value is listed, the resin contained no carbon black.

APPENDIX D

APPENDIX D

FOURIER-TRANSFORM INFRARED SURFACE ANALYSIS RESULTS

Part I: Rationale, Results and Discussions, and Conclusions

Part II: Fourier-Transform Infrared Spectra

draft

Part I: Rationale, Results and Discussions, and Conclusions

draft

APPENDIX D

FOURIER-TRANSFORM INFRARED SURFACE ANALYSIS RESULTS

Surface Analysis

Rationale for Test

Surface analysis by Fourier-transform infrared (FTIR) was conducted to assess whether radioactivity in the test leachate impacted the molecular structure of polyethylene molecules on the surface of the geomembranes. Studies on polyethylene films exposed to high energy radiation in the presence of oxygen (oxygen may be dissolved in the test leachate) indicate that as films are exposed to increasing doses of high energy radiation, carbonyl energy bands (bands of infrared (IR) energy in the range of 1,700 to 1,800 wave numbers in the FTIR spectrum) are formed (carbonyl bands are indicative of the chemical band of carbon and oxygen). The intensity, or height, of the bands decrease as a function of the depth in the material. (The reaction of oxygen and polyethylene is often referred to as oxidation.) Oxidation modifies the molecular structure of polyethylene, resulting in the reduction of mechanical properties of polyethylene materials [Soo et al., 1986]. Therefore, FTIR can be used to quantify the extent of oxidation occurring in a material.

Results and Discussion

The surfaces of the control and exposed geomembrane samples were analyzed. Using a microtome, transparent sections were shaved from the surface of each sample. The sections were then subjected to IR energy in a FTIR spectrometer. The resulting IR spectrum for each sample is provided in Part II of this Appendix. Inspection of the spectra reveals that there is no difference between the spectra of the control and the exposed samples, i.e., there was no development of a carbonyl band (at approximately 1,700 to 1,800 wave numbers) in either the controls or the exposed samples. The results indicate that 120 days of exposure to the test leachate has not resulted in measurable oxidation of the geomembrane surface.

Conclusion

The results of the FTIR surface analyses indicate that the test leachate did not measurably oxidize the geomembrane surfaces.

draft

Part II: Fourier-Transform Infrared Spectra

draft

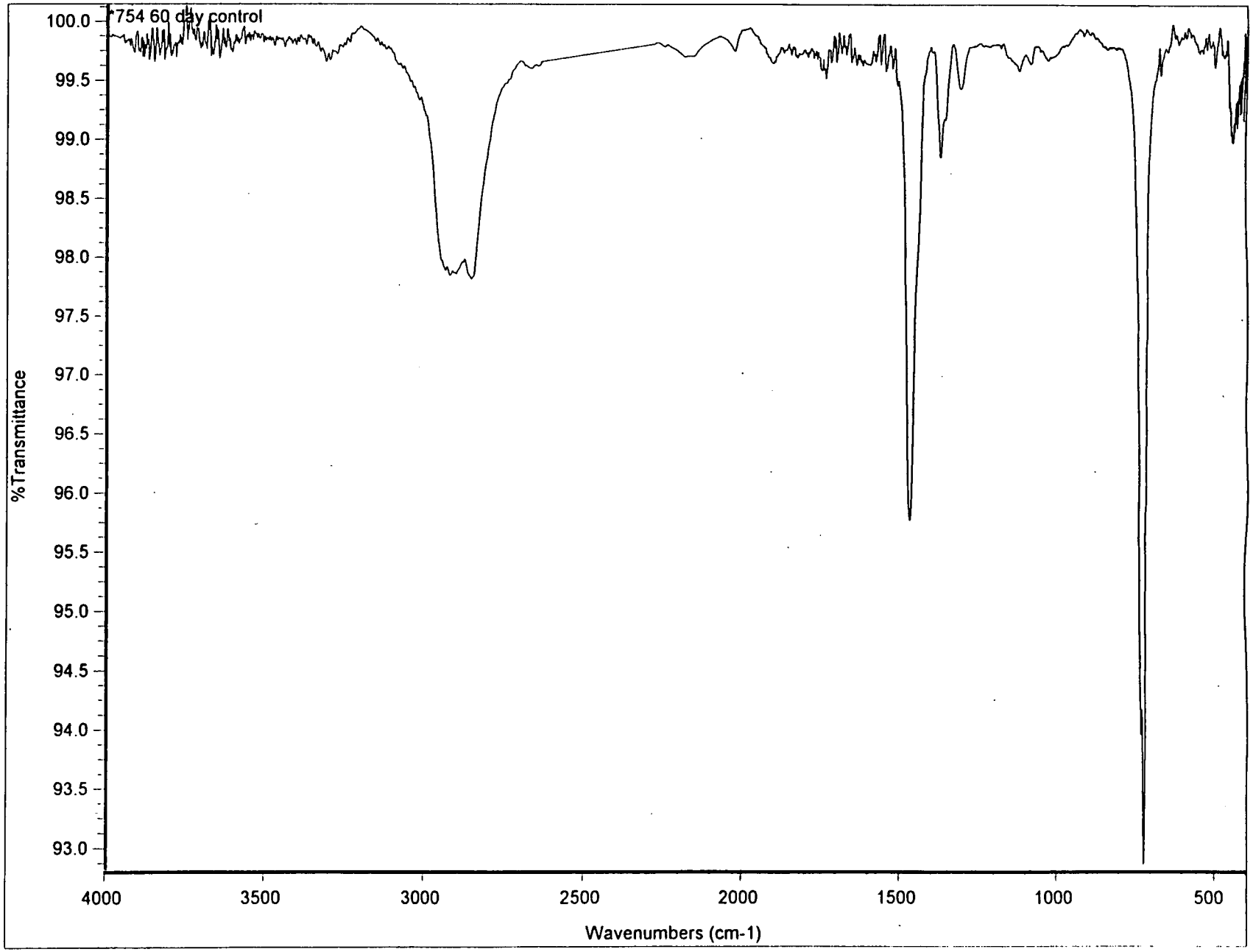
PART II

FTIR SPECTRA

FTIR spectra are presented in Part II of this appendix. Sample identification numbers appear in the upper left corner of the spectra, and are described below:

- 754 = GSE-SLT;
- 755 = NSC;
- 756 = GSE Gundle;
- 757 = POLYFLEX;
- 758 = SERROT;
- 60 = 60-day exposure test;
- 120 = 120-day exposure test;
- 23 = Exposure at 23°C;
- 50 = Exposure at 50°C; and
- Control = control.

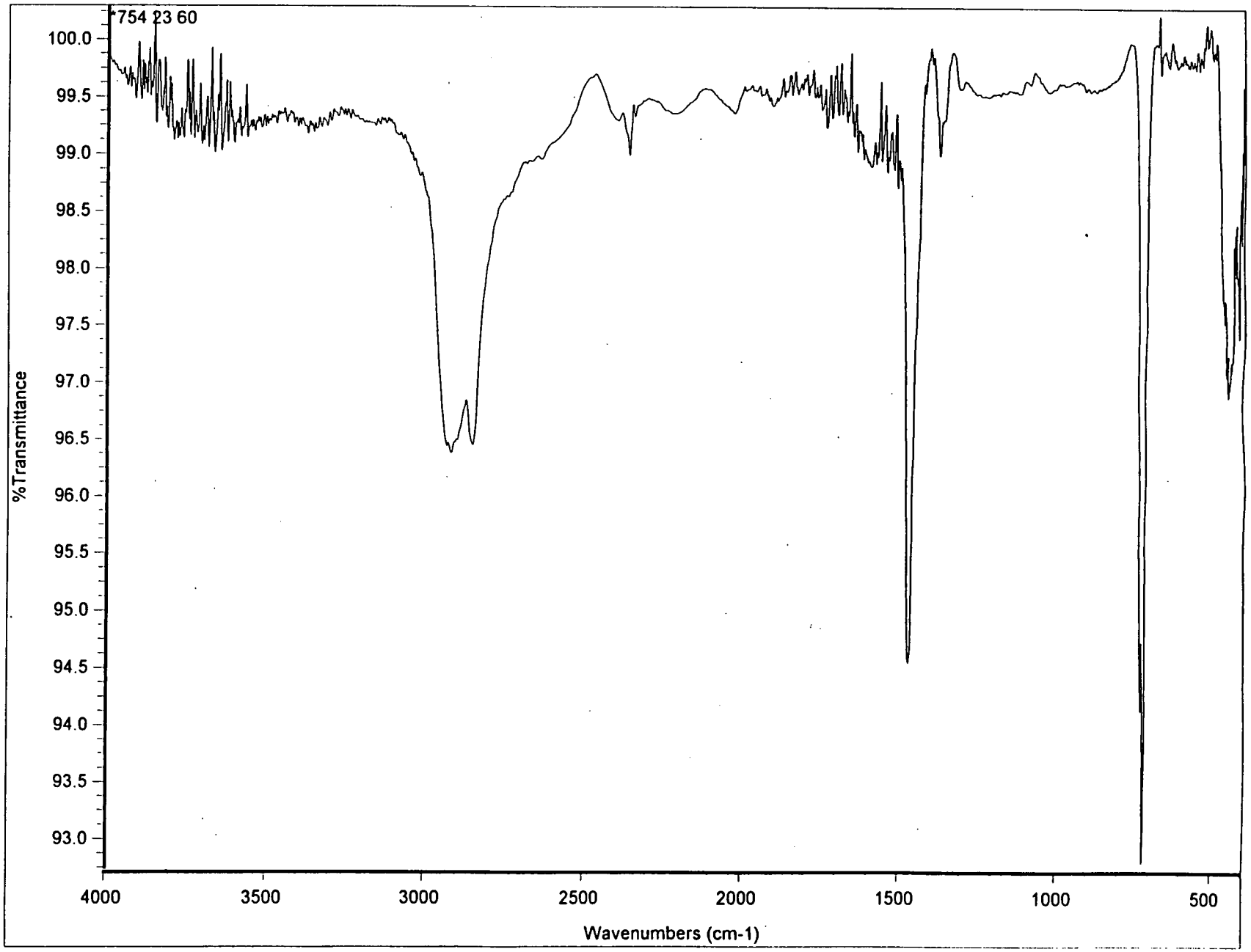
draft



GeoSyntec Consultants

000383

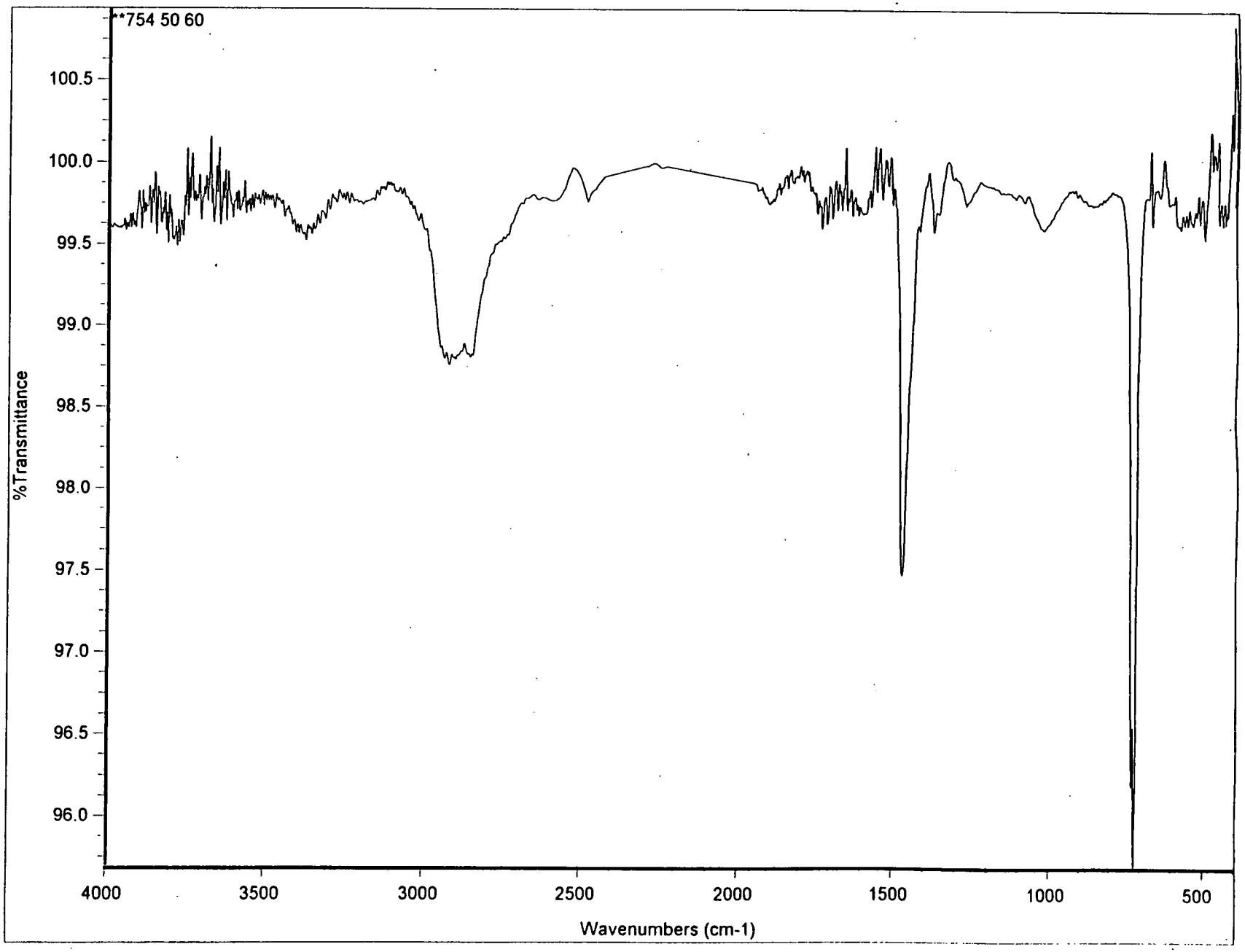
383



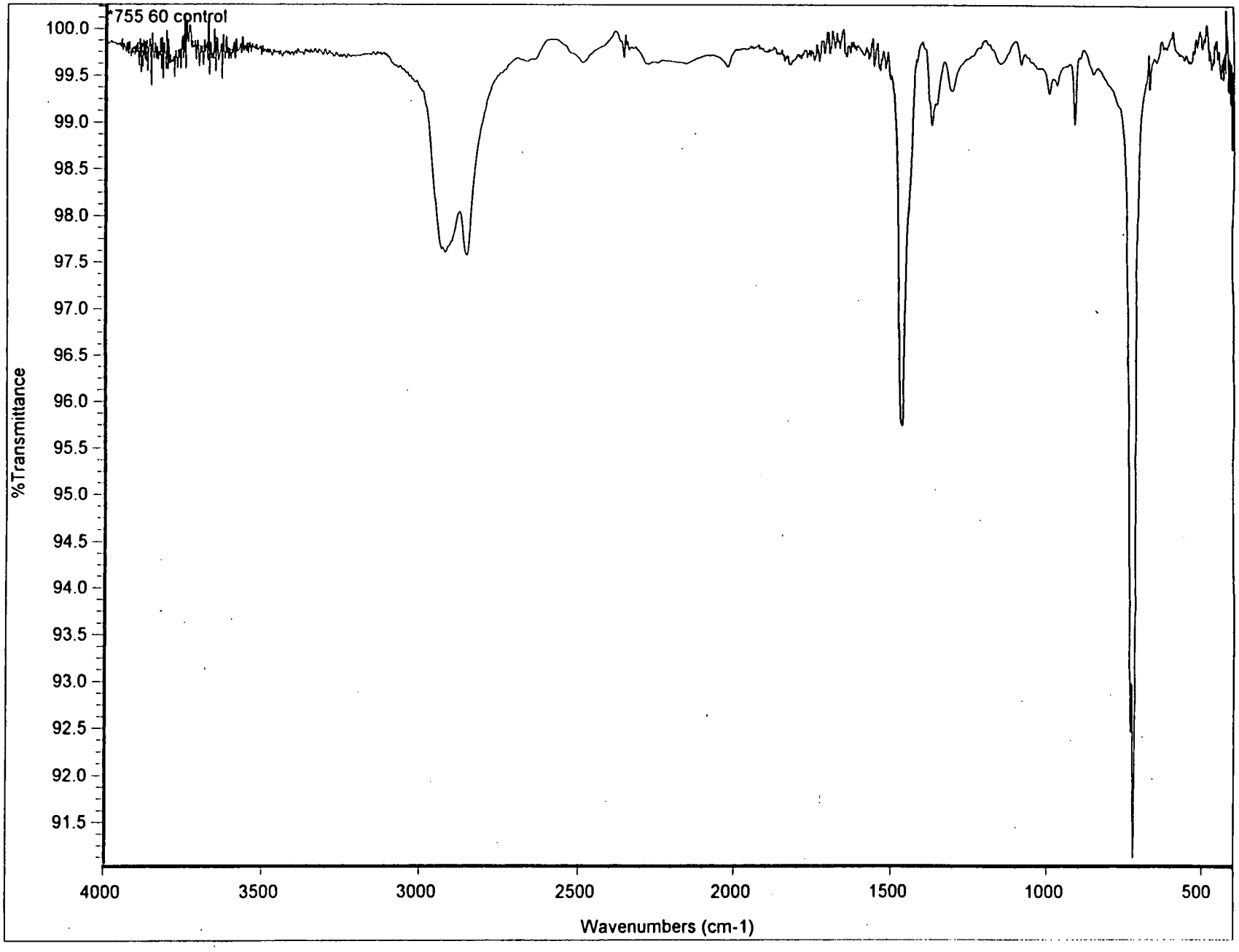
GeoSyntec Consultants

000384

387



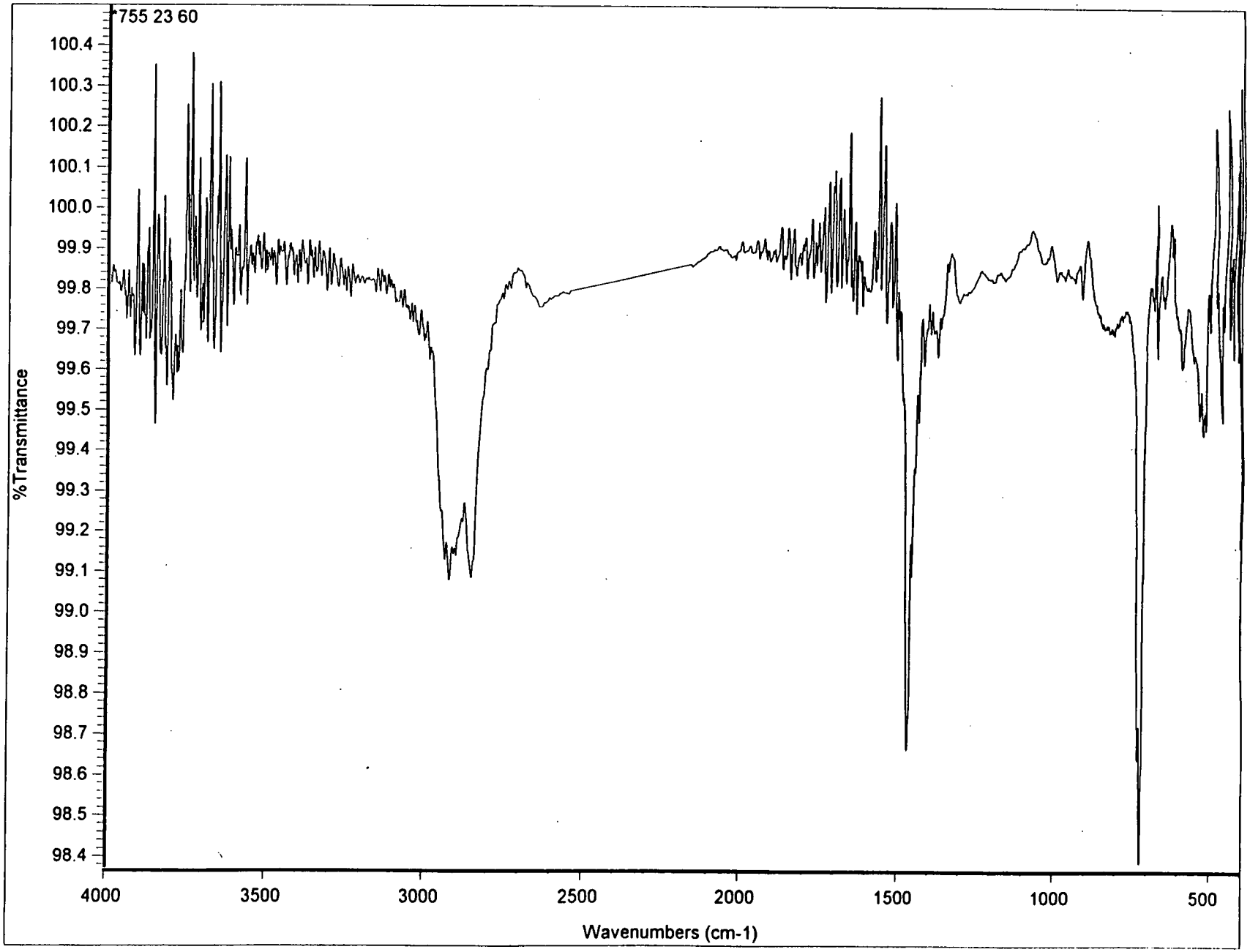
GeoSyntec Consultants



GeoSyntec Consultants

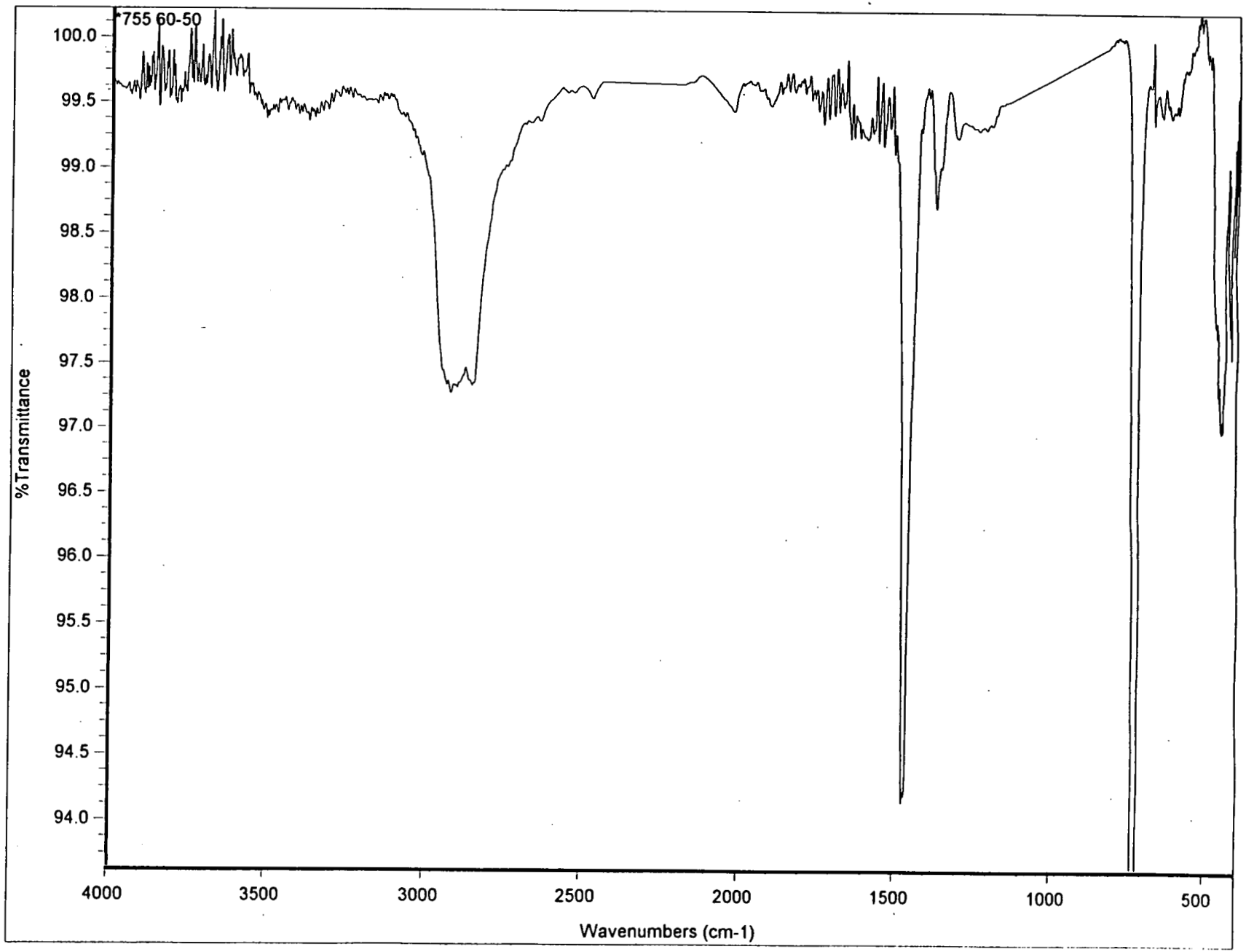
000386

387



GeoSyntec Consultants

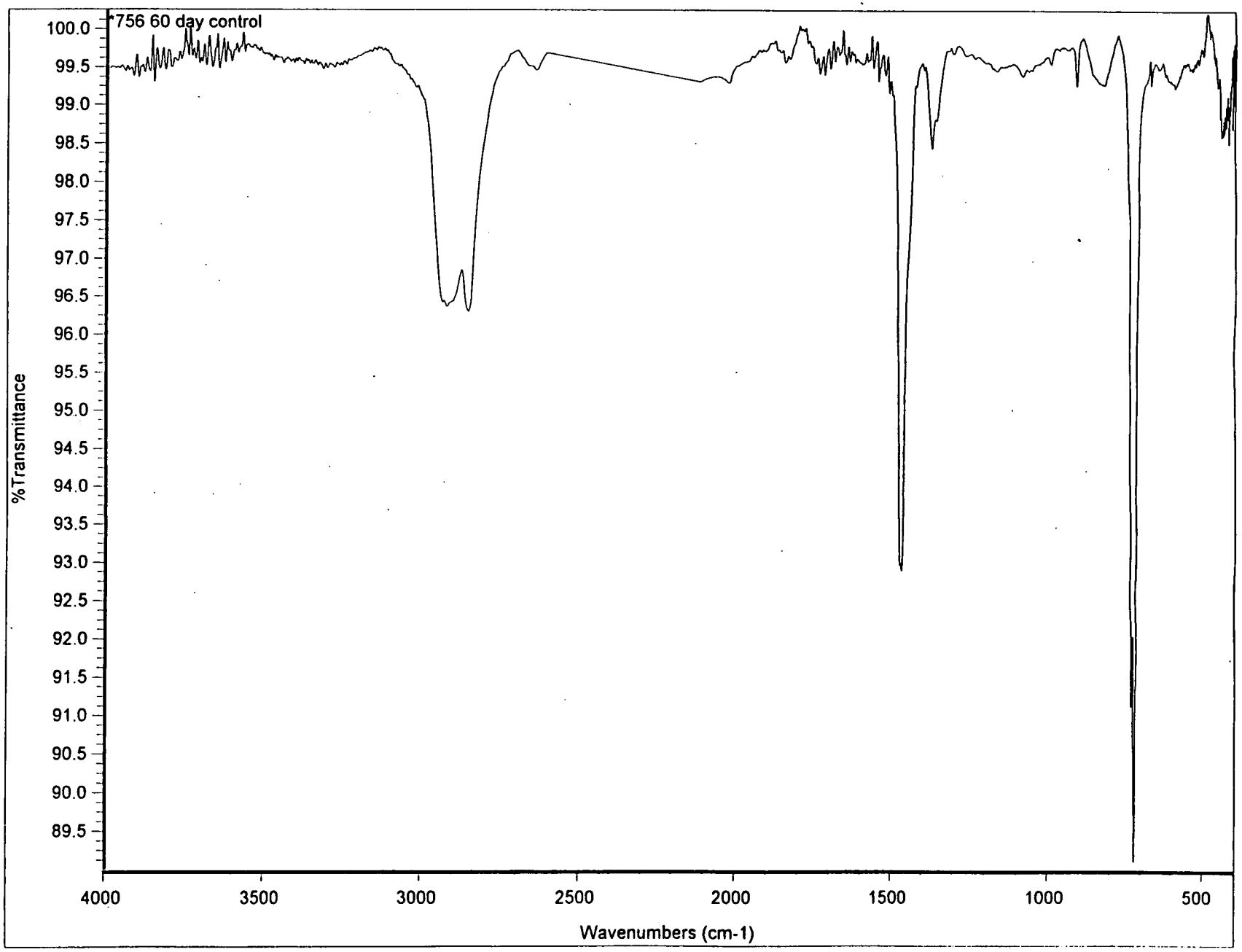
000387



GeoSyntec Consultants

000388

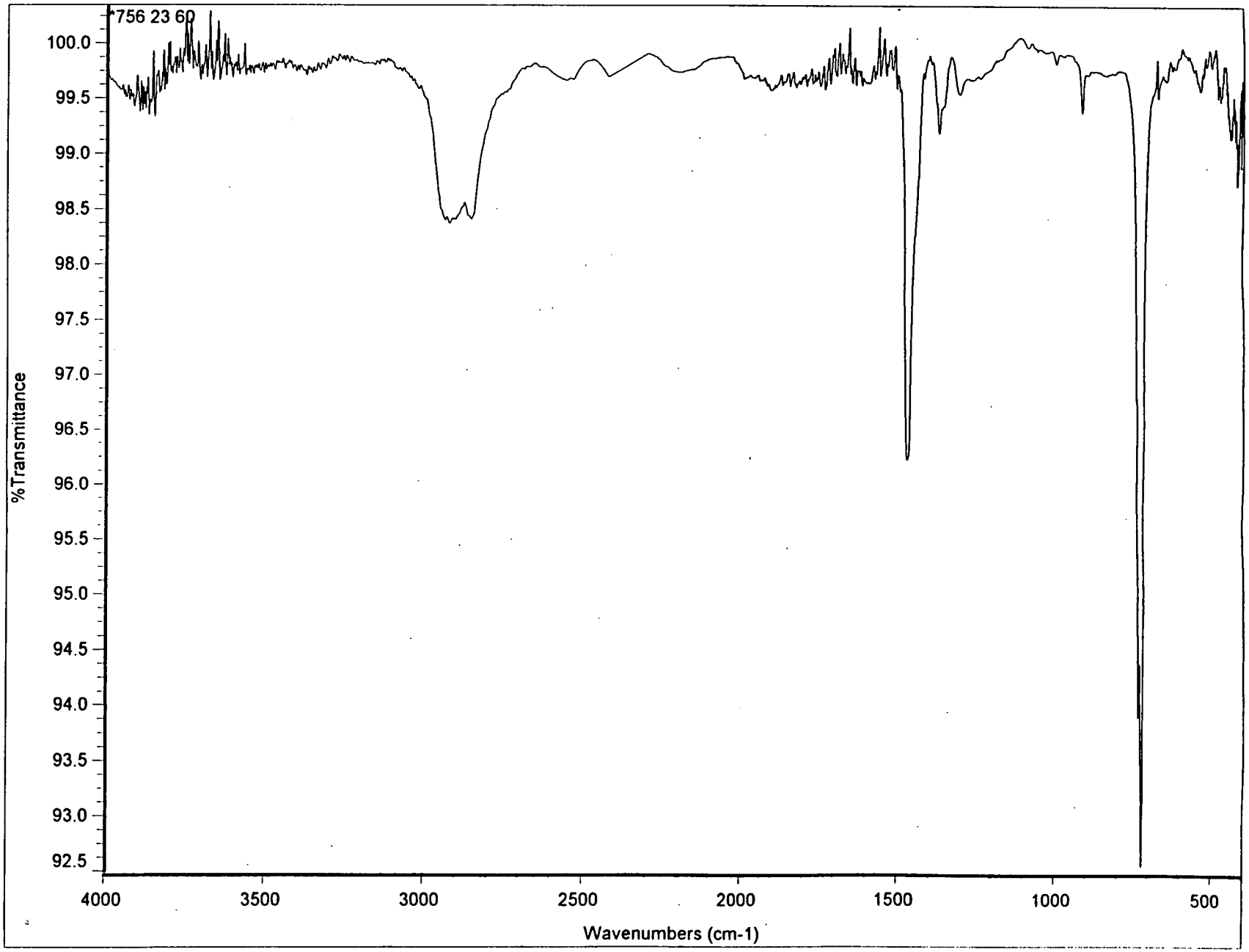
388



GeoSyntec Consultants

000389

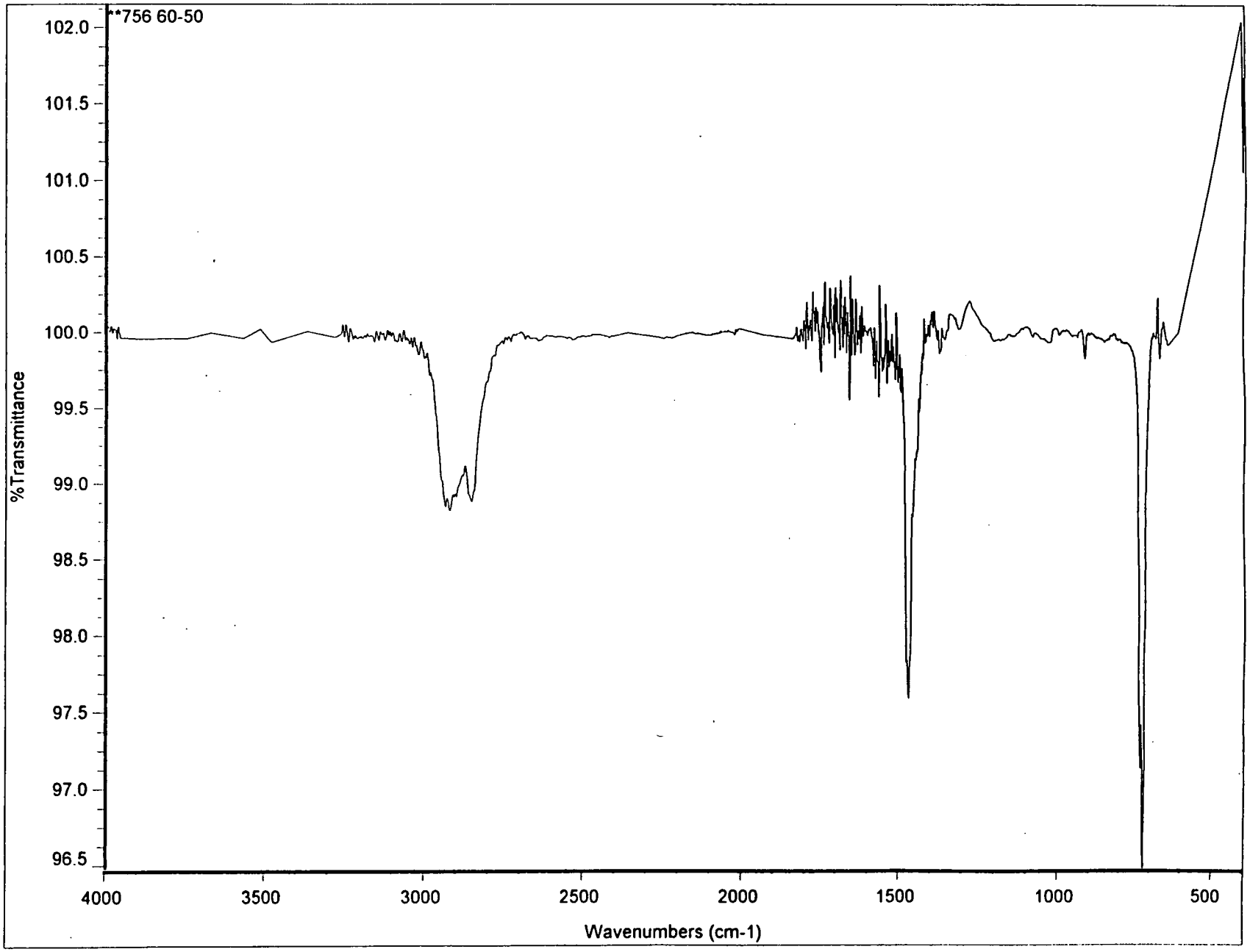
382



GeoSyntec Consultants

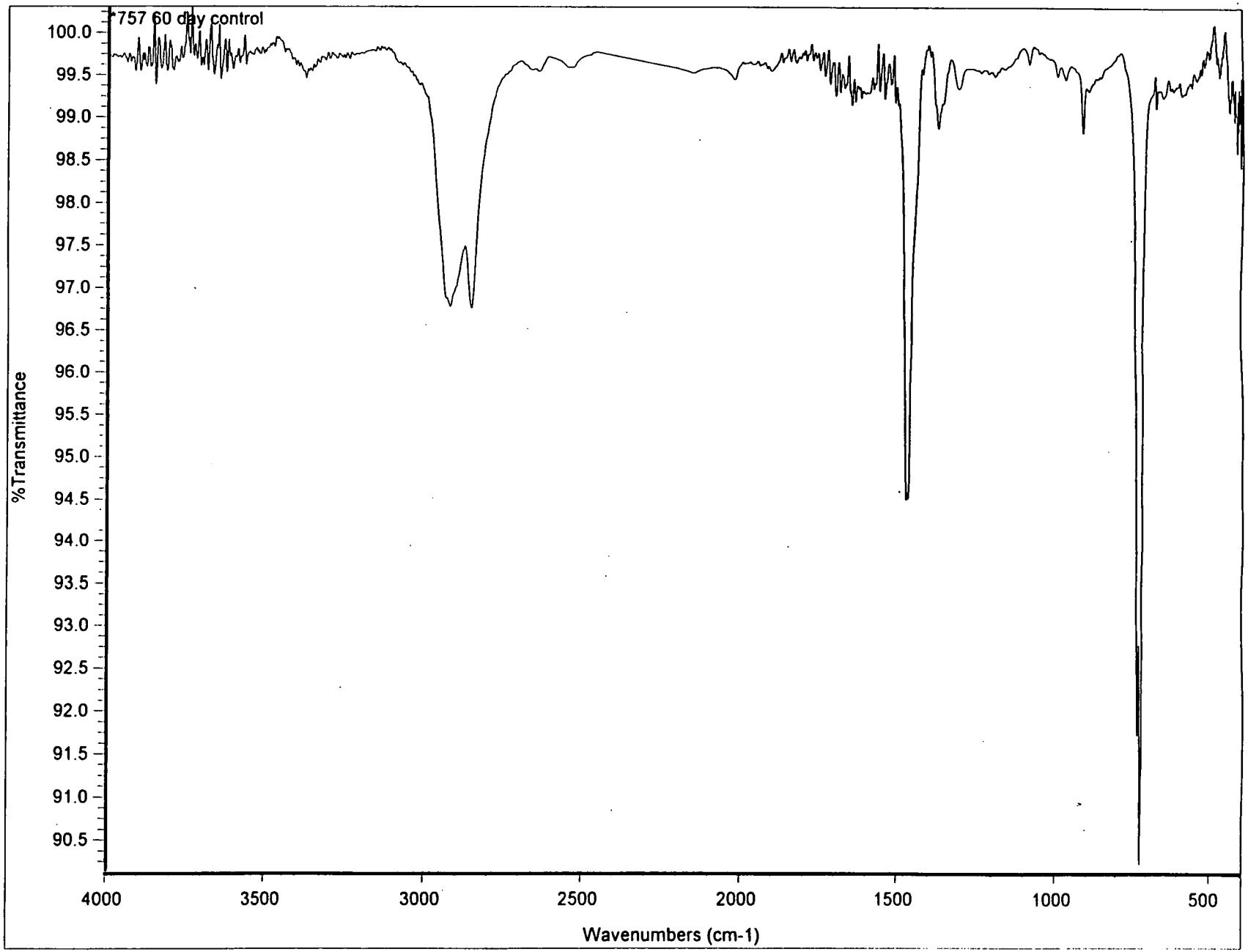
000390

387

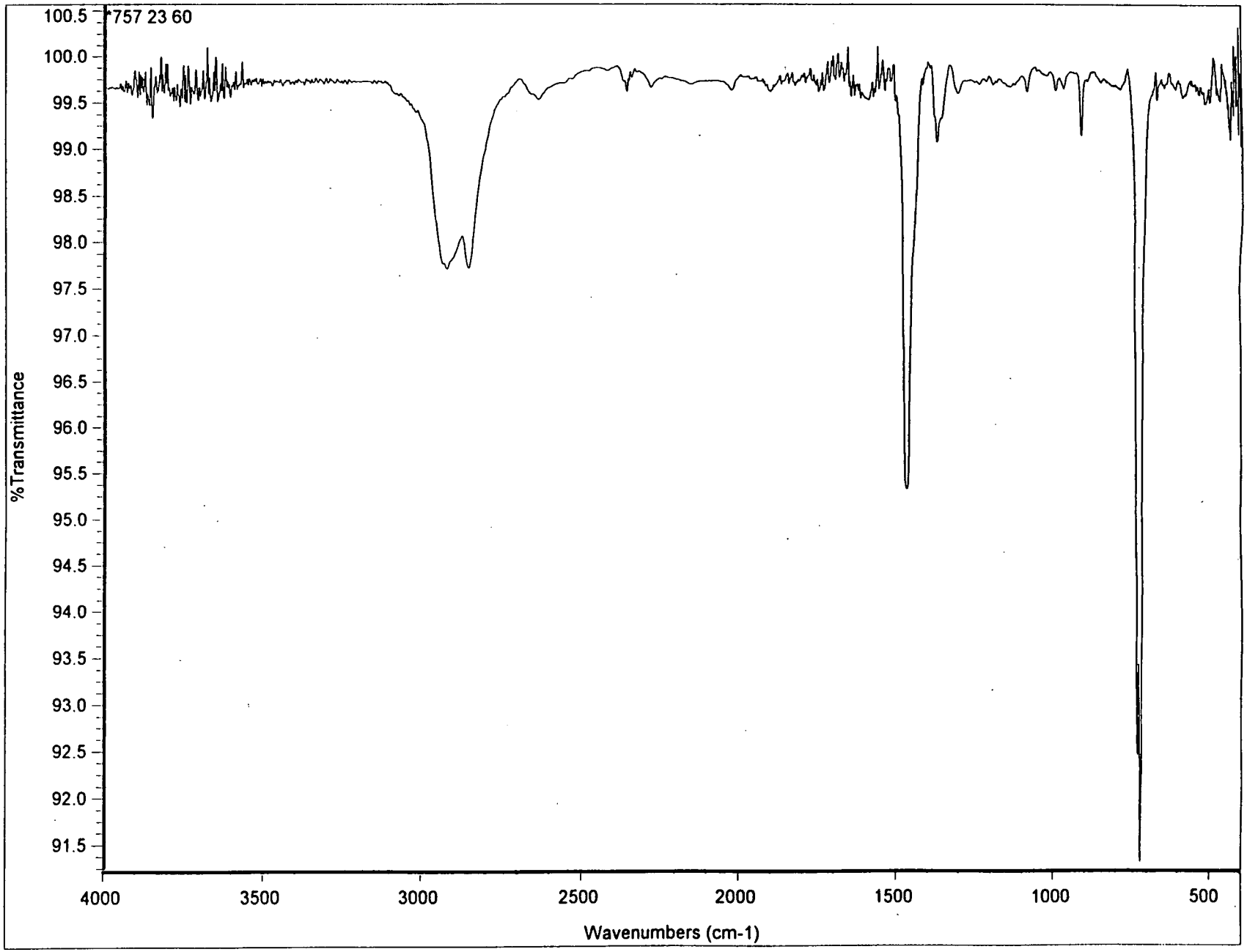


GeoSyntec Consultants

0003391



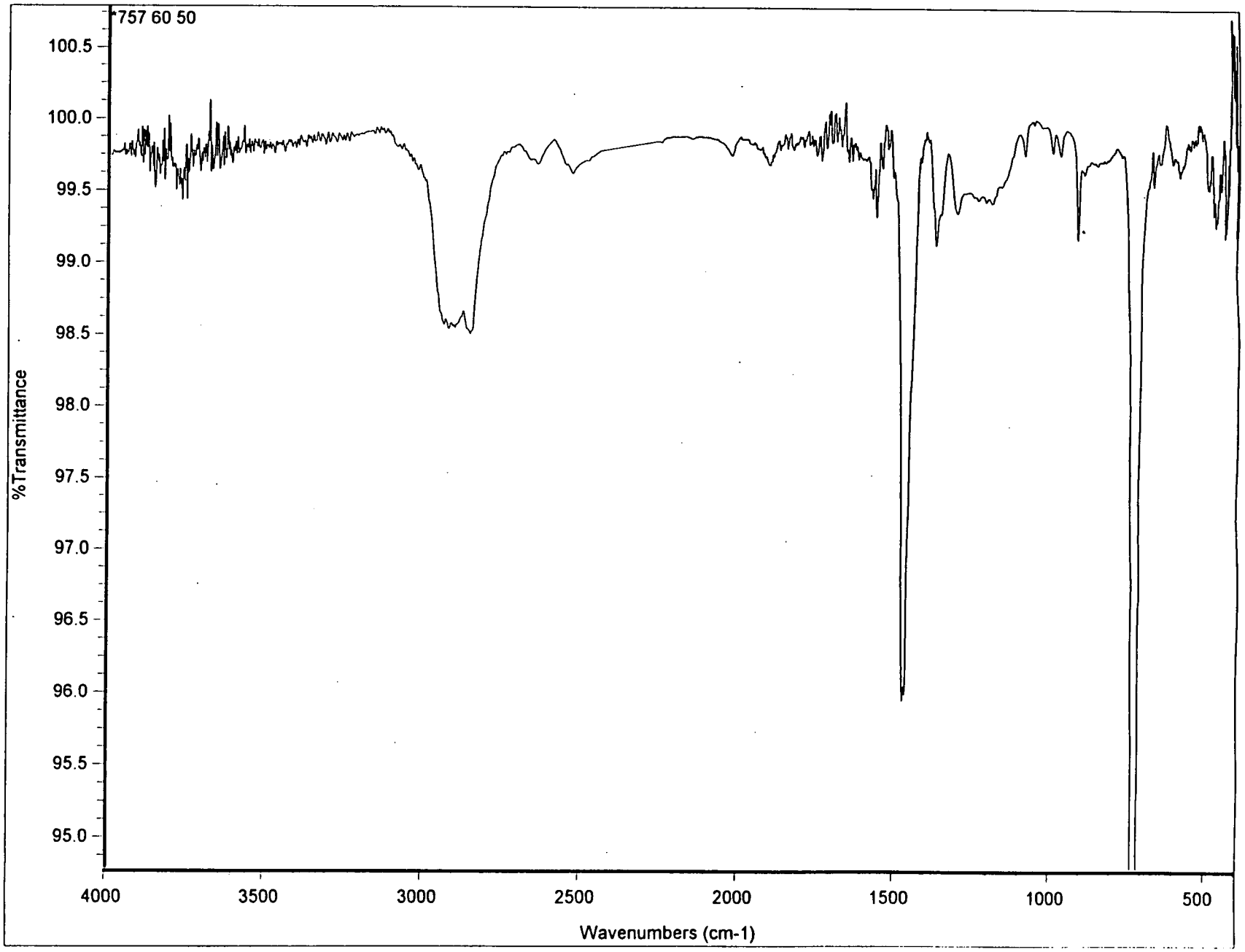
GeoSyntec Consultants



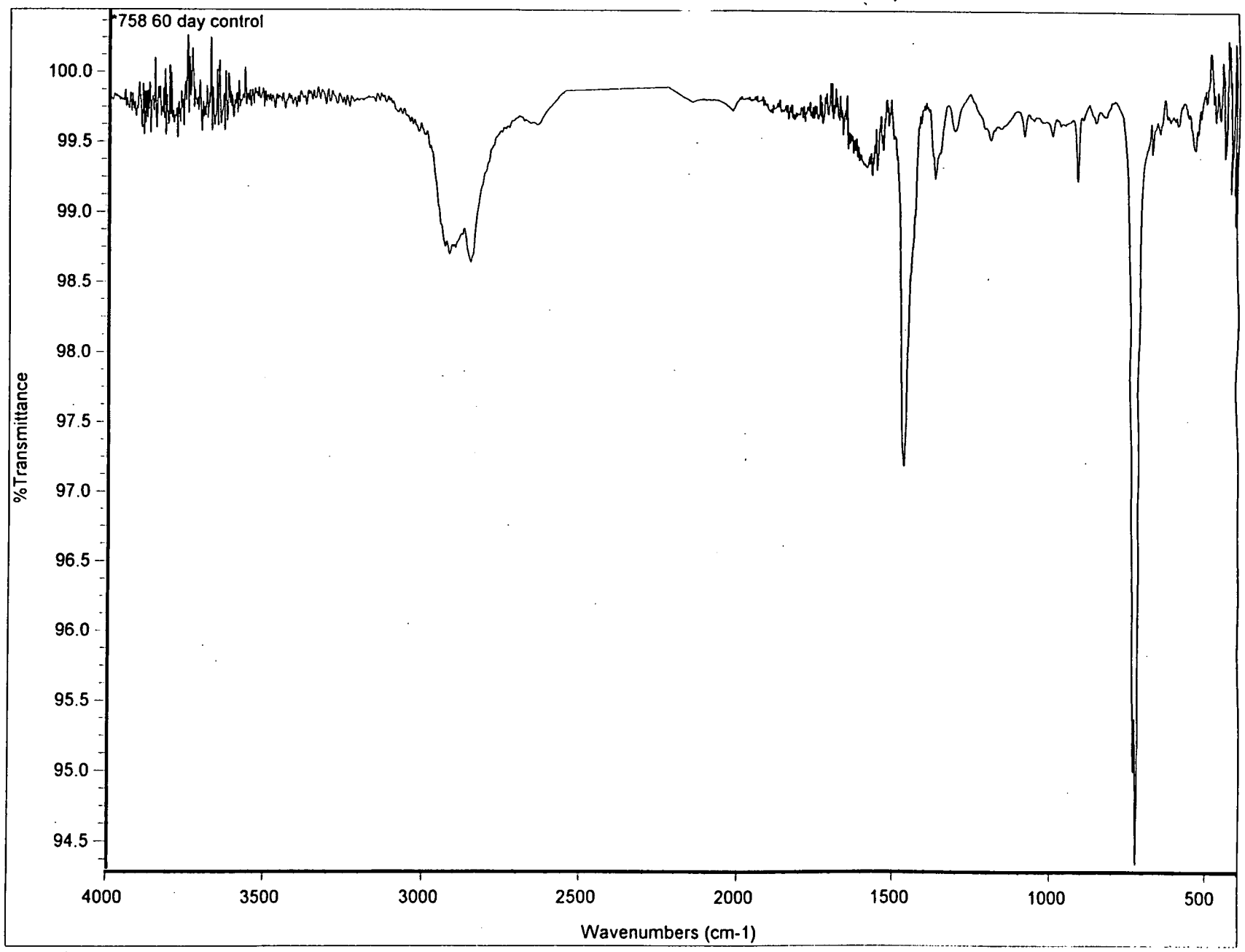
GeoSyntec Consultants

000393

387



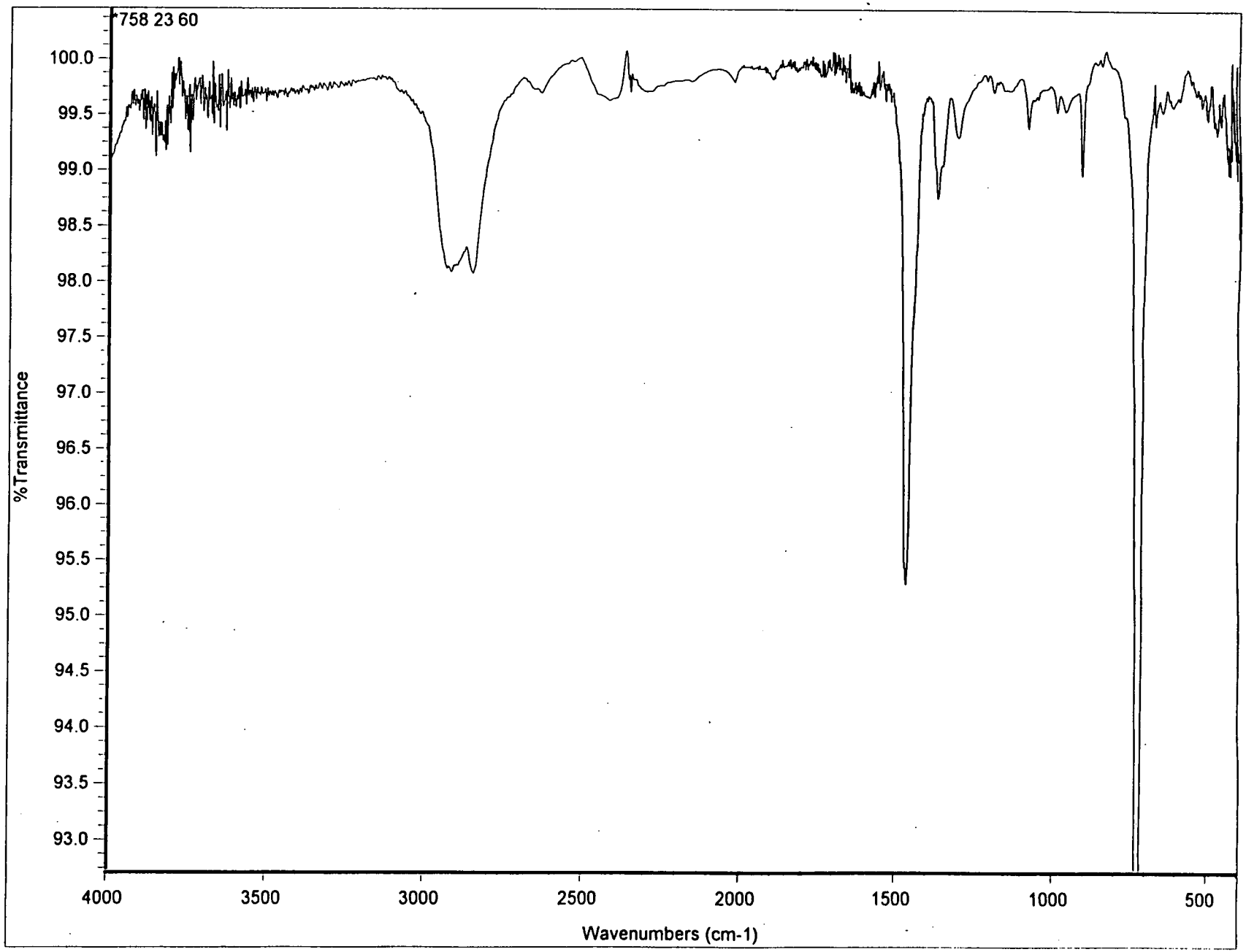
GeoSyntec Consultants



GeoSyntec Consultants

000395

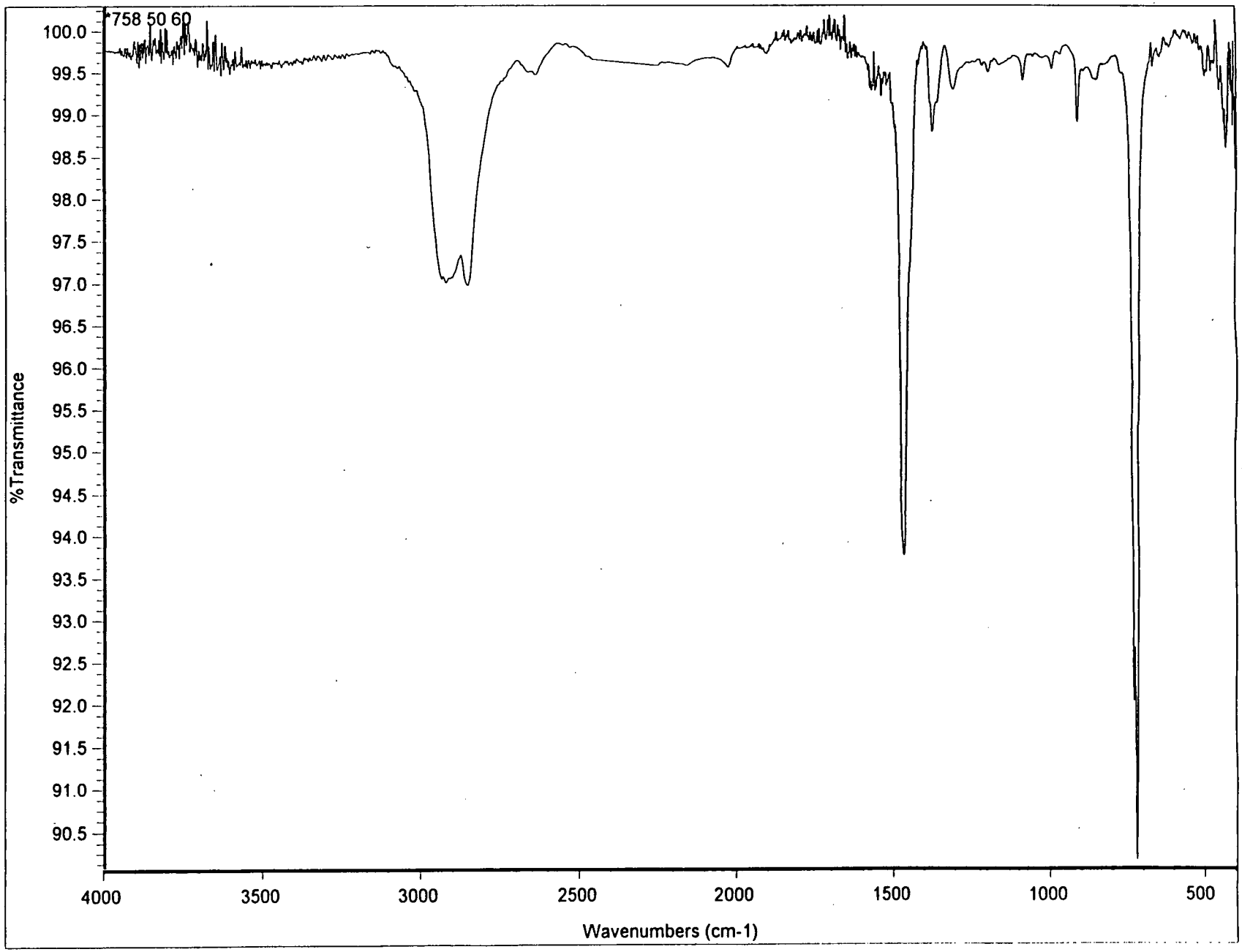
387



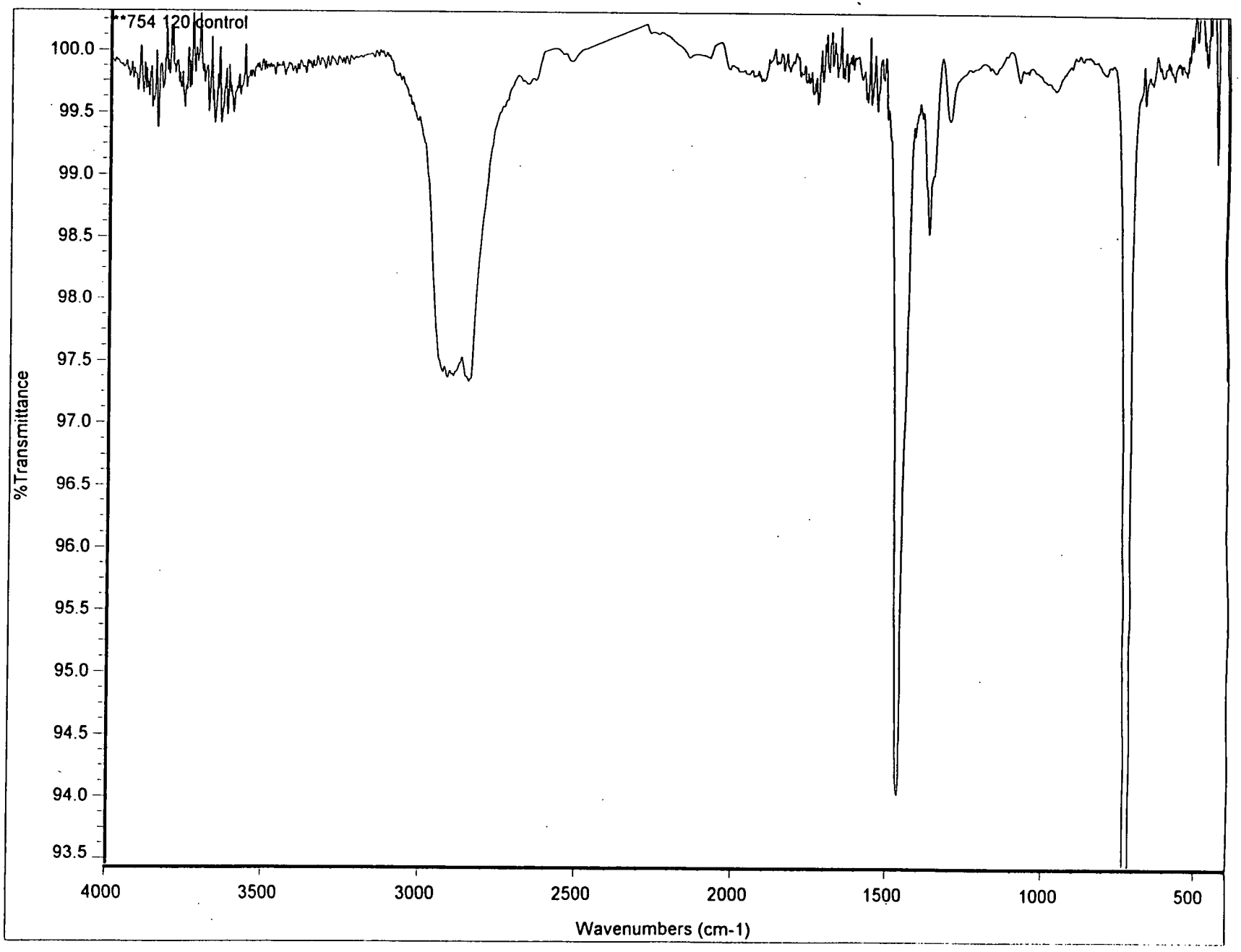
000396

387

GeoSyntec Consultants



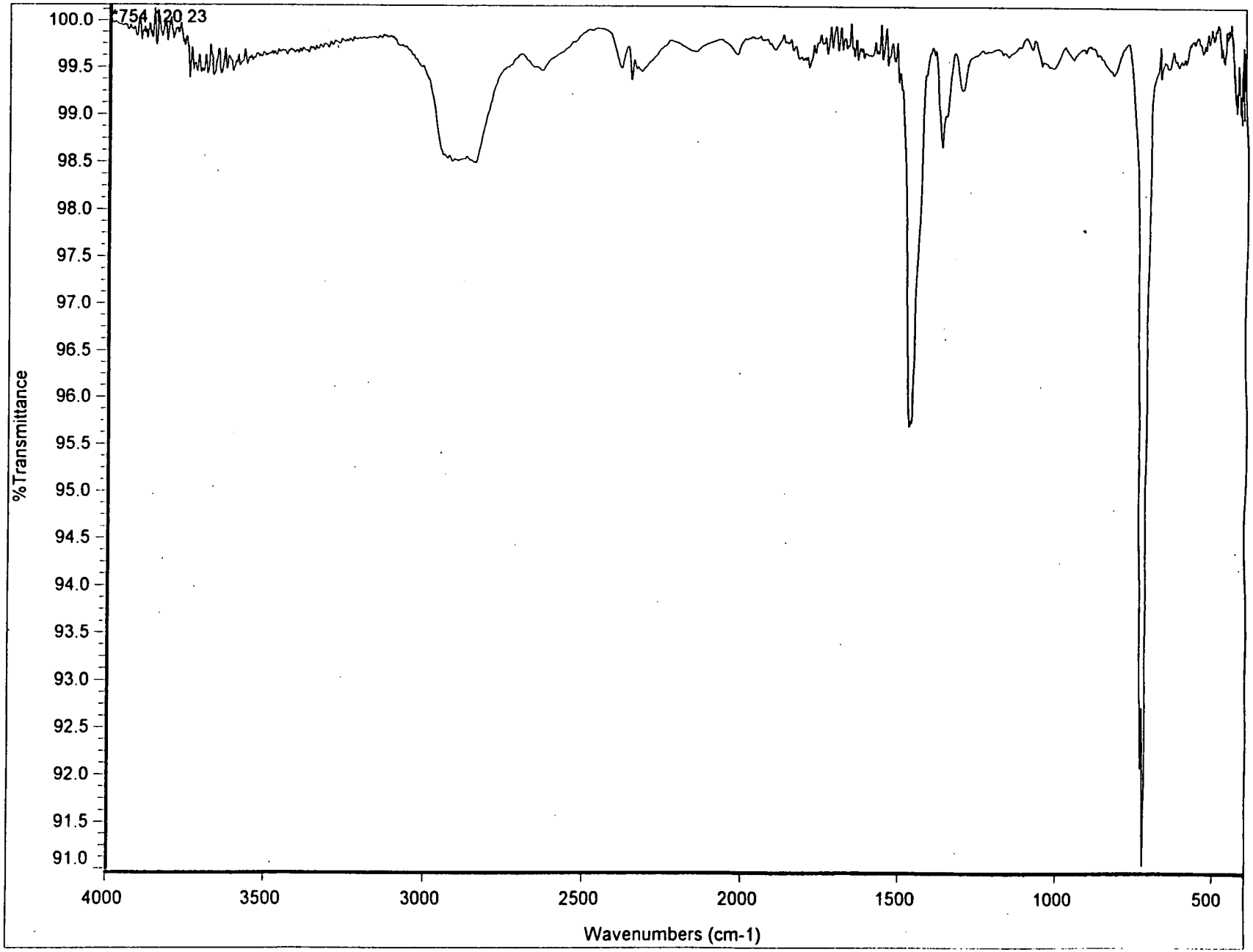
GeoSyntec Consultants



GeoSyntec Consultants

000398

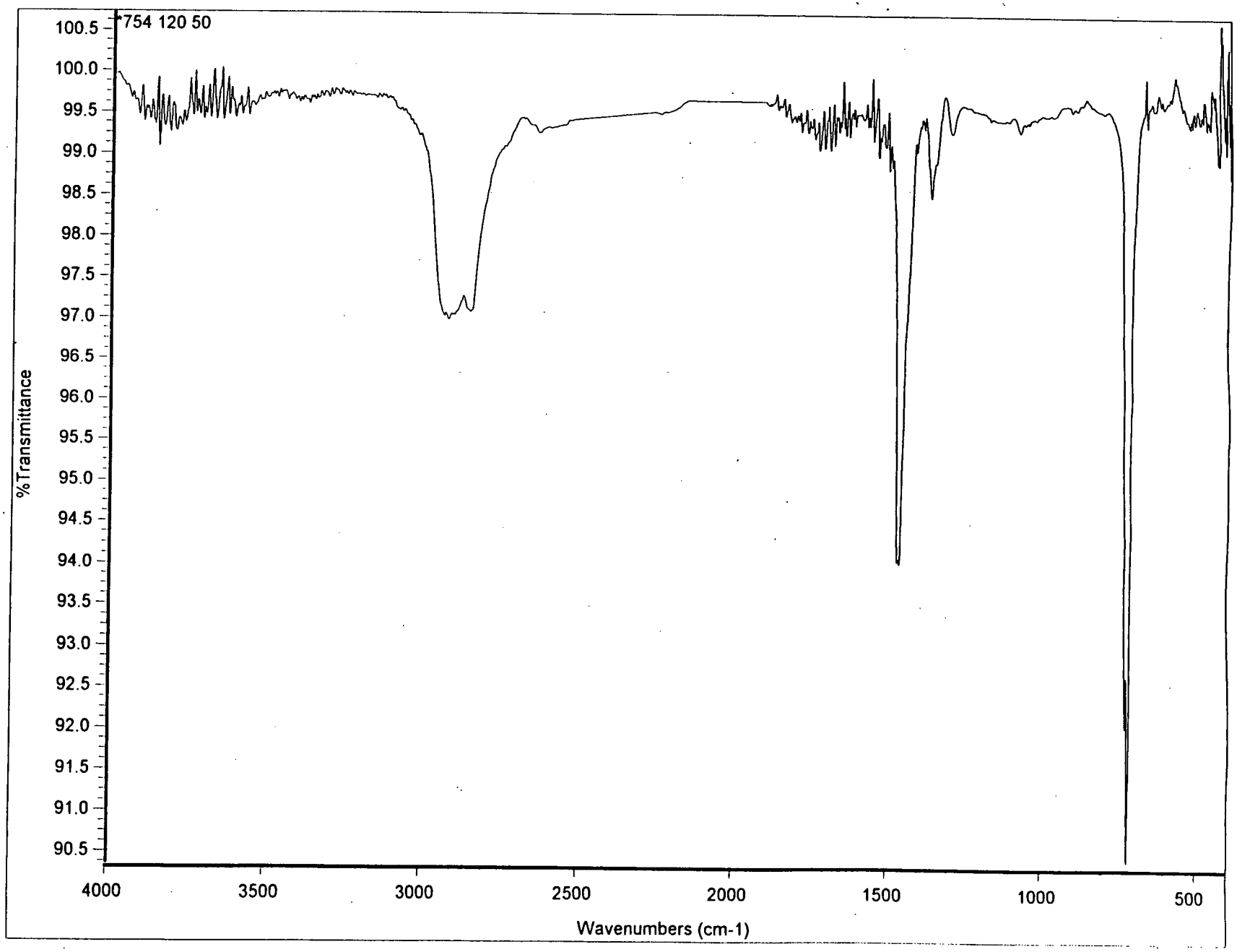
382



000399

387

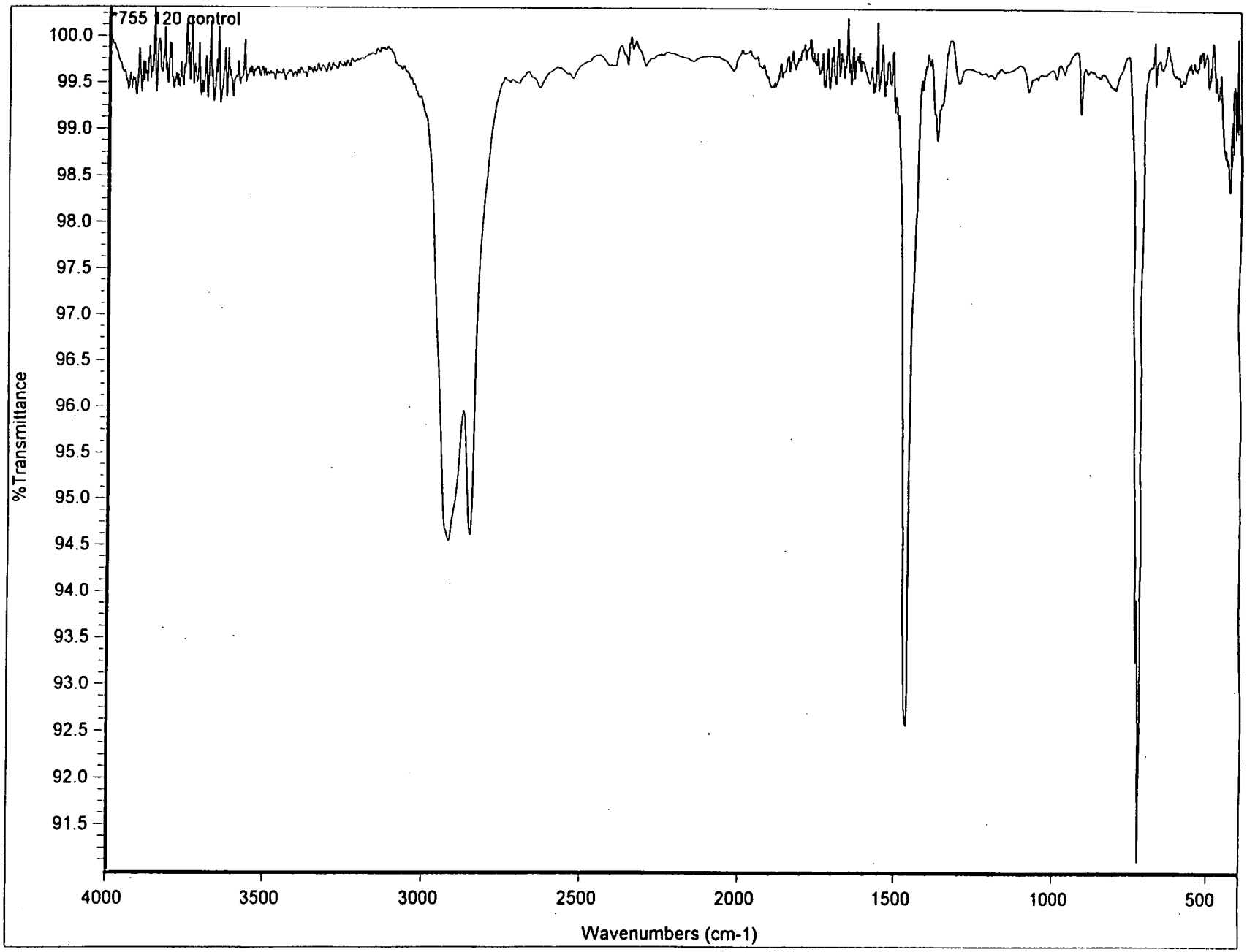
GeoSyntec Consultants



GeoSyntec Consultants

000400

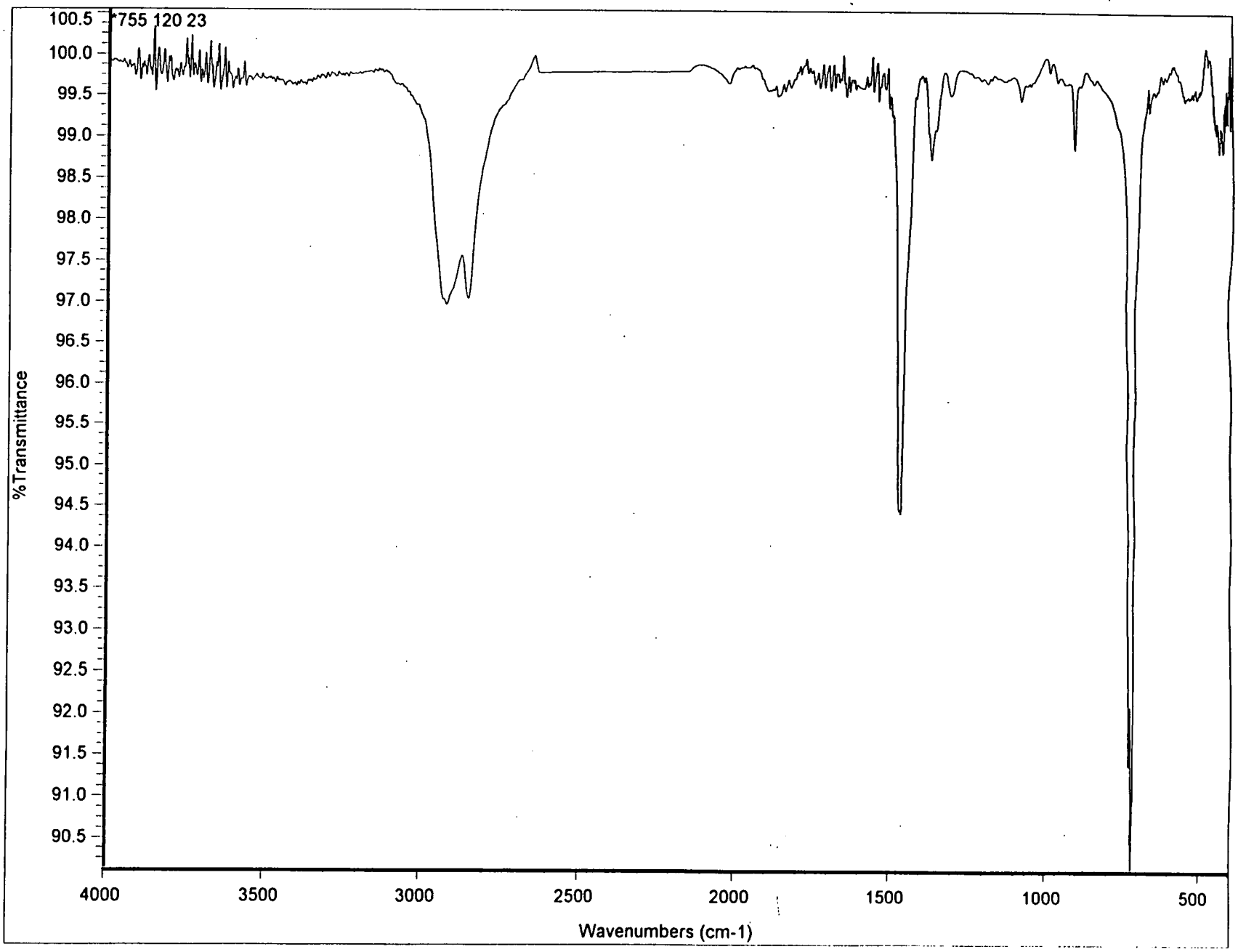
382



GeoSyntec Consultants

000401

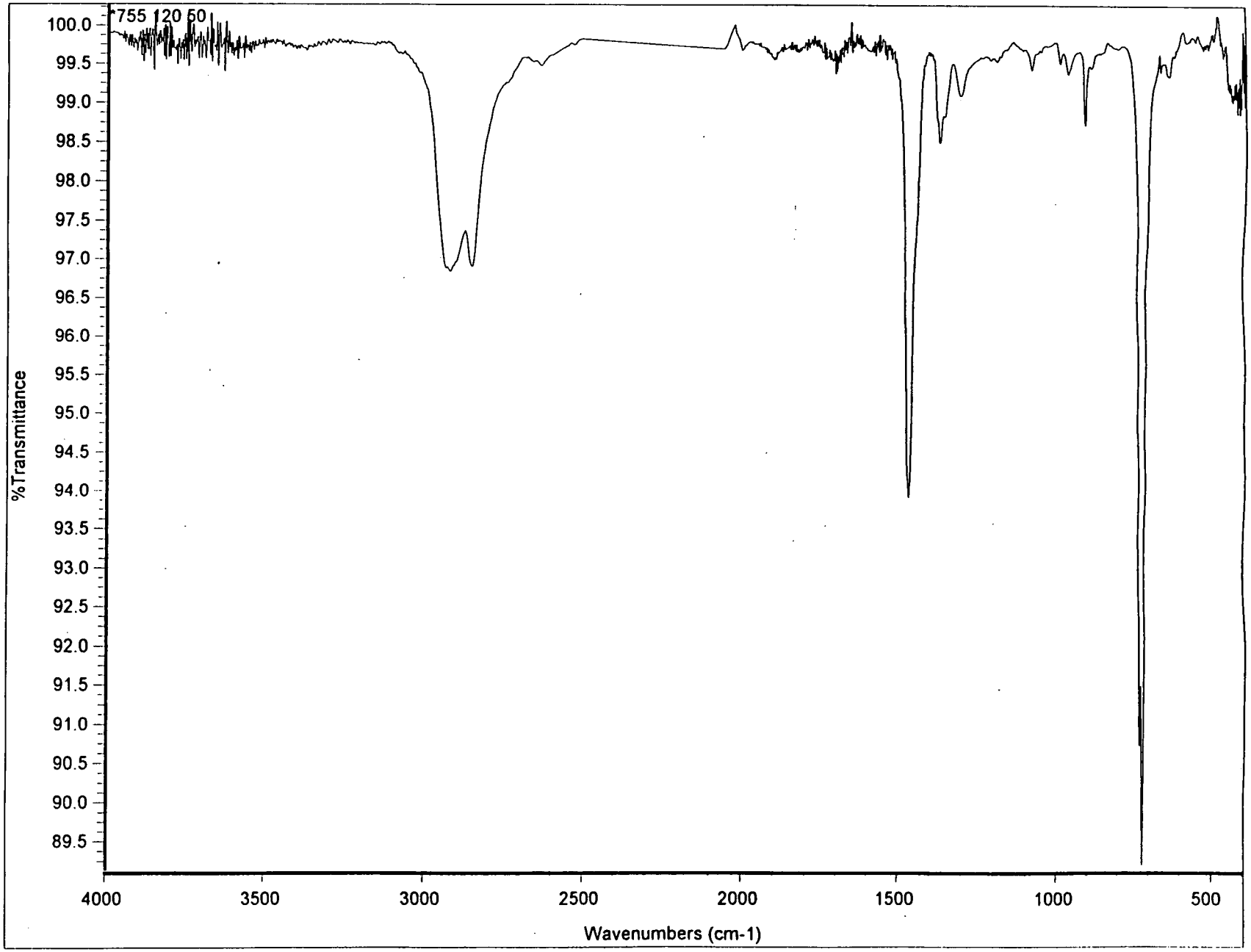
382



GeoSyntec Consultants

000402

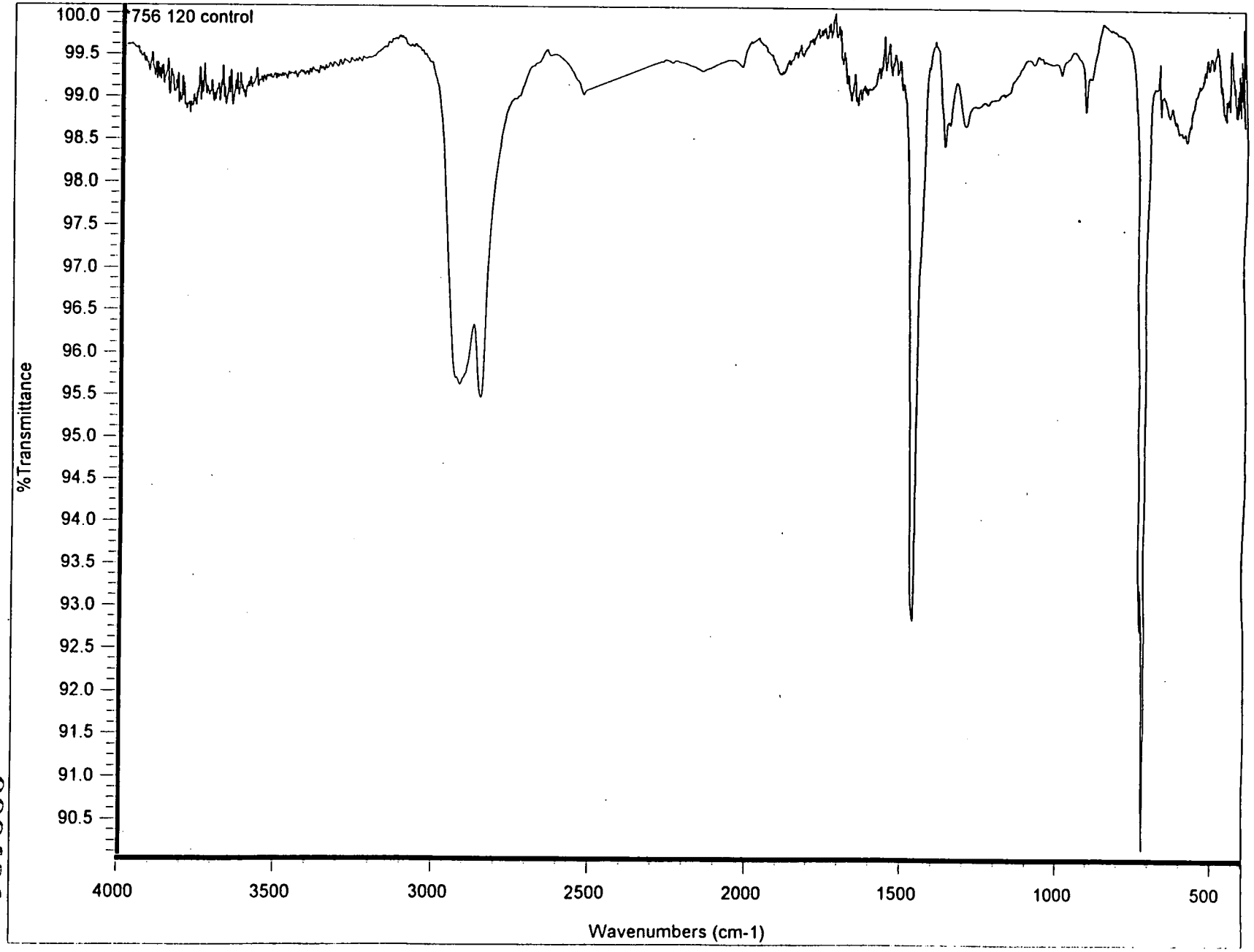
382



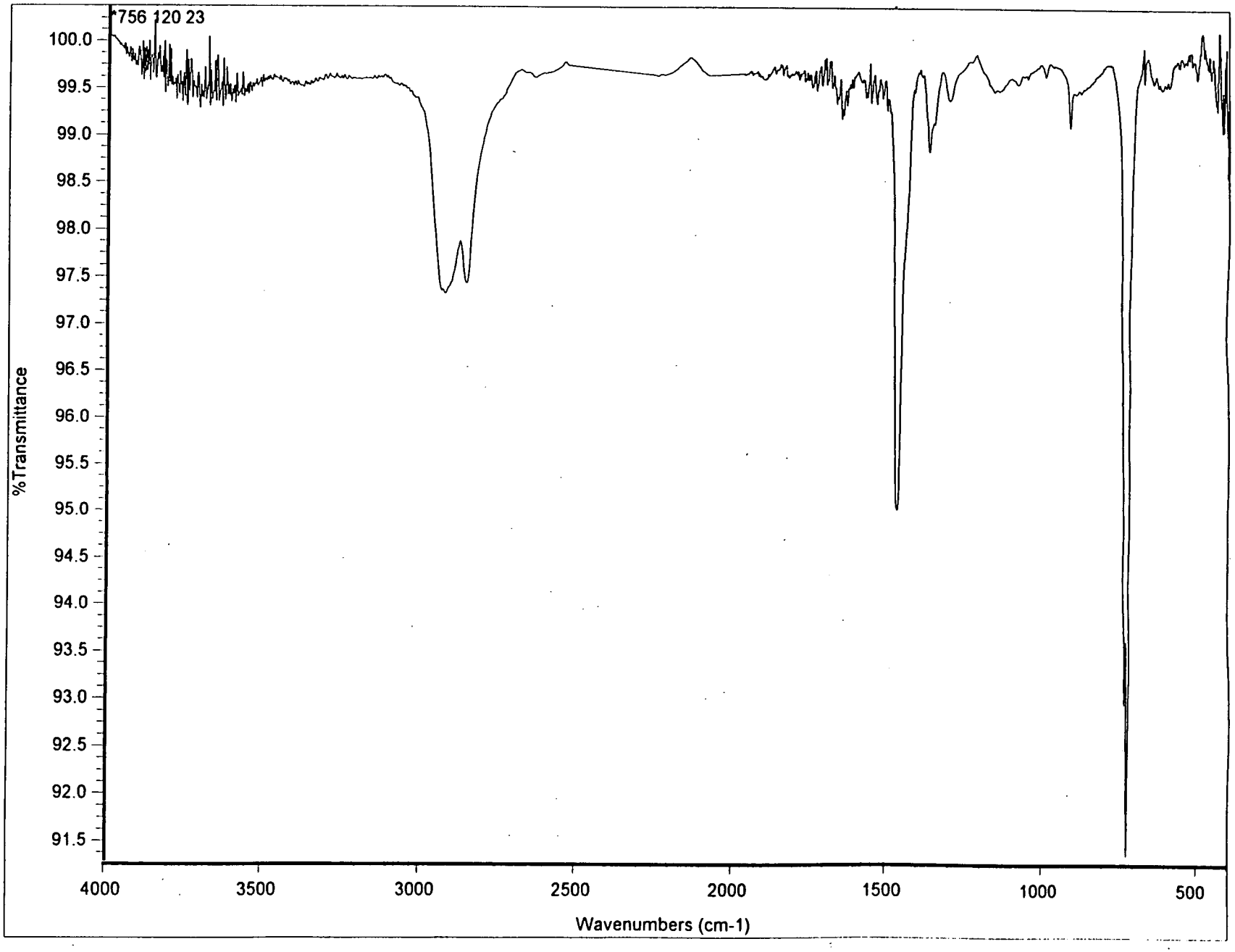
GeoSyntec Consultants

000503

387



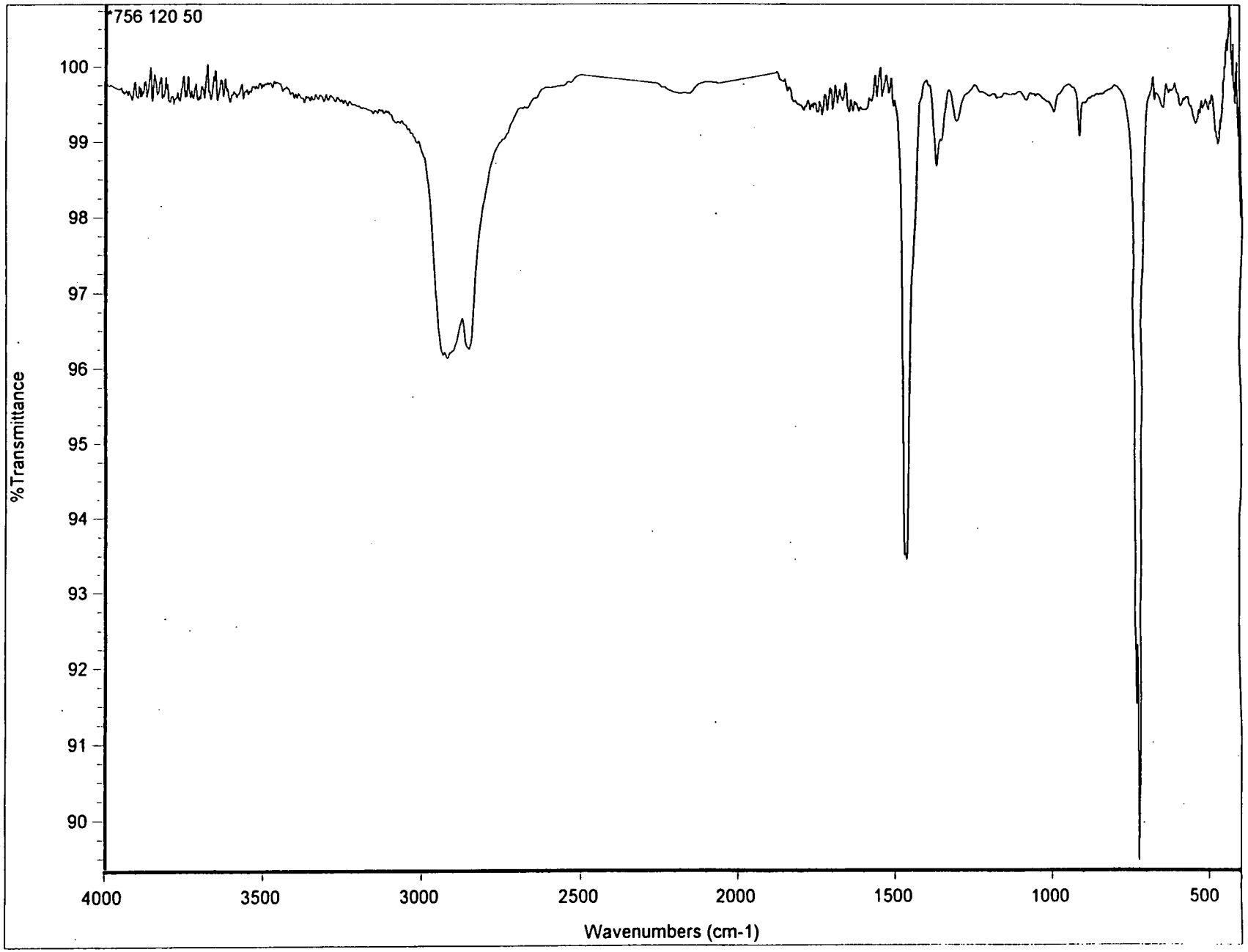
GeoSyntec Consultants



000405

387

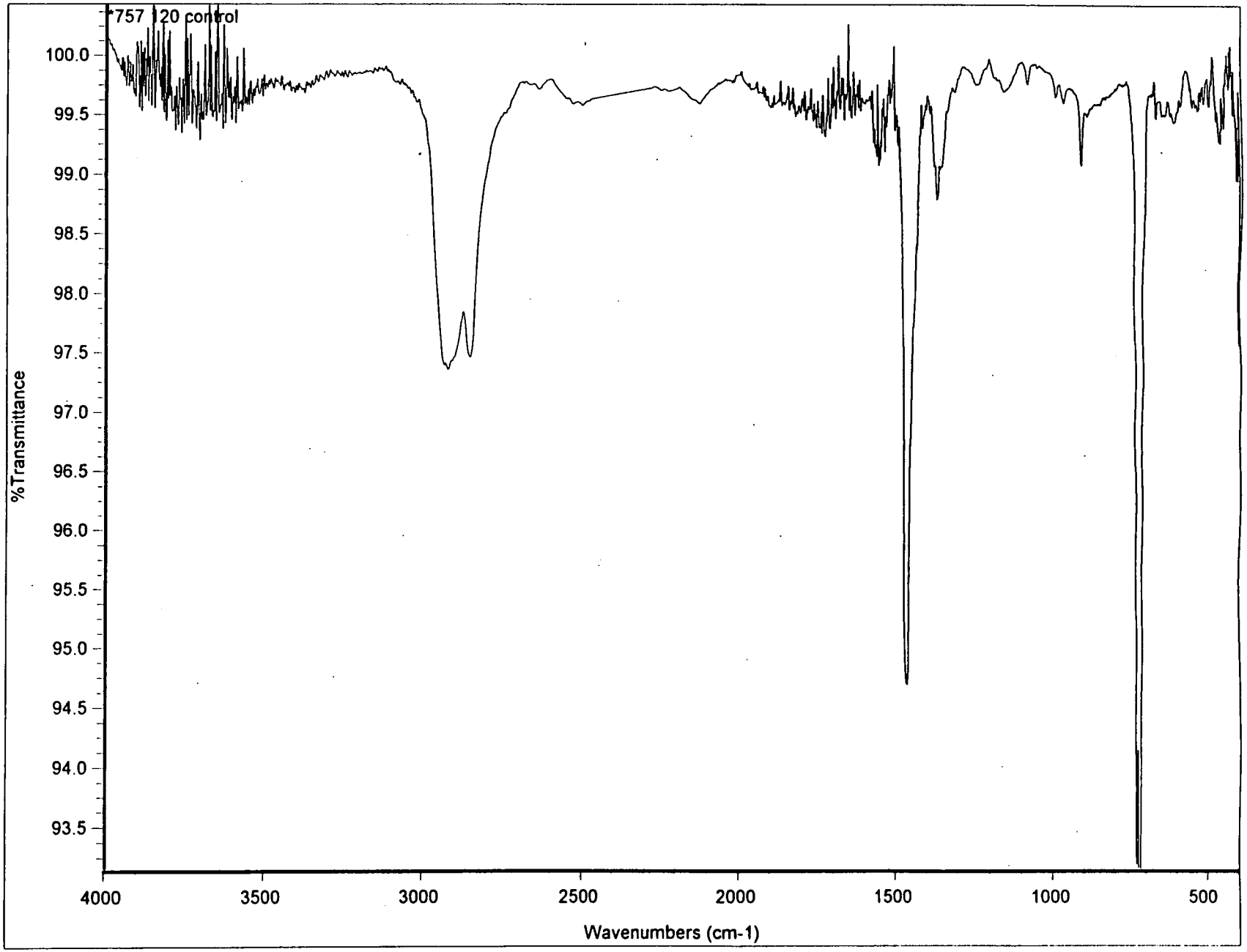
GeoSyntec Consultants



GeoSyntec Consultants

000406

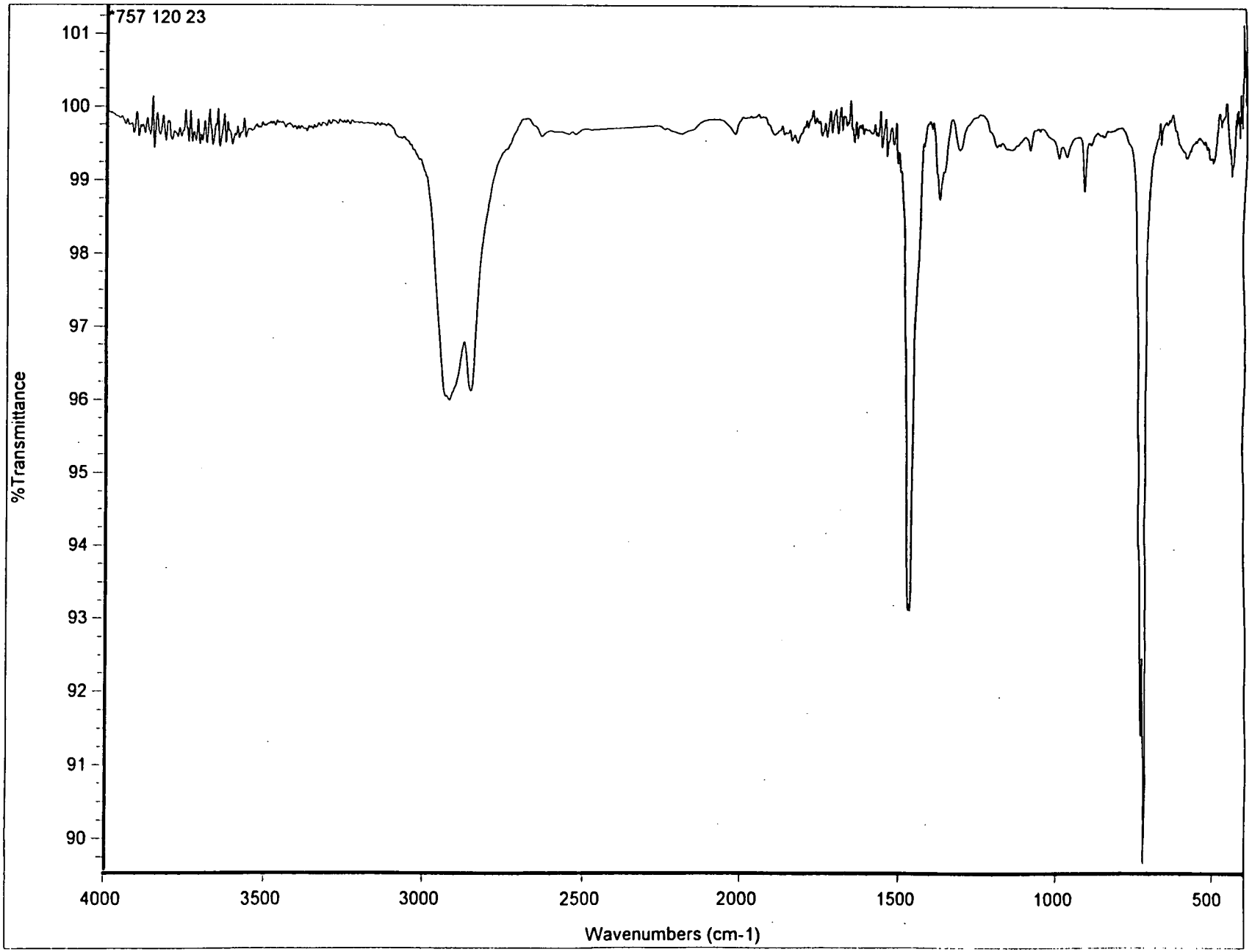
382



GeoSyntec Consultants

000407

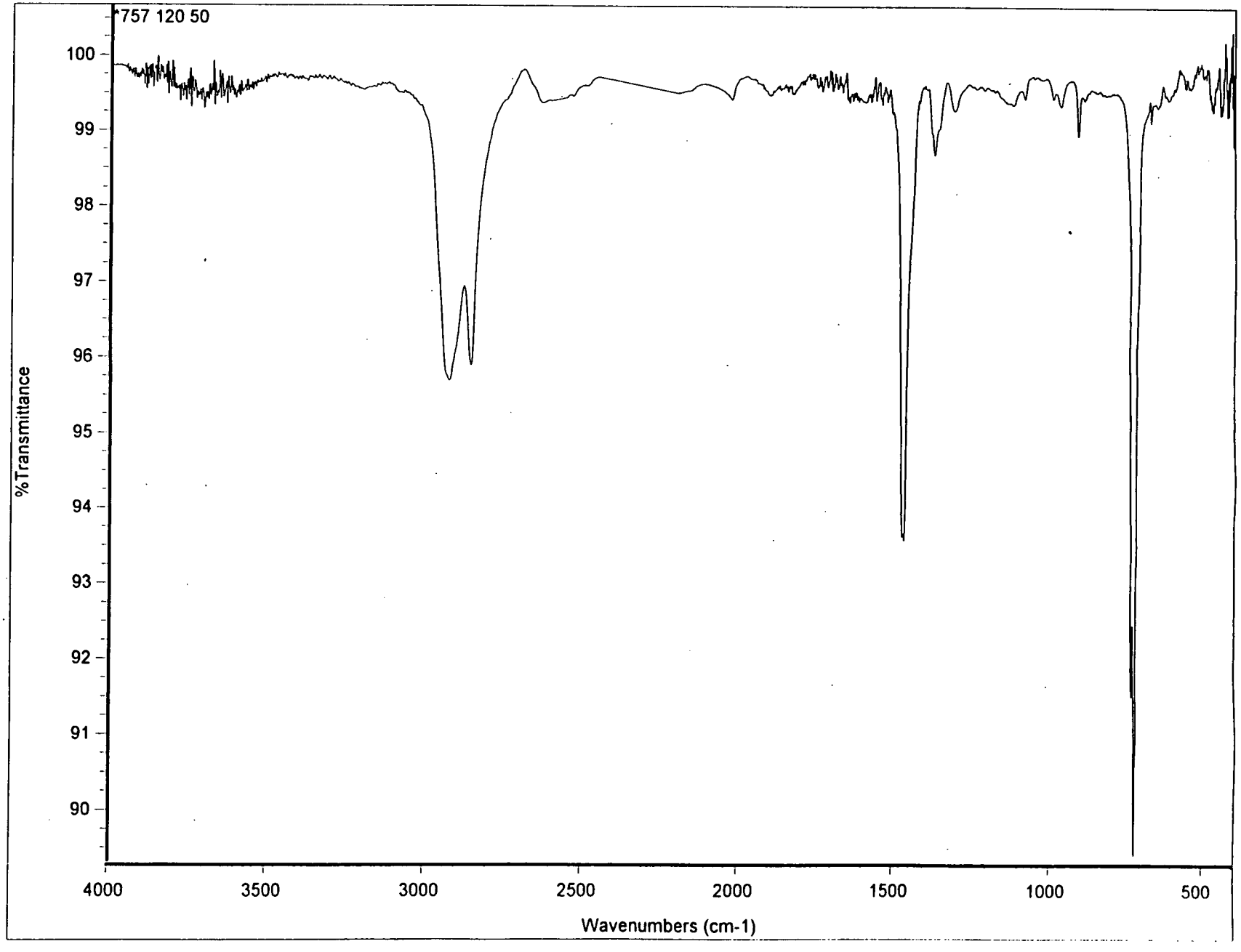
387



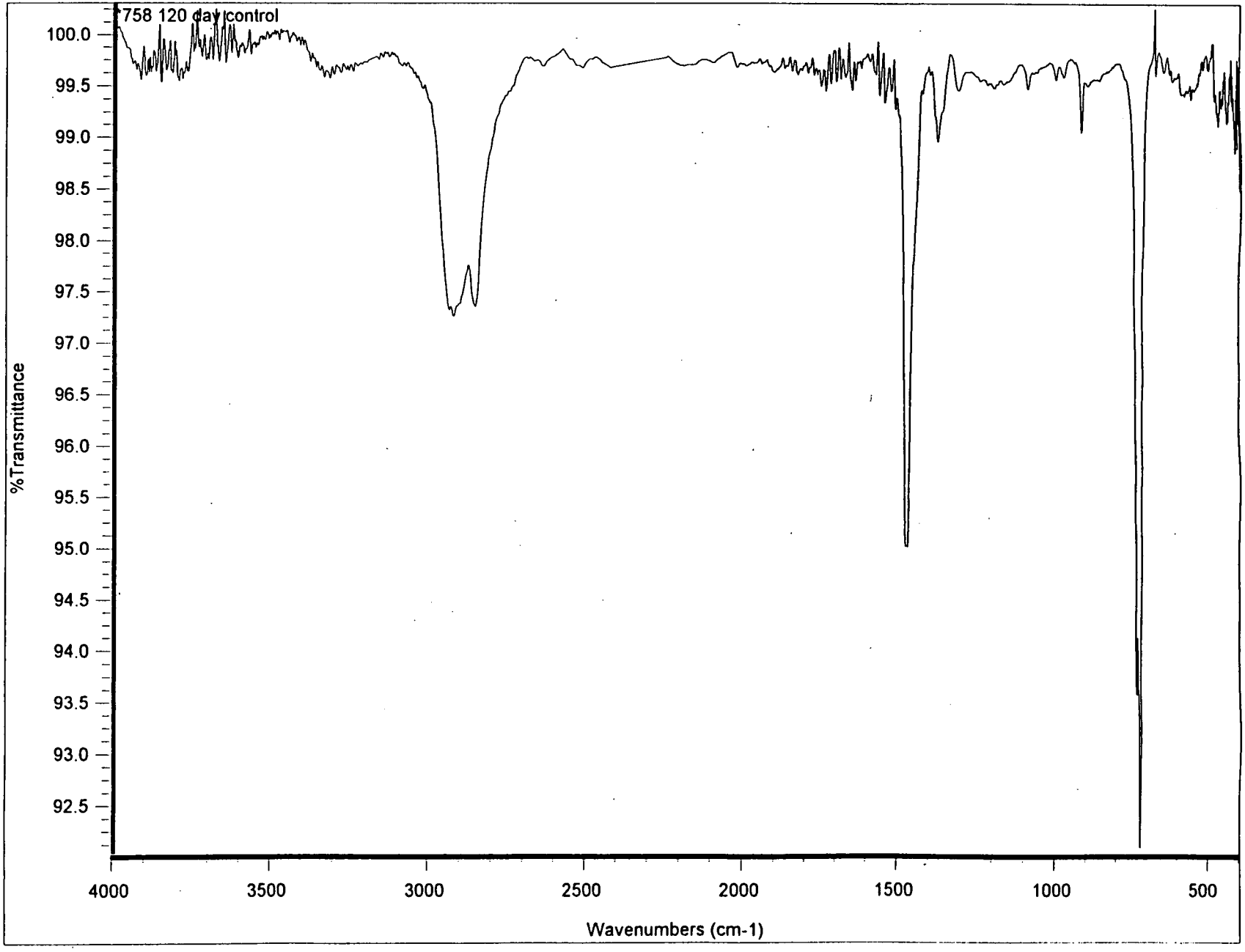
GeoSyntec Consultants

007008

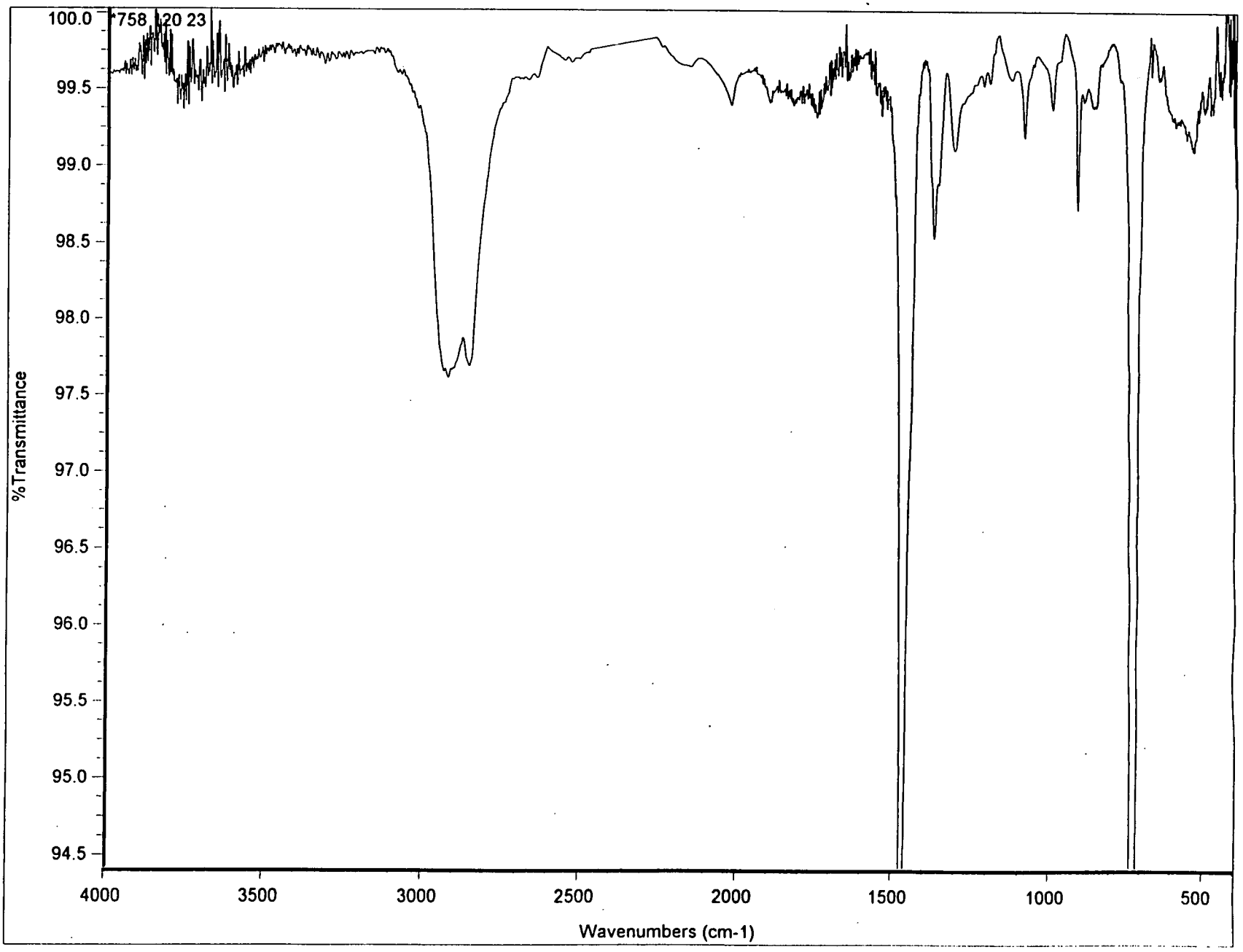
387



GeoSyntec Consultants



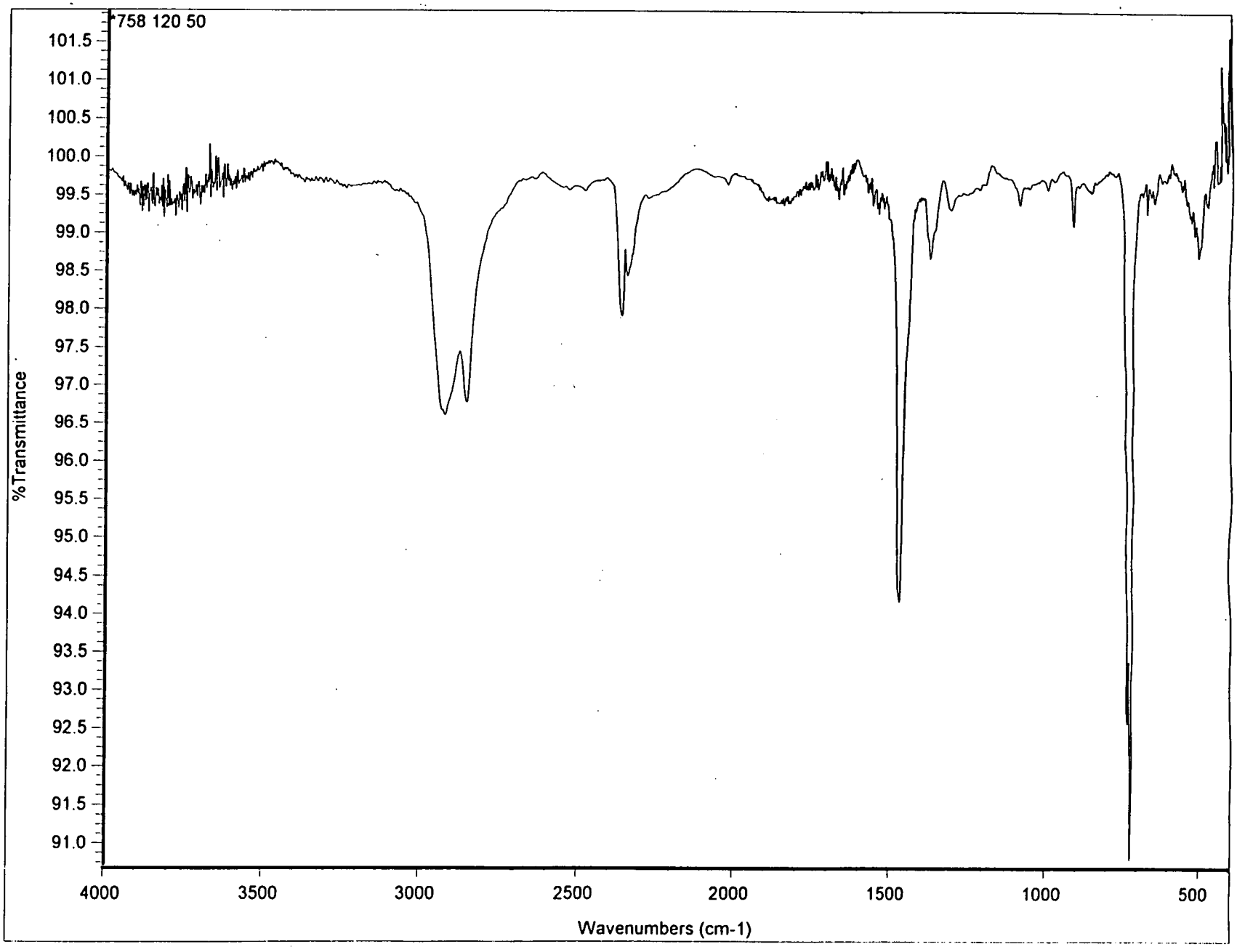
GeoSyntec Consultants



GeoSyntec Consultants

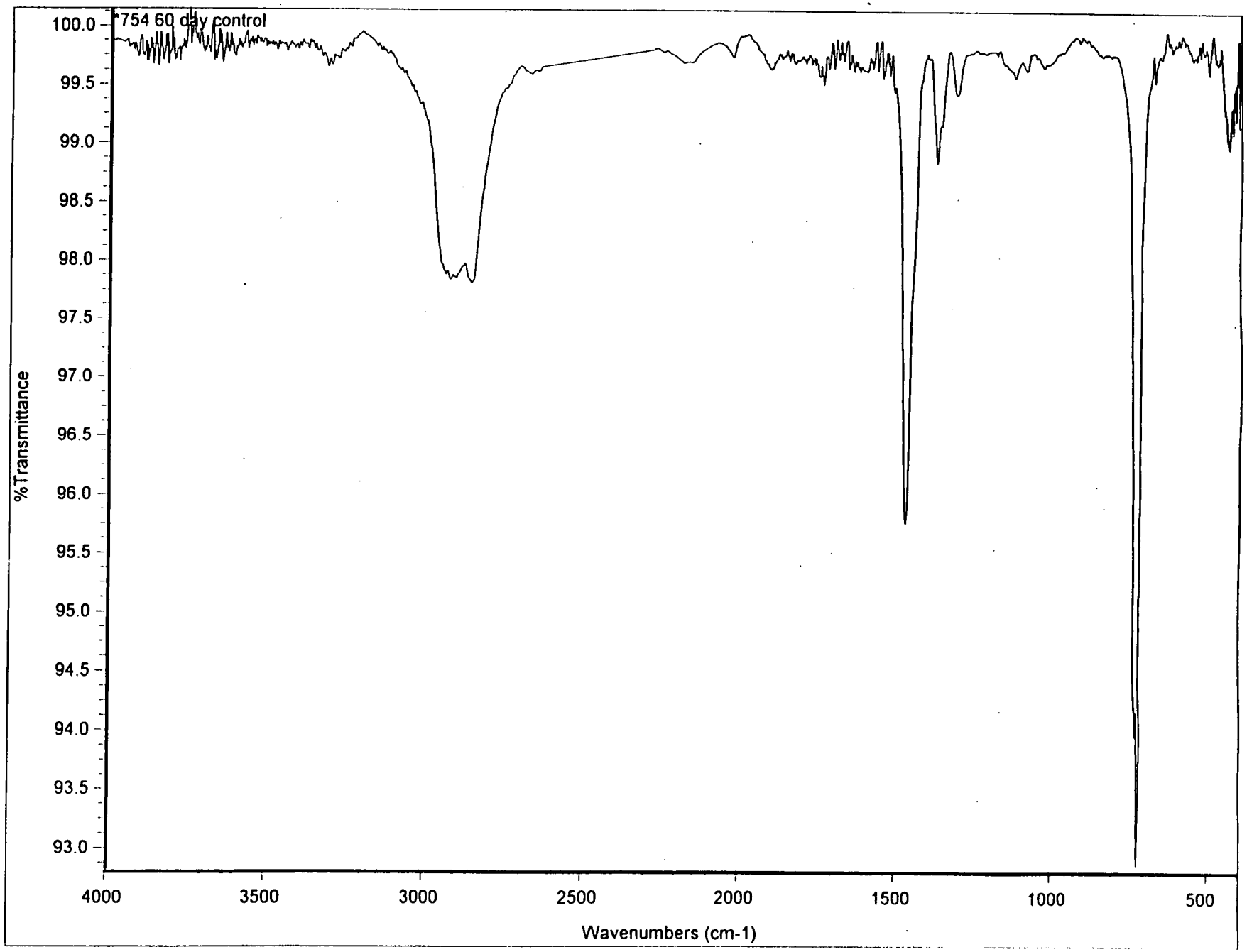
000411

387



000412

GeoSyntec Consultants



000413

GeoSyntec Consultants

387

APPENDIX E

STRESS CRACKING RESISTANCE

Part I: Rationale, Results and Discussions, and Conclusions

Part II: Stress-Time Curves

draft

Part I: Rationale, Results and Discussions, and Conclusions

draft

APPENDIX E

STRESS CRACKING RESISTANCE

Environmental Stress Cracking Resistance

Environmental stress cracking resistance of the five geomembranes was assessed by conducting notched constant tensile load (NCTL) tests in accordance with ASTM D 5397. Results are provided below based on a 2,000-hour test duration.

Rationale for Test

In the NCTL test, geomembrane specimens are subjected to constant stress at pre-established percentages of the short-term yield stress of the geomembrane. The time required for the geomembrane specimen to rupture at a specific stress level is measured and recorded. Curves are developed by graphing percent of stress (ordinate) versus rupture time (abscissa). From these curves, the time to rupture at 6.2 MPa (900 psi), which is the industry accepted stress level for specifying environmental stress cracking resistance, and the ductile to brittle transition time, can be assessed. The longer the time to rupture at 6.2 MPa (900 psi), the greater the stress cracking resistance of a material.

draft

Results and Discussion

The test results for the NCTL tests on the five geomembranes are summarized in Table E-1 and complete results are given in Table E-2.

Inspection of Table E-1 reveals that the GSE-SLT and the NSC geomembranes have better stress crack resistance than the GSE-Gundle, Serrot, and Polyflex geomembranes because neither the time to rupture at 6.2 MPa (900 psi) nor the ductile to brittle transition times have been achieved. Furthermore, the GSE-SLT geomembrane appears to have somewhat greater stress cracking resistance than the NSC geomembrane because specimens that have higher stress levels have not yet ruptured,

TABLE E-1

SUMMARY OF NCTL TEST RESULTS

Geomembrane/Resin	Time to Rupture at 6.2 MPa (900 psi)	Estimated Ductile-to-Brittle Transition Time
GSE-SLT/Mobil	(1)	(2)
NSC/Union Carbide	(3)	(4)
GSE-Gundle/Phillips	536 hr	450 hr
Serrot/Solvay	535 hr	526 hr
Polyflex/Phillips	182 hr	50 hr

Notes:
(1) Specimens with <40% of yield stress did not rupture.
(2) Only ductile ruptures were observed.
(3) Specimens with <30% of yield stress did not rupture.
(4) Only ductile ruptures have been observed.

TABLE E-2

NOTCHED CONSTANT TENSILE LOAD DATA

Sample	Yield Stress	Hours to Rupture at Percent of Yield Stress[2]									
		20%	25%	30%	35%	40%	45%	50%	55%	60%	65%
GSE-SLT	2,351 psi	470 psi NR[1]	588 psi NR	705 psi NR	823 psi NR	940 psi 1564[3]	1058 psi 361 hr	1176 psi 244 hr	1293 psi 180 hr	1411 psi 4 hr	1528 psi 0.1 hr
NSC	2,814 psi	563 psi NR	704 psi NR	844 psi 1412 hr	985 psi 109 hr	1126 psi 58 hr	1266 psi 21 hr	1407 psi 3 hr	1548 psi 0.2 hr	1688 psi 0.04 hr	1829 psi 0.01 hr
GSE-Gundle	2,851 psi	570 psi NR	713 psi 805 hr	855 psi 564 hr	998 psi 478 hr	1140 psi 184 hr	1283 psi 56 hr	1426 psi 28 hr	1568 psi 0.7 hr	1711 psi 0.02 hr	1853 psi 0.008 hr
Polyflex	3,086 psi	617 psi 1451 hr	772 psi 393 hr	926 psi 182 hr	1080 psi 81 hr	1234 psi 49 hr	1389 psi 5.1 hr	1343 psi 3 hr	1697 psi 0.1 hr	1852 psi 0.03 hr	2,000 psi 0.004 hr
Serrot	2,600 psi	520 psi NR	650 psi 883 hr	780 psi 468 hr	910 psi 556 hr	1040 psi 155 hr	1170 psi 73 hr	1300 psi 8 hr	1430 psi 8 hr	1360 psi 0.2 hr	1690 psi 0.03 hr

Notes:
(1) NR = specimen did not rupture.
(2) Hours are an average of three specimens.
(3) Single specimen.

compared to the NSC geomembrane. Specimens having higher stresses tend to rupture in a ductile mode and rupture more quickly than specimens having lower stresses, which take longer to rupture and tend to rupture in a brittle mode. In addition, from Table E-1, the Polyflex geomembrane has values that are well below those of any of the other geomembranes, appearing inferior, in terms of stress cracking resistance, to the other four geomembranes.

Conclusion

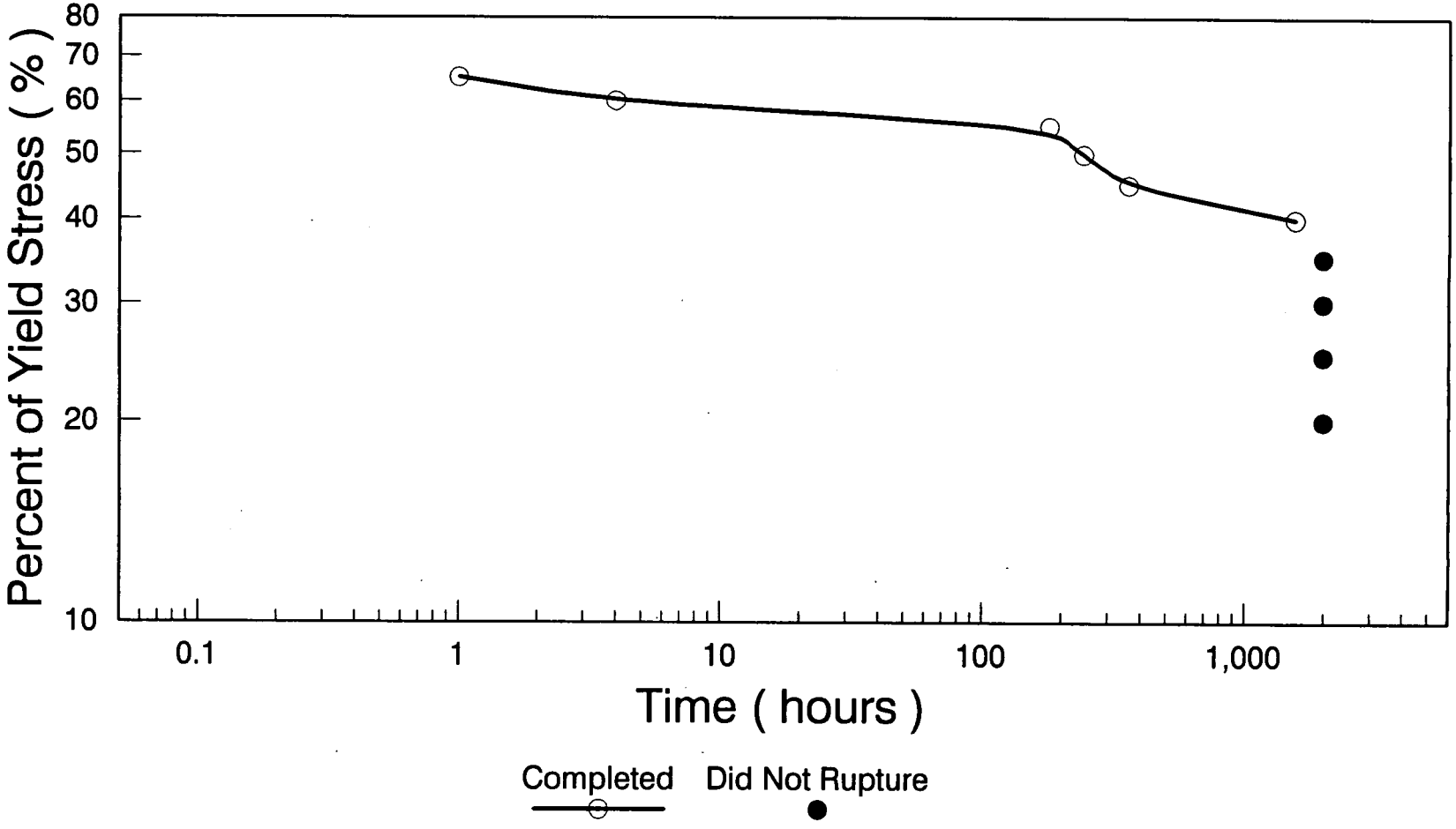
Based on these test results, it is recommended that the specified time-to-rupture for HDPE geomembranes, tested in accordance with ASTM D 5397 at 6.2 MPa (900 psi), be greater than 500 hours. This appears to be an achievable level of performance for four existing HDPE geomembranes, and is likely achievable by other manufacturers if necessary to meet a specification requirement.

Part II: Stress-Time Curves

draft

NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

Sample: 754 (GSE - SLT)

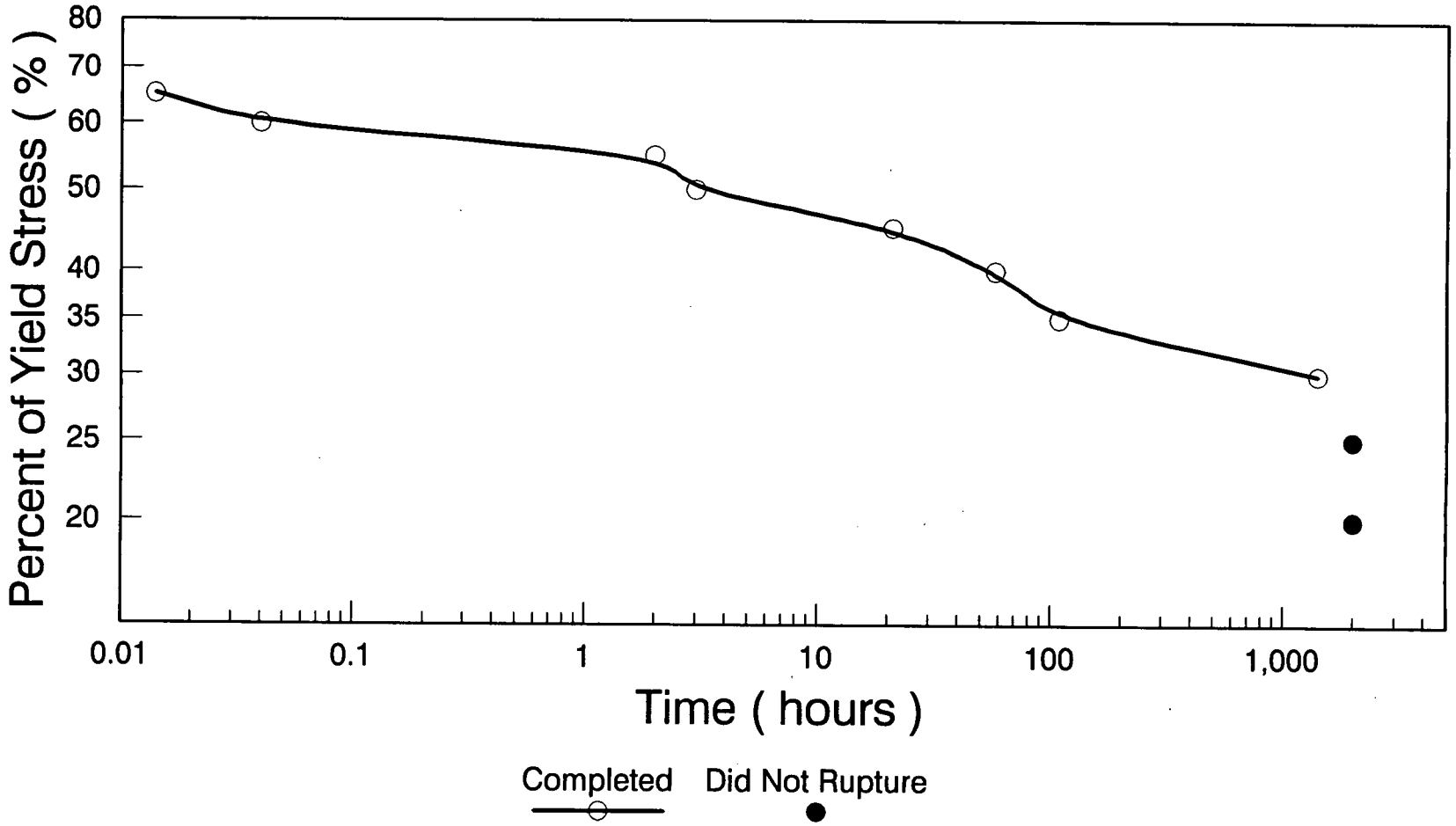


Yield Stress = 2351psi

August 12, 1996

NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

Sample: 755 (NSC)

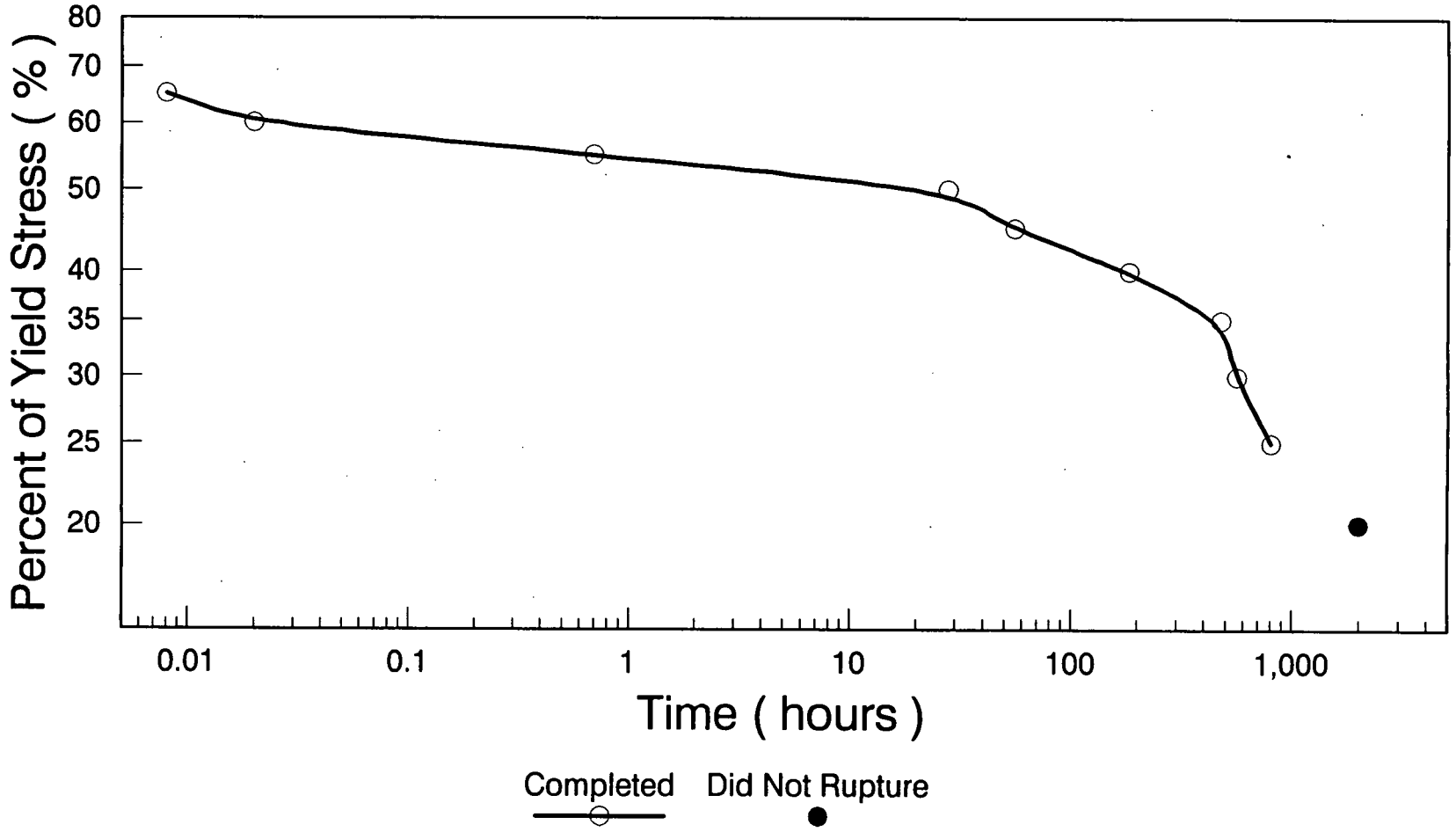


Yield Stress=2814 psi

August 12, 1996

NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

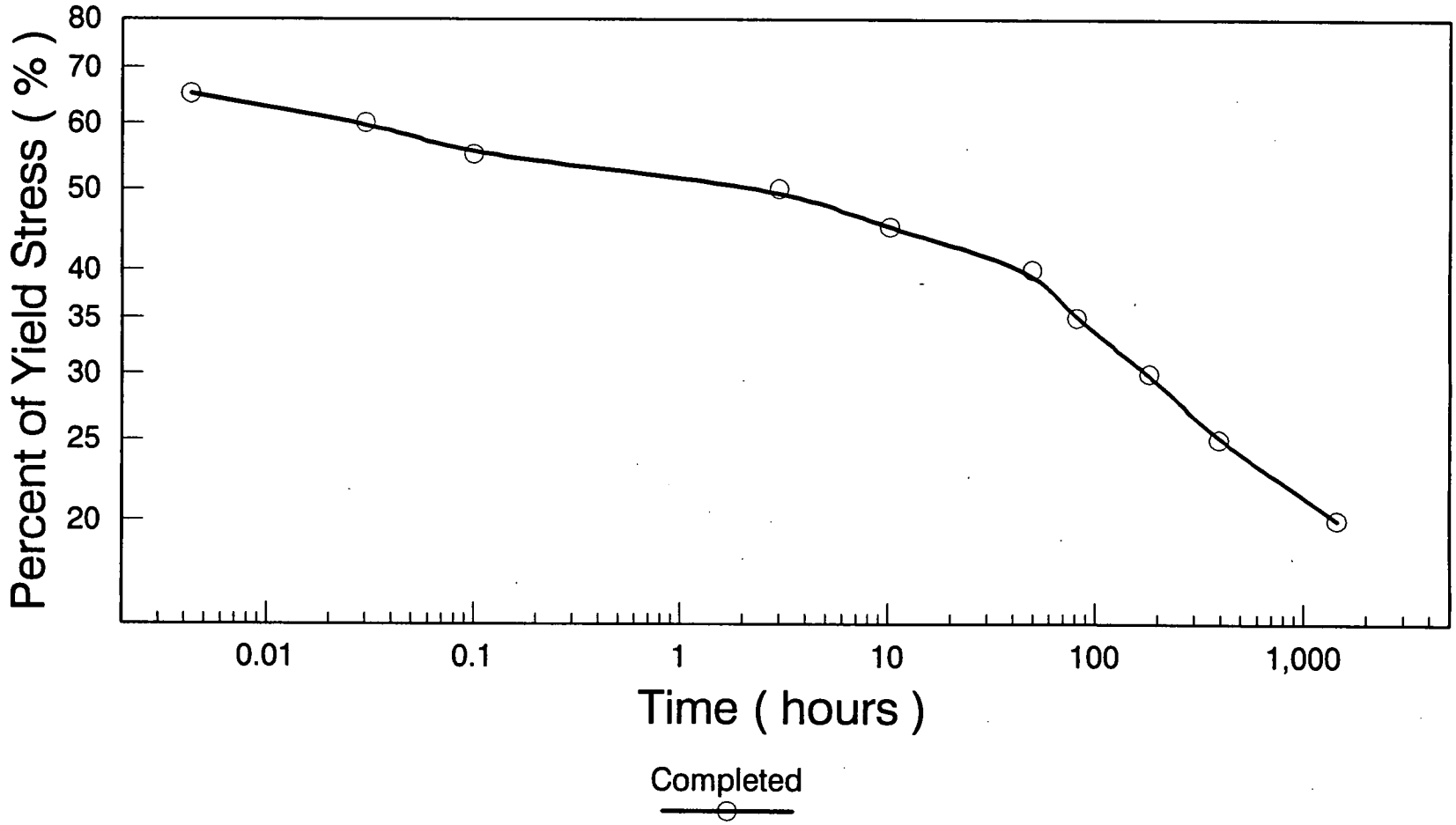
Sample: 756 (GSE - GUNDLE)



Yield Stress=2851 psi
August 12, 1996

NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

Sample: 757 (POLYFLEX)

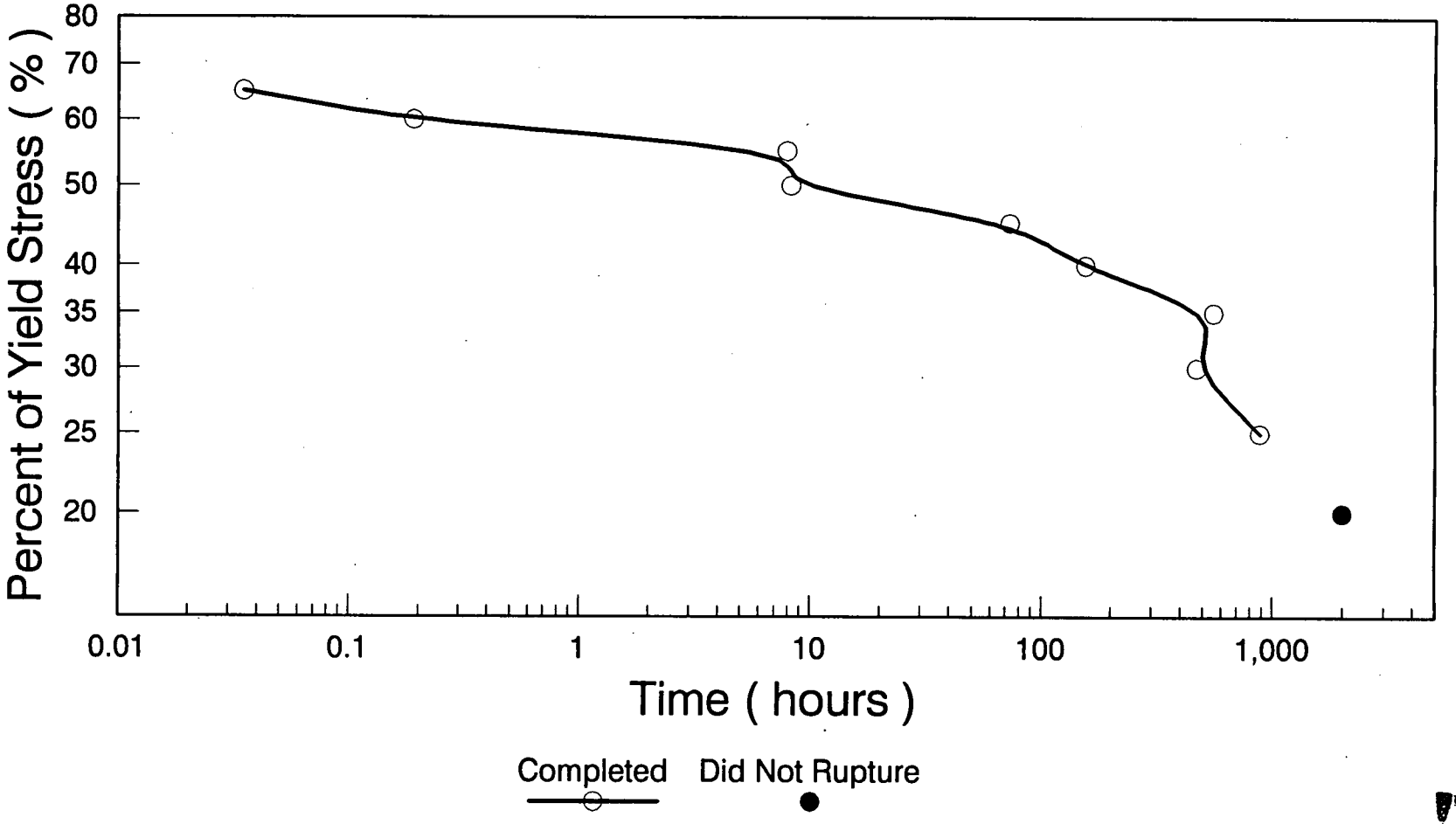


Yield Stress = 3086 psi

August 12, 1996

NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

Sample: 758 (SERROT)



Yield Stress=2600 psi

August 12, 1996

000425