706

20110-RP-0001

# LEACHATE / LINER COMPATIBILITY STUDY
# FINAL REPORT

## ON-SITE DISPOSAL FACILITY

REVISION C
APRIL 1997

INFORMATION ONLY

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
**Fluor Daniel Fernald**
Subcontract 95PS005028

000001

706


**Department of Energy**

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


MAY 7 1997
**DOE-0920-97**

**Mr. James A. Saric, Remedial Project Director**
**U.S. Environmental Protection Agency**
**Region 5 - SRF-5J**
**77 West Jackson Boulevard**
**Chicago, Illinois 90904-3590**

**Mr. Thomas Schneider, Project manager**
**Ohio Environmental Protection Agency**
**401 East Fifth Street**
**Dayton, Ohio 45402-2911**

**Dear Mr. Saric and Mr. Schneider:**

**SUBMITTAL OF RESPONSE TO COMMENTS AND THE FINAL LEACHATE/LINER COMPATIBILITY STUDY REPORT FOR THE ON-SITE DISPOSAL FACILITY**

**This letter submits the Response to Comments (RTC) and the Final Leachate/Liner Compatibility Study Report (LLCSR) for your review. The RTC presents our response to the draft LLCSR and action items to address the questions. The LLCSR 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).**

**Please contact Rod Warner at (513) 684-3156 if there are any questions regarding this submittal.**

**Sincerely,**

**Johnny W. Reising**
**Fernald Remedial Action**
**Project Manager**

**FEMP:Warner**

**Enclosures: As Stated**

*Recycled and Recyclable*

1A

cc w/enc:

N. Hallein, EM-42/CLOV
R. Beaumier, TPSS/DERR, OEPA, Columbus
F. Bell, ATSDR
G. Jablonowski, USEPA-V, 5HRE-8J
R. Geiger, PRC
R. Vandegrift, ODOH
D. Ward, GeoTrans
AR Coordinator/78

cc w/o enc:

J. Jalovec, DOE-FEMP
S. Peterman, DOE-FEMP
J. Reising, DOE-FEMP
R. Warner, DOE-FEMP
D. Carr, FDF/9
S. Garland, FDF/52-8
M. Hickey, FDF/64
U. Kumthekar, FDF/64
T. Walsh, FDF/65-2

No. 33
706

# LEACHATE/LINER COMPATIBILITY STUDY
# FINAL REPORT

## ON-SITE DISPOSAL FACILITY

**Revision C**
**April 1997**

## United States Department of Energy

**Fluor Daniel Fernald**
**Fernald, Ohio**

*Prepared by*

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

*Under*

Fluor Daniel Fernald
Subcontract 95PS005028

INFORMATION ONLY

000002

# 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 |
| FDF | Fluor Daniel Fernald |
| FEMP | Fernald Environmental Management Project |
| 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

## 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

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

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 CRACK RESISTANCE
Part I: Rationale, Results and Discussions, and Conclusions
Part II: Stress-Time Curves

## TABLE OF CONTENTS (continued)

## 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 Summary of USEPA Method 9090 Test Results

## LIST OF FIGURES

3-1 Flow Diagram for Interpretation of USEPA Method 909 Test Results

3-2 Illustration of Comparison with One Standard Deviation

3-3 Illustration of Temporal Trends

3-4 Illustration of Consistency Between Temporal and Thermal Trends

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 Fluor Daniel Fernald (FDF) 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

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.

# 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.

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.

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.

- 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.

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

# 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.

- 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.

## 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 FDF 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 FDF 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 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.

# 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. FDF 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.

## 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.

### 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.

### 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

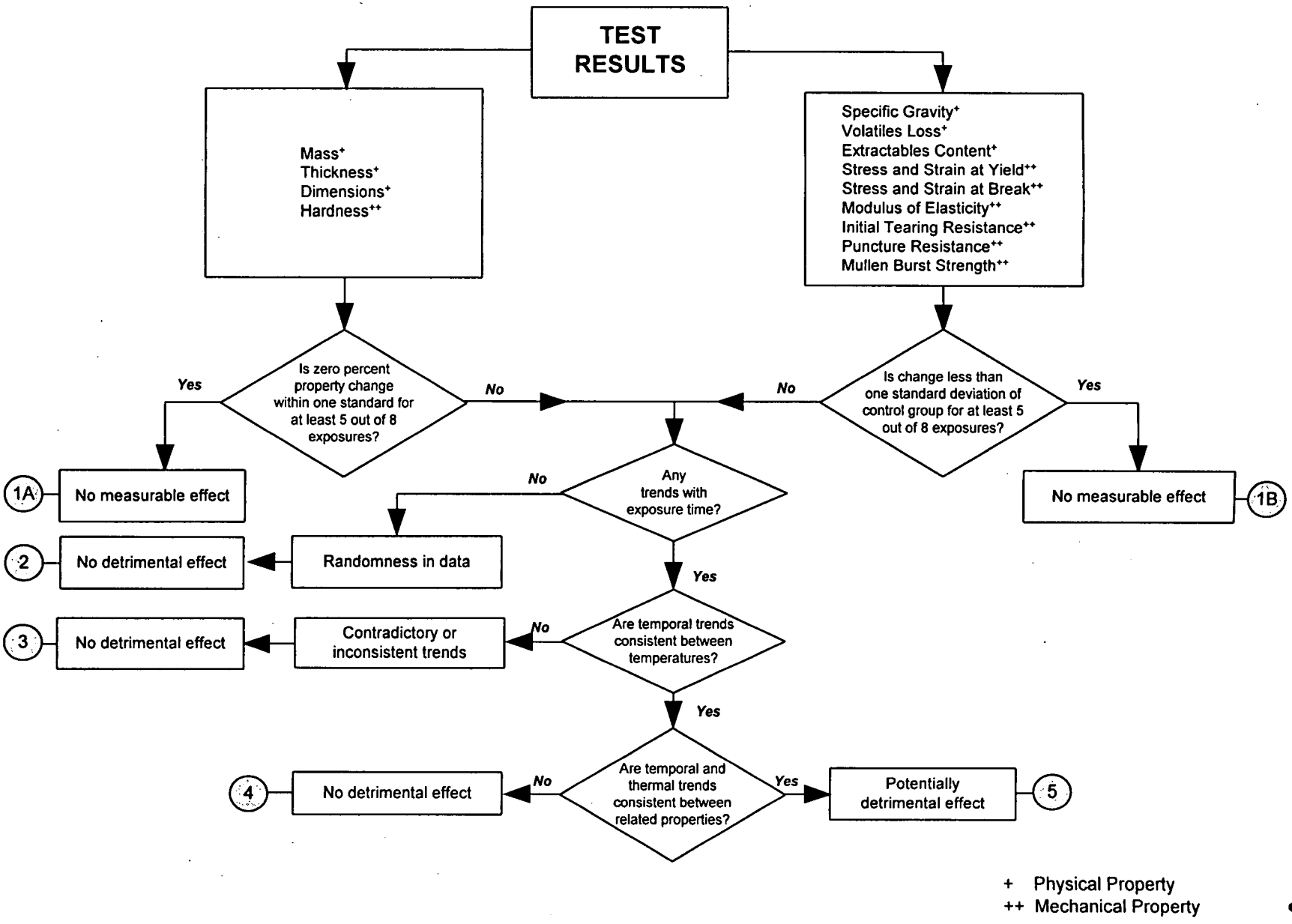
The HDPE geomembrane samples were tested for compatibility with the test leachate using the USEPA Method 9090, and surface analysis by infrared spectrophotometry. Stress crack resistance of the HDPE geomembranes was assessed using the Notched Constant Tensile Load (NCTL) test performed in accordance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

### 3.4.2 Evaluation of Data

The results from the USEPA Method 9090 tests on the five geomembrane sample types were analyzed and interpreted according to the flow diagram shown in Figure 3-1. The attributes of the methodology adopted in Figure 3-1 are described below.

- *Analyses criteria and comparison with one standard deviation*: Test results were analyzed using two distinct criteria based on the similarity of the nature of the test samples. Properties for which the same samples were tested before and after exposure to the test leachate (i.e., mass, thickness, dimensions, and hardness) were analyzed using the same criterion. Properties for which a set of samples were used as a control group, and sets of samples were exposed to the test leachate at various exposure times and temperatures before being tested (i.e., specific gravity, volatiles losses, extractables content, stress and strain at yield, stress and strain at break, modulus of elasticity, initial tearing resistance, puncture resistance, and Mullen burst strength) were analyzed using a different criterion. Methodology adopted for evaluation of test results using the two distinct criteria are illustrated in Figure 3-2.

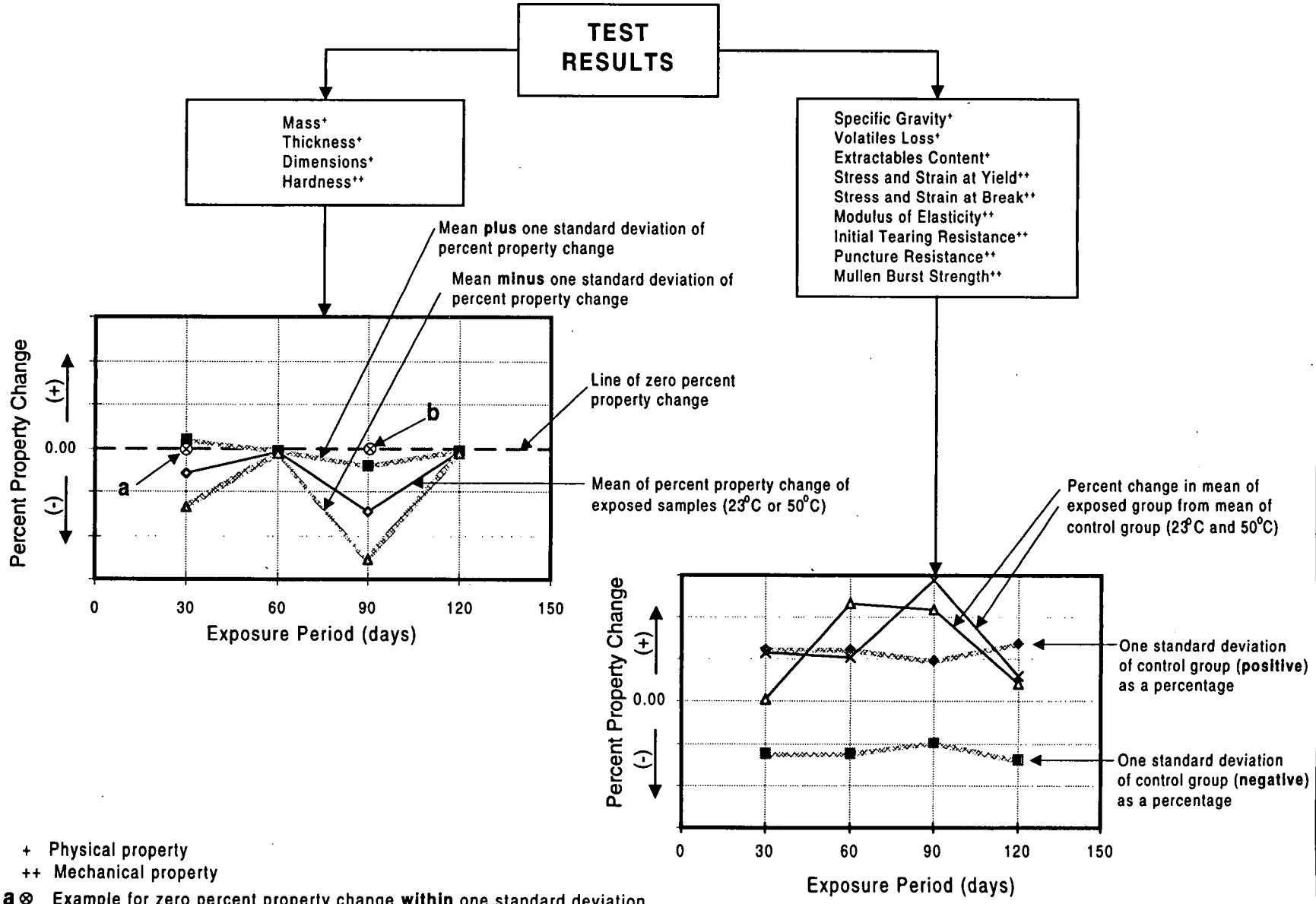
# FLOW DIAGRAM FOR INTERPRETATION OF USEPA METHOD 9090 TEST RESULTS




GEOSYNTEC CONSULTANTS
ATLANTA, GEORGIA

FIGURE NO. 3-1
PROJECT NO. GE3900-07.4
DOCUMENT NO. F9630165.FIG
FILE NO. FIG_3-1.VSD

# ILLUSTRATION OF COMPARISON WITH ONE STANDARD DEVIATION




\+ Physical property

++ Mechanical property

a⊗ Example for zero percent property change **within** one standard deviation

b⊗ Example for zero percent property change **not within** one standard deviation

GEOSYNTEC CONSULTANTS

ATLANTA, GEORGIA

FIGURE NO. 3-2

PROJECT NO. GE3900-07.4

DOCUMENT NO. F9630165.FIG

FILE NO. FIG_3-2.VSD

000025

- *Temporal trends*: Test results, that met the one standard deviation criteria, were examined for trends with exposure periods. The methodology used in distinguishing between the observed temporal trends are illustrated in Figure 3-3.

- *Consistency between temporal and thermal trends*: Test results, for those tests that exhibited temporal trends, were further examined for consistency between temporal and thermal trends. The criteria used in distinguishing between the observed consistencies between temporal and thermal trends are illustrated in Figure 3-4.

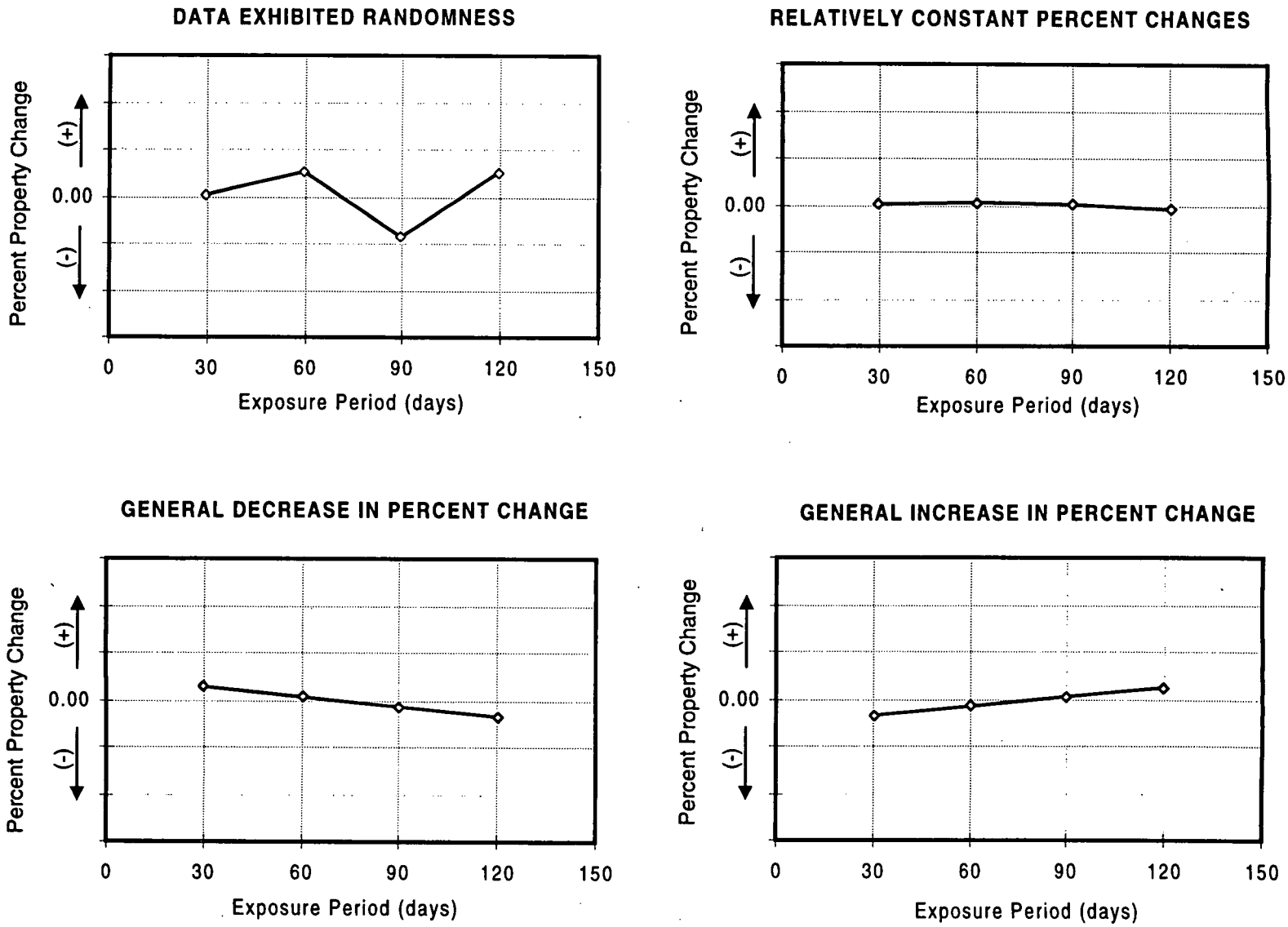
- *Consistency between related properties*: Test results that exhibited consistent temporal trends between temperatures were examined for consistency of trends between related properties (i.e., a certain trend exhibited in one property was expected to be reflected as a trend in another related property). Specific cases of test results that were correlated are described below.

    - 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.

    - 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) are expected to undergo similar changes. For example, if yield strength increases because of leachate, then hardness, break stress, modulus of elasticity, initial

# ILLUSTRATION OF TEMPORAL TRENDS



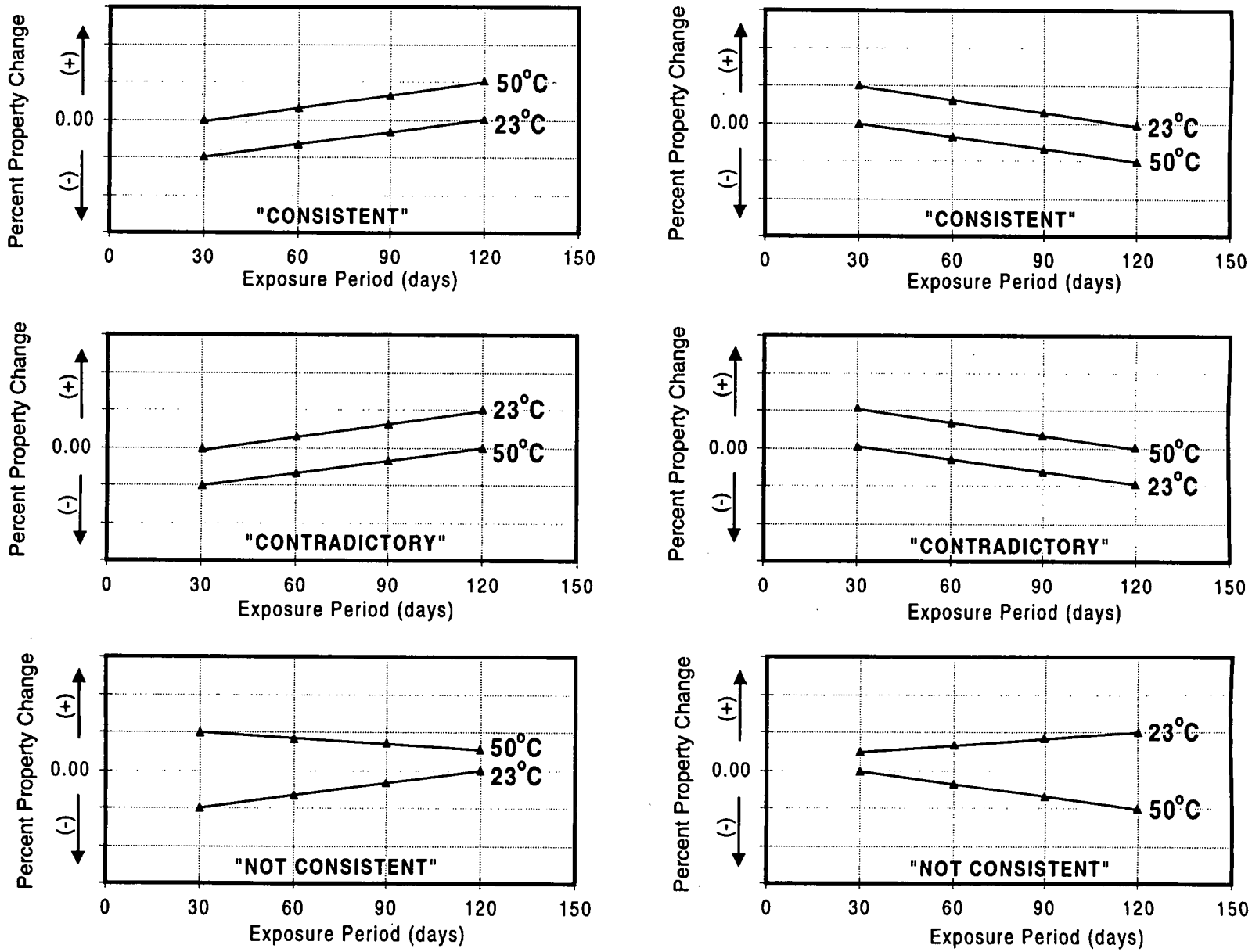

GEOSYNTEC CONSULTANTS
ATLANTA, GEORGIA

FIGURE NO. 3-3
PROJECT NO. GE3900-07.4
DOCUMENT NO. F9630165.FIG
FILE NO. _3-3.VSD

000027

706

# ILLUSTRATION OF CONSISTENCY BETWEEN TEMPORAL AND THERMAL TRENDS




NOTE: All lines shown in graphs are shown as 'straight lines' only for the purpose of illustration.

GEOSYNTEC CONSULTANTS
ATLANTA, GEORGIA

FIGURE NO. 3-4
PROJECT NO. GE3900-07.4
DOCUMENT NO. F9630165.FIG
FILE NO. FIG_3-4.VSD

tearing resistance, 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 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.

### 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."

### 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].

#### 3.4.4.2 Stress Crack Evaluation

The stress crack resistance of the candidate geomembranes was evaluated only on the unexposed samples using ASTM D 5397, "Standard Test Method for Evaluation of the Stress Crack 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 crack potential of the geomembrane. Stress crack 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 crack tests are provided in this report.

## 3.5 Summary of Results

The results of the USEPA Method 9090 compatibility testing program are summarized in Table 3-1. Detailed descriptions of the results and laboratory data for the various tests are provided in Appendix B. No measurable or detrimental effects were observed on mass, thickness, dimensions, specific gravity, extractables content, stress at yield, strain at yield, strain at break, hardness, puncture resistance, and Mullen burst strength of any the five candidate HDPE geomembranes. Test results for volatiles losses and stress at break of GSE-SLT geomembrane and modulus of elasticity and initial tearing resistance of GSE-Gundle and Serrot geomembranes exhibit consistent temporal and thermal trends; however, no detrimental effects are expected due to inconsistency between related properties.

# TABLE 3-1
# SUMMARY OF USEPA METHOD 9090 TEST RESULTS

| Property | | Appendix | Results: Maximum % Std. Deviation of Control Group | | | | | Results: Maximum % Change in Property | | | | | Results: Comparison[A] With One Std. Deviation | | | | | Results: Temporal Trends[B] | | | | | Results: Thermal Trends[C] | | | | | Interpretation using Flow Diagram (Figure 3-1) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| **Physical Properties** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mass | | B.2.1 | 0.03 | 0.06 | 0.40 | 0.20 | 0.40 | 0.02 | 0.10 | 0.2 | 0.10 | -0.1 | ✓ | ✓ | × | ✓ | ✓ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | 1A | 1A | 2 | 1A | 1A |
| Thickness | | B.2.2 | 3.50 | 0.80 | 2.00 | 4.00 | 4.00 | 1.00 | 0.60 | -0.4 | -2.0 | -0.5 | ✓ | ✓ | ✓ | ✓ | ✓ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | 1A | 1A | 1A | 1A | 1A |
| Dimensions: Length | | B.2.3 | 0.90 | 0.30 | 0.20 | 0.70 | 0.70 | 0.50 | 0.20 | -0.1 | -0.4 | -0.4 | ✓ | ✓ | ✓ | ✓ | ✓ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | 1A | 1A | 1A | 1A | 1A |
| Dimensions: Width | | B.2.3 | 0.20 | 0.30 | 0.20 | 0.10 | 0.20 | 0.20 | -0.2 | -0.1 | -0.1 | 0.06 | ✓ | ✓ | × | × | ✓ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | 1A | 1A | 2 | 2 | 1A |
| Specific Gravity | | B.2.4 | 0.20 | 0.05 | 0.08 | 0.05 | 0.10 | 0.40 | 0.30 | 0.30 | 0.30 | -0.4 | × | × | × | × | × | ↓ | ↓ | ↕ | ↕ | ↓ | ■ | ■ | ↕ | ↕ | ■ | 3 | 3 | 2 | 2 | 3 |
| Volatiles Losses | | B.2.5 | 9 | 63 | 64 | 35 | 73 | 479 | 219 | 1624 | 1115 | 858 | × | × | × | × | × | ↕ | ↕ | ↕ | ↓ | ↕ | □ | ↕ | ↕ | ■ | ↕ | 4 | 2 | 2 | 3 | 2 |
| Extractables Content | | B.2.6 | 8 | 58 | 78 | 11 | 32 | 756 | 1140 | 1905 | 379 | 374 | × | × | × | × | × | ↕ | ↕ | ↕ | ↓ | ↕ | ↕ | ↕ | ↕ | ■ | ↕ | 2 | 2 | 2 | 3 | 2 |
| **Mechanical Properties** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Stress at Yield | *Roll* | B.2.7 | 5.0 | 2.0 | 3.0 | 4.5 | 5.5 | -11 | 2 | -10 | -7 | 6.5 | × | ✓ | × | × | ✓ | ↓ | ↔ | ↓ | ↓ | ↔ | ↕ | ↔ | ↕ | ↕ | ↔ | 3 | 1B | 3 | 2 | 1B |
| | *Cross-roll* | B.2.7 | 3.0 | 3.0 | 3.5 | 3.0 | 4.0 | 15 | 9 | -5.1 | 13 | -8.5 | × | × | × | × | × | ↓ | ↓ | ↕ | ↕ | ↓ | ↕ | ■ | ↕ | ↕ | ■ | 3 | 3 | 3 | 2 | 3 |
| Strain at Yield | *Roll* | B.2.7 | 6.0 | 6.0 | 6.5 | 4.0 | 6.0 | -7 | 7 | -12 | -6 | 12 | ✓ | ✓ | ✓ | ✓ | ✓ | ↑ | ↔ | ↓ | ↔ | ↕ | □ | □ | ↕ | ↔ | ↕ | 1B | 1B | 1B | 1B | 1B |
| | *Cross-roll* | B.2.7 | 6.0 | 5.0 | 4.5 | 6.5 | 9.5 | -11 | -9 | 16.5 | -12 | 10 | ✓ | × | × | × | × | ↕ | ↑ | ↓ | ↕ | ↕ | ↕ | ■ | ↕ | ↕ | ↕ | 1B | 3 | 3 | 2 | 2 |
| Stress at Break | *Roll* | B.2.8 | 9.0 | 9.0 | 9.5 | 18.0 | 17.0 | -14 | 11 | -7 | 18.5 | 24.5 | × | × | ✓ | ✓ | ✓ | ↓ | ↔ | ↔ | ↔ | ↔ | ↕ | ↔ | ↔ | ↔ | ↔ | 3 | 1B | 1B | 1B | 1B |
| | *Cross-roll* | B.2.8 | 41.0 | 5.0 | 7.0 | 26.5 | 28.5 | 19.5 | -12 | -13 | -44 | 25.5 | × | ✓ | × | ✓ | × | ↓ | ↔ | ↔ | ↓ | ↔ | □ | ↔ | ↔ | ↕ | ↔ | 4 | 1B | 2 | 1B | 1B |
| Strain at Break | *Roll* | B.2.8 | 18.0 | 7.5 | 10.0 | 14.5 | 18.0 | 29 | 12 | 5.5 | 11 | -11 | ✓ | ✓ | ✓ | ✓ | ✓ | ↕ | ↔ | ↔ | ↔ | ↔ | ↕ | ↔ | ↔ | ↔ | ↔ | 1B | 1B | 1B | 1B | 1B |
| | *Cross-roll* | B.2.8 | 21.0 | 4.5 | 5.5 | 18.5 | 21.0 | 37.5 | 5 | -10 | -33 | 17.5 | × | ✓ | ✓ | ✓ | × | ↕ | ↔ | ↔ | ↓ | ↔ | ↕ | ↔ | ↔ | ↕ | ↔ | 2 | 1B | 1B | 1B | 1B |
| Modulus of Elasticity | *Roll* | B.2.9 | 10.5 | 6.5 | 9.5 | 10.0 | 6.0 | -9.5 | -14 | 15 | 8 | -16.5 | ✓ | × | × | ✓ | × | ↕ | ↕ | ↓ | ↕ | ↔ | ↕ | ↕ | ■ | ↕ | ↕ | 1B | 2 | 3 | 1B | 3 |
| | *Cross-roll* | B.2.9 | 7.5 | 6.0 | 6.0 | 5.0 | 7.0 | 16.5 | 15.5 | 7.5 | 7 | -17 | ✓ | × | × | ✓ | × | ↕ | ↓ | ↔ | ↔ | ↔ | ↕ | ↕ | ↔ | ↔ | ↕ | 1B | 3 | 4 | 1B | 3 |
| Initial Tearing Resistance | *Roll* | B.2.10 | 6.0 | 4.5 | 4.0 | 5.5 | 5.5 | 7.5 | 11 | -6 | -10 | 9 | ✓ | × | ✓ | × | × | ↔ | ↑ | ↓ | ↕ | ↓ | ↔ | ↕ | □ | ↕ | □ | 1B | 3 | 1B | 2 | 4 |
| | *Cross-roll* | B.2.10 | 4.5 | 4.0 | 3.0 | 3.0 | 4.5 | -12 | 13 | -7 | 11 | 12 | ✓ | × | × | × | × | ↔ | ↕ | ↓ | ↕ | ↓ | ↔ | ↕ | □ | ↕ | □ | 1B | 2 | 4 | 2 | 4 |
| Hardness | | B.2.11 | 3.5 | 4.0 | 4.0 | 3.5 | 4.0 | 3 | 3 | 3.5 | 4.5 | 4.5 | ✓ | ✓ | ✓ | ✓ | ✓ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | ↕ | 1A | 1A | 1A | 1A | 1A |
| Puncture Resistance | | B.2.12 | 4.0 | 3.0 | 3.0 | 4.5 | 5.5 | 8 | 7 | 5.5 | -8 | 10 | × | × | ✓ | ✓ | × | ↕ | ↓ | ↔ | ↕ | ↓ | ↕ | ↕ | ↔ | ↕ | ↕ | 2 | 3 | 1B | 1B | 3 |
| Mullen Burst Strength | | B.2.13 | 2.5 | 4.0 | 6.0 | 4.0 | 6.5 | -12 | -7.5 | 10 | 14 | 11.5 | × | × | × | ✓ | × | ↓ | ↓ | ↓ | ↕ | ↓ | ■ | ■ | ↕ | ↕ | ↕ | 3 | 3 | 3 | 1B | 3 |

*Geomembrane Types*

1 GSE-SLT Geomembrane
2 NSC Geomembrane
3 GSE-Gundle Geomembrane
4 PolyFlex Geomembrane
5 Serrot Geomembrane

*A. Comparison with One Std. Deviation*

✓ Percent changes were within one Std. Deviation for at least 5 out of 8 exposures

× Percent changes were not within one Std. Deviation for at least 4 out of 8 exposures

✓ Zero percent property change was within one Std. Deviation for at least 5 out of 8 exposures

× Zero percent property change was not within one Std. Deviation for at least 4 out of 8 exposures

*B. Temporal Trends*

↑ General increase in percent change

↓ General decrease in percent change

↔ Percent changes were relatively constant

↕ Data exhibited randomness, i.e., no consisitent trends

*C. Thermal Trends*

□ Trends observed with exposure time were consistent between temperatures

■ Trends observed with exposure time were contradicted between temperatures

↔ Percent changes were relatively constant

↕ Data exhibited randomness, i.e., no consisitent trends

↕ Trends observed with exposure time were not consistent between temperatures

000032

706

The results of infrared surface analysis (spectra), presented in Appendix D of this report, did not reveal any indication of surface oxidation of the geomembranes due to exposure to the test leachate. The results in Appendix D support the conclusion that the immersion in the test leachate did not measurably affect the five candidate 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 crack 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.

## 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 crack tests indicate that the geomembranes have different stress crack resistance, as discussed in Section 3.5, when evaluated in accordance with ASTM D 5397. Based on the stress crack 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 effects 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 crack.

## 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.

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.

APPENDIX A

[redacted]

# APPENDIX A

# PERCHED GROUND WATER TEST LEACHATE CHEMICAL ANALYSES

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

# Part I: Summary Tables

# 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.

# 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

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. Gil 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: 4/24/96

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)

706

# 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 | MDC |
|---|---|---|---|---|---|---|---|---|---|
| 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 | 2600 |
| 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 | 0.06 | 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 | 0.33 | 0.17 | 0.18 | 0.29 |
| 200212369 | 96-A3405 | WATER | 0.5 | RADIUM 228 | pCi/L | 5.3 | 4.1 | 4.2 | 6.1 |
| 200212369 | 96-A3405 | WATER | 0.5 | RADIUM 226 | 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: [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 reported
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 | 0.55 | 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 | 36000 | 410 |
| 200212392 | 96-A3406 | WATER | 0.5 | CESIUM 137 | pCi/L | 6.5 | 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. Cl Date: 4/24/96

Concurred by: V. R. Cruz Date: 4-30-5

**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)
E: (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 | 0.66 |
| 200212379 | 96-A3407 | WATER | 0.5 | RADIUM 228 | pCi/L | 0.4 | 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 |

7290 4

12

706

# FEMP WATER SAMPLE COLLECTION LOG

CONTROL NO.: GWM00483 PAGE 2 OF 4

| | | | |
|---|---|---|---|
| [redacted] BADGE NO. 70653 | DATE: 1/30/96 | REVIEWED BY NAME: [redacted] BADGE NO. 18174 | DATE: 2/21/96 |
| PROJECT NAME: PDZ | | PROJECT NO. / RIFS WBS NO.: 26.03.11 | CHARGE NO.: 26D3 |

| | | |
|---|---|---|
| SAMPLE TEAM LEAD NAME: [redacted] BADGE NO.: 70653 | SAMPLE COLLECTION TEAM MEMBER NAMES: [redacted] BADGE NO.: 70656 | SAMPLE LOCATION: CLARIFIER F27 DRUMS S-39 |
| SAMPLING TEAM LETTER: D | N/A | |

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 | 200212343 - 52 |
| | | 200212356 |
| 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 | VARI STALTIC |
| 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

| TOTAL DEPTH (ft) | − | WATER LEVEL (ft) | = | WATER COLUMN (ft) | N/A (gal/ft) | = | 1 PURGE VOLUME (gal) | × 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 LEVEL (ft):
SCREEN LENGTH (ft):

WATER QUALITY DATA

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

MICRO-PURGE VOLUME: ☐ (gal.) ☐ (mL) 000057

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

FORM I[illegible]-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: [signature] (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.

FORM F[illegible]-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. |

000059

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

Concurred by: Date: 3/21/96

QC Check of Subcontractor Submissions by: Date:

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



002

FERMCO TOTAL ANALYSIS
93FM-10033

| | | | |
|---|---|---|---|
| TCT SAMPLE NUMBER - | 9602006-12A | REPORT DATE - | 02/29/96 |
| FERMCO SITE ID - | 20021236 | 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) | ASLB Val Qual | DATE ANALYZED |
|---|---|---|---|---|---|
| 9020A | TOX | 5 | 611 | J | 02/09/96 |

3/2/96

000060 3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

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

000061 3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

| | | | |
|---|---|---|---|
| TCT SAMPLE NUMBER - | 9602005-16A | 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 | Result CONC UG/L | ASL By | DATE ANALYZED |
|---|---|---|---|---|---|
| 420.2 | PHENOLS | 5 | 5.6 | — | 02/07/96 |

3/24/96

0000092-3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

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 |

3/21/96

3/14/96

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 | J | 02/09/96 | 1:5 dil |
| 120.1 | CONDUCTIVITY (uMHOS/cm) | – | 3720 | – | 02/21/96 | |

3/21/96

000064

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

| | | | |
|---|---|---|---|
| TCT SAMPLE NUMBER - | 9602005-19A | REPORT DATE - | 02/29/96 |
| FERMCO SITE ID - | 200212368 | 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 | 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

| | | | |
|---|---|---|---|
| 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 | 4 | ND | 02/09/96 |

3/21/96

000066

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

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 | Results Vol Ad | ASLB | CONC (MG/L) | DATE ANALYZED |
|---|---|---|---|---|---|---|
| 9060 | TOC | 1 | 4 | | ND | 02/23/96 |

3/21/96

000067

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 Val Qual | CONC (UG/L) | DATE ANALYZED |
|---|---|---|---|---|---|
| 420.2 | PHENOLS | 5 | U | ND | 02/07/96 |

3/21/96

000068

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

| | | | |
|---|---|---|---|
| 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

000009 3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

| | | | |
|---|---|---|---|
| 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 | | 02/21/96 |

3/24/96



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 | Results CONC | 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

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER - 9602005-02A
FERMCO SITE ID - 200212384
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) Result | ASLB | DATE ANALYZED |
|---|---|---|---|---|---|
| 9020A | TOX | 5 | 417 | J | 02/09/96 |

3/21/96

000072

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

| | | | |
|---|---|---|---|
| TCT SAMPLE NUMBER - | 9602005-03A | REPORT DATE - | 02/29/96 |
| FERMCO SITE ID - | 200212385 | 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 |
|---|---|---|---|---|---|
| 9060 | TOC | 1 | 9.68 | J | 02/23/96 |

3/21/96



3/14/96

FERMCC 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 Val Qual | DATE ANALYZED |
|---|---|---|---|---|---|
| 420.2 | PHENOLS | 5 | 8.8 | — | 02/07/96 |

3/4/96



3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

| | | | |
|---|---|---|---|
| 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 | Result Validation ASLB | CONC (MG/L) | DATE ANALYZED |
|---|---|---|---|---|---|
| 376.1 | SULFIDES | 1 | U | ND | 02/06/96 |

3/4/96



3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

| | | | |
|---|---|---|---|
| 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

000076 3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER - 9602005-09A
FERMCO SITE ID - 200212391
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 | Results CONC | ASLB | 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



3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

| | | | |
|---|---|---|---|
| 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 | 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



3/14/96

FERMCO QC ANALYSIS
93FM-10033

| | | | |
|---|---|---|---|
| TCT SAMPLE NUMBER - | 9602005-12A | REPORT DATE - | 02/29/96 |
| FERMCO SITE ID - | 200212861 | 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

000079

3/14/96

field dup of 706
212384

FERMCO TOTAL ANALYSIS
93PM-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

000080 3/14/96

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 |

3/21/96

000081

3/14/96

field dup of 212390706

PERMCO TOTAL ANALYSIS
93PM-10033

| | | | |
|---|---|---|---|
| TCT SAMPLE NUMBER - | 9602005-18A | REPORT DATE - | 02/29/96 |
| PERMCO 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 | 980 | 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 | 2.98 | 02/09/96 | 1:5 dil |
| 120.1 | CONDUCTIVITY (uMHOS/cm) | - | 3720 | 02/21/96 | |

3/14/96

000082

3/14/96

field dup of 212361 706

FERMCO TOTAL ANALYSIS
99FM-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) | DATE ANALYZED |
|---|---|---|---|---|
| 9020A | TOX | 5 | 417 | 02/09/96 |

3/2/96

000083

jr 3/14/96

field dup of 212362

706

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

000084

3/14/96

field dup of 212367

706

FERMCO TOTAL ANALYSIS
93FM-10033

| | | | |
|---|---|---|---|
| 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 | |

000085

3/21/96

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.
(When Necessary - Initial & Date.) They all begin with "2000".
Perched Water Clarifier Pit

| 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. |

980086

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.



902

FORM FS-F-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.
(When Necessary - They all begin with "2000".
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. |

000087

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.



902

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

ASLC Val. Check

| 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 | U |
| 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

ENVIROFORMS/INORGANIC CLP

706
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 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 | 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:

DPB 3/15/96

FORM I - IN

000089

pr 3/13/96

706

SAMPLE NO.

212387

ENVIROFORMS/INORGANIC CLP

1

# INORGANIC ANALYSIS DATA SHEET

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. Check

| CAS No. | Analyte | Concentration | C | Q | M | |
|---|---|---|---|---|---|---|
| 7429-90-5 | Aluminum | 485 | | * | P | |
| 7440-36-0 | Antimony | 4.0 | U | N | P | |
| 7440-38-2 | Arsenic | 9.7 | B | | P | |
| 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 | |
| 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 | | N* | 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

3/13/96

FORM I - IN

# 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 | 1.0 | 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 | | | | | | | | | | | |

3/13/96

3/15/96

FORM III - IN

3/13/96

ENVIROFORMS/INORGANIC CLP

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



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 706

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

field dup of 706
212364

ENVIROFORMS/INORGANIC CLP

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

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 |

960096

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

Concurred by:  Date: 3/27/96

QC Check of Subcontractor Deliverable by: n/a  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.

902

# 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.

706

1A
# VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212360

Lab Name: TC~~P~~-ST. LOUIS Contract: 434286

Lab Code: TC~~P~~ 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 | A2C |
|---|---|---|---|---|
| 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 | 10U |
| 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 | 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 | 90 | | 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

3/27/96

3/27/96 AA

000098

16

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

3/16/96



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: TCE 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 | 21.99 | 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

3/16/96



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 5/20/96 AT |
| 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 | |
| 75-25-2 | 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 | N |



3/7/96
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 | ASLC |
|---|---|---|---|---|
| 1330-20-7 | Xylene (total) | 50 | U | Z |

FORM I VOA-2 3/90 Rev

3/16/96

000102 3/14/96 MK

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 | 10U |
| 67-64-1 | Acetone | 32 | B | U |
| 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 | 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-[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 | ASLC |
|---|---|---|---|---|
| 1330-20-7 | Xylene (total) | 10 | U | U |

FORM I VOA-2 3/90 Rev

DPS 3/18/96

3/14/96 AA

706

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 3/18/96

3/14/96 AA

706

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 | | |
| 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 | 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-[illegible] | 2-Hexanone | 10 | U | U |
| 127-[illegible] | Tetrachloroethene | 75 | | |
| 79-[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

000106

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

000107 3/14/96 AA

706

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

3/16/96

000108 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 | 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 | 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 | Z |
| 79-01-6 | Trichloroethene | 530 | | Z 3/20/5 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 | 72 | | |
| 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

3/14/96 MA

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

000110 3/14/96 MA

706

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

3/18/96

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 | |
| 75-01-4 | Vinyl chloride | 10 | U | |
| 75-00-3 | Chloroethane | 10 | U | U |
| 75-09-2 | Methylene Chloride | 2 | BJ | 10U |
| 67-64-1 | Acetone | 60 | B | U |
| 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 | 6 | J | 5J |
| 71-55-6 | 1,1,1-Trichloroethane | 10 | U | 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 | |
| 591-7[illegible] | 2-Hexanone | 10 | U | |
| 127-1[illegible] | Tetrachloroethene | 10 | U | |
| 79-3[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 | U |

FORM I VOA 3/90 Rev

3/16/96

3/18/96 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: 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

3/18/96

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 | 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 | U |



3/27/96



3/27/96

1C
# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212363

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: 2005-14A

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 | AS2C |
|---|---|---|---|---|
| 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 | UJ |
| 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 |

1F

# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
## TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212363

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: 2005-14A

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

FORM I SV-TIC 3/90 Rev

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: TCL-ST. LOUIS Contract: 434286

Lab Code: TCL 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 | UJ |
| 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 |



3/27/96



3/27/96

1F
# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
## TENTATIVELY IDENTIFIED COMPOUNDS

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 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

3/22/96

3/22/96

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 |



3/27/96

3/20/96

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

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 | 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]-8 | Di-n-octylphthalate | 20 | U | U |
| 205-[illegible]-2 | Benzo(b)fluoranthene | 20 | U | |
| 207-[illegible]-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 | U |



3/22/96

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 | JBN |
| 2. | 563804 | 3-Methyl-2-butanone | 5.12 | 15 | JBN |
| 3. | 1569502 | 3-Penten-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
RR
JN
JN
R
AW 3-11-96

FORM I SV-TIC 3/90 Rev

3/27/96
3/27/96 KP

213383
706

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

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

3/14/96

3/14/96 RTX

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

3/18/96

3/18/96 AA

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 | ASLC |
|---|---|---|---|---|
| 1330-20-7 | Xylene (total) | 50 | U | Z |

FORM I VOA-2 3/90 Rev

3/15/96

000127 3/14/96 MK

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
J

MW 3.1.96

FORM I VOA-TIC 3/90 Rev

3/15/96

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 | |
| 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 | 10U |
| 67-64-1 | Acetone | 32 | 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 | | |
| 71-55-6 | 1,1,1-Trichloroethane | 1 | 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 | 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

3/15/96

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

3/14/96

3/14/96 AA

706

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

000131

57

1A
# VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO. 706

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

893 3/18/96

3/19/96 AA

706

EPA SAMPLE NO.

VBLK3682

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: 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

3/19/96 KK

000134

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 |



3/18/96

3/14/96

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

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

000137

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 | 0U |
| 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 3/20 |
| 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 | 90 | | |
| 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 | |

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

000139 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

ASLC

| 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

3/14/96

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 |
| 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[redacted] | Bromoform | 50 | U | |
| 108-[redacted] | 4-Methyl-2-pentanone | 50 | U | |
| 591-[redacted] | 2-Hexanone | 50 | U | |
| 127-[redacted] | Tetrachloroethene | 66 | | |
| 79-3[redacted] | 1,1,2,2-Tetrachloroethane | 50 | U | |
| 108-[redacted] | 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

Z

FORM I VOA-2 3/90 Rev

3/16/96

3/14/96 MK

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 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 | 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

3/18/96

0001 13/14/96 KA

1A-2
# VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212370

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: 02005-20A

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

3/14/96 AA

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 | 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

7/18/96

000146  8/14/96 KA

1A-2
# VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212383

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: >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 |
|---|---|---|---|
| 1330-20-7 | Xylene (total) | 10 | U |

ASLC

FORM I VOA-2 3/90 Rev

3/18/96

0001 178 | 4/96

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212383

Lab Name: TCT-ST. LOUIS Contract: 434286

Lab Code: TCP 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

3/18/96
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 3/20/96 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 | |
| 108-[illegible] | 4-Methyl-2-pentanone | 50 | U | |
| 591-[illegible] | 2-Hexanone | 50 | U | |
| 12[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 |



3/14/96

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 MA

706

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

3/14/96

0001513

1B
# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212386

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: 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 | |
| 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 |



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

| 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 | U |
| 56-[illegible] | Benzo(a)anthracene | 20 | U | U |
| 21[illegible] | Chrysene | 20 | U | U |
| 1[illegible] | bis(2-Ethylhexyl)phthalate | 5 | J | BOU |
| 1[illegible] | Di-n-octylphthalate | 20 | U | 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 | U |



3/27/96

3/21/96

706
212373
212363

6B

# SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: TCF-ST.LOUIS Contract: 434286

Lab Code: TCF 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 |
| Acenaph[illegible] | * | 2.047 | 1.837 | 1.686 | 1.515 | 1.422 | 1.701 | 14.7* |
| 2,6-Din[illegible]ene | * | .387 | .387 | .383 | .372 | .343 | .374 | 5.0* |
| 3-Nitro[illegible] | | .452 | .440 | .460 | .470 | .457 | .456 | 2.4 |
| Acenaph[illegible] | * | 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

3/27/96

000154

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-Penten-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. | | | | | |

AW 3-11-96

FORM I SV-TIC 3/90 Rev

3/27/96

706
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-d6 | 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 3/24/96

3/21/96 AM

000156

6B

# SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

212336

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

3/22/96

3/21/96

706
212386

7C

# SEMIVOLATILE CONTINUING CALIBRATION CHECK

Lab Name: TCP-ST.LOUIS Contract: 434286

Lab Code: TCP 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 |
| Nit[illegible]zene-d5 | .502 | .494 | .200 | 1.5 | 25.0 |
| 2-[illegible]phenyl | 1.434 | 1.467 | .700 | 2.3 | 25.0 |
| Te[illegible]-d14 | 1.193 | 1.240 | .500 | 3.9 | 25.0 |
| Phe[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

000138 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 ([redacted]) = D10 PHENANTHRENE
IS5 ([redacted]) = D12 CHRYSENE
IS6 ([redacted]) = D12 PERYLENE

AREA [redacted] LIMIT = +100% of internal standard area
AREA LO[redacted] 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] | bis(2-Ethylhexyl)phthalate | 4 | J |
| 1[illegible] | Di-n-octylphthalate | 20 | U |
| 20[illegible] | Benzo(b)fluoranthene | 20 | U |
| 20[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

000161 3/21/96

1B
# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

212363 MSD

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: 2005-14A

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

000162 3/21/96

1C

# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

212363 MSD

Lab Name: [redacted]-ST. LOUIS Contract: 434286

Lab Code: [redacted] 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 |
| [redacted] | Chrysene | 20 | U |
| [redacted] | bis(2-Ethylhexyl)phthalate | 5 | J |
| [redacted] | Di-n-octylphthalate | 20 | U |
| [redacted] | Benzo(b)fluoranthene | 20 | U |
| [redacted] | Benzo(k)fluoranthene | 20 | U |
| [redacted] | 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

000163 3/21/96

1B
# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212363

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: 2005-14A

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 | 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 | U |



3/27/96



3/21/96

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 | UJ |
| 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 | UJ |
| 126-73-8 | Tributylphosphate | 6 | J | UJ |
| 534-52-1 | 4,6-Dinitro-2-methylphenol | 50 | U | UJ |
| 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 | UJ |
| 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 | UJ |
| 129-00-0 | Pyrene | 20 | U | UJ |
| 85-68-7 | Butylbenzylphthalate | 20 | U | |
| 91-[illegible] | 3,3'-Dichlorobenzidine | 20 | U | |
| 56-[illegible] | Benzo(a)anthracene | 20 | U | |
| 218-[illegible] | Chrysene | 20 | U | UJ |
| 117-[illegible] | Bis(2-Ethylhexyl)phthalate | 5 | J | 20UJ |
| 117-[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 |



3/27/96



3/21/96

706

1F

# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
## TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212363

Lab Name: TCS-ST.LOUIS Contract: 434286

Lab Code: TCS 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. | 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

SW 3/27/96

000166 3/21/96 MM

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[illegible]-2 | 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

1C

# SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field 6/9 1C
212373

Lab Name: [redacted]. LOUIS  Contract: 434286

Lab Code: TCS  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 | U J |
| 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 | |
| [redacted] | 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 | J |
| [redacted] | Di-n-octylphthalate | 20 | U | U |
| [redacted] | Benzo(b)fluoranthene | 20 | U | U J |
| 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 |

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. | | | | |



3/27/96

 3/27/96

APPENDIX B

# APPENDIX B

# GEOMEMBRANE/LEACHATE USEPA METHOD 9090 COMPATIBILITY TEST RESULTS

# 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.

### 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.

## 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 following observations were made regarding the percent change in mass of the five geomembranes.

GSE-SLT Geomembrane. The means of percent property changes showed variations of less than 0.02% for all exposures. The line of zero percent property change was within one standard deviation for all exposures except the 120-day exposure at 23°C, and the 60-day and the 120-day exposures at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

NSC Geomembrane. The means of percent property changes showed variations of less than 0.1% for all exposures. The line of zero percent property change was within one standard deviation for all exposures except the 60-day, the 90-day, and the 120-day exposures at 23°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

GSE-Gundle Geomembrane. The means of percent property changes showed variations of less than 0.2% for all exposures. The line of zero percent property change was within one standard deviation for the 60-day and the 90-day exposures at 23°C, and the 90-day and the 120-day exposures at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

PolyFlex Geomembrane. The means of percent property changes showed variations of less than 0.1% for all exposures. The line of zero percent property

change was within one standard deviation for all exposures except the 120-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

Serrot Geomembrane. The means of percent property changes showed variations of less than 0.05% for all exposures. The line of zero percent property change was within one standard deviation for all exposures except the 120-day exposure at 23°C, and the 60-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

*Conclusion*

The test leachate caused mean percent changes in thickness of less than 0.2%, for all the five geomembranes tested. No detrimental effects on the integrity of the geomembrane are expected due to the small change in the tested property. Furthermore, none of the five geomembranes exhibited a consistent trend for the changes in property with exposure time or temperature.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

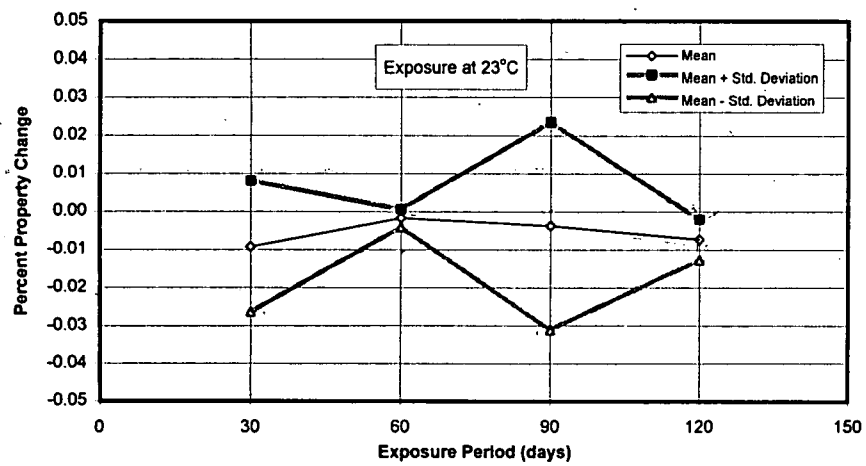
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

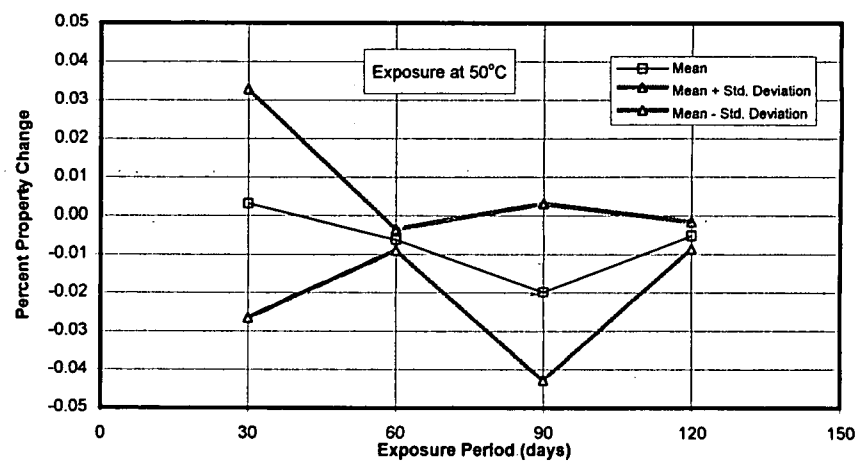
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* GSE-SLT
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** MASS (g)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 75.947 | 75.931 | -0.021 | 72.461 | 72.460 | -0.001 | 69.566 | 69.570 | 0.006 | 69.273 | 69.270 | -0.004 |
| | 72.647 | 72.631 | -0.022 | 70.489 | 70.490 | 0.001 | 69.510 | 69.480 | -0.043 | 74.430 | 74.421 | -0.012 |
| | 73.561 | 73.572 | 0.015 | 74.023 | 74.021 | -0.003 | 75.512 | 75.514 | 0.003 | 70.047 | 70.039 | -0.011 |
| | 69.024 | 69.018 | -0.009 | 74.587 | 74.584 | -0.004 | 75.482 | 75.497 | 0.020 | 76.114 | 76.113 | -0.001 |
| Mean of Percent Property Change= | | | -0.009 | | | -0.002 | | | -0.004 | | | -0.007 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.017 | | | 0.002 | | | 0.027 | | | 0.005 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | No |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 73.831 | 73.828 | -0.004 | 69.071 | 69.069 | -0.003 | 77.905 | 77.896 | -0.012 | 72.218 | 72.211 | -0.010 |
| | 68.102 | 68.081 | -0.031 | 70.186 | 70.181 | -0.007 | 73.896 | 73.856 | -0.054 | 73.849 | 73.846 | -0.004 |
| | 75.878 | 75.909 | 0.041 | 74.787 | 74.780 | -0.009 | 73.677 | 73.673 | -0.005 | 75.305 | 75.304 | -0.001 |
| | 74.003 | 74.008 | 0.007 | 74.815 | 74.811 | -0.005 | 72.268 | 72.262 | -0.008 | 73.552 | 73.548 | -0.005 |
| Mean of Percent Property Change= | | | 0.003 | | | -0.006 | | | -0.020 | | | -0.005 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.030 | | | 0.003 | | | 0.023 | | | 0.003 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | Yes | | | No |




000275

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

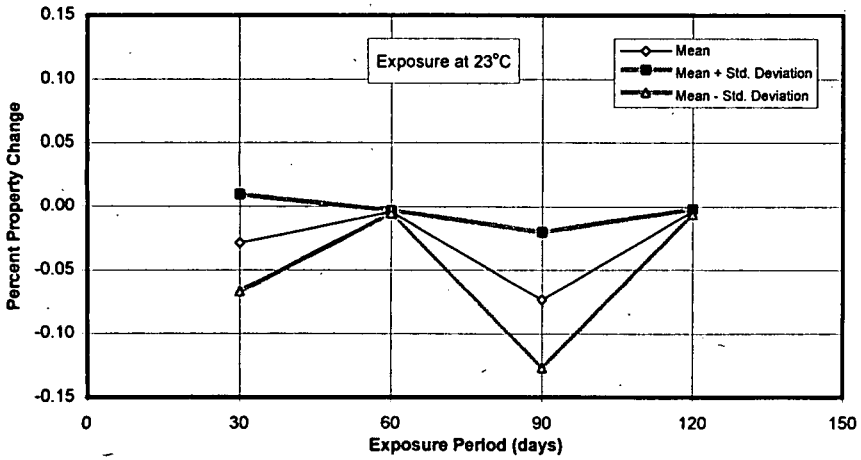
*CLIENT:* *FERMCO*
*METHOD:* *EPA 9090*
*DATE TESTED:* *6/14/96*

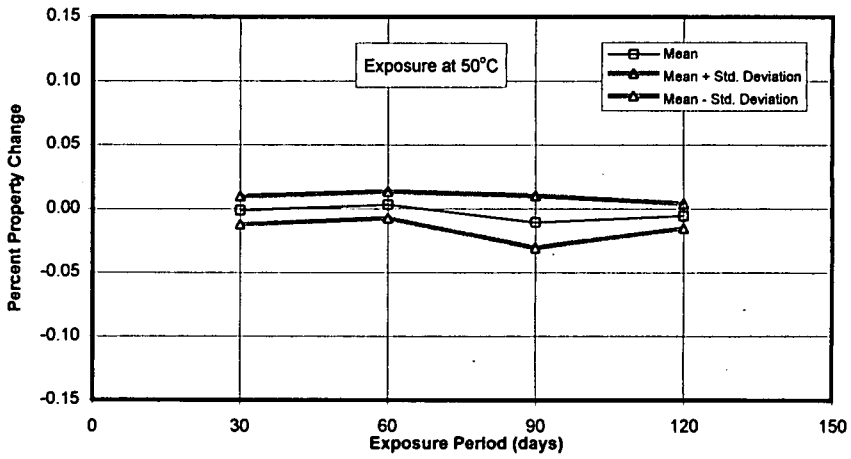
*GEOSYNTEC JOB NO.:* *GE3900*
*MATERIAL TYPE:* *NSC*
*CHARACTERISTICS:* *80 mil HDPE Geomembrane*
*IMMERSION MEDIUM:* *Perched Ground Water*

**PROPERTY (UNIT):** MASS (g)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 72.048 | 72.044 | -0.006 | 71.864 | 71.861 | -0.004 | 69.579 | 69.504 | -0.108 | 68.476 | 68.475 | -0.001 |
| | 72.081 | 72.020 | -0.085 | 70.455 | 70.453 | -0.003 | 70.595 | 70.516 | -0.112 | 70.193 | 70.189 | -0.006 |
| | 72.319 | 72.303 | -0.022 | 69.797 | 69.793 | -0.006 | 65.710 | 65.712 | 0.003 | 73.113 | 73.111 | -0.003 |
| | 75.815 | 75.813 | -0.003 | 68.980 | 68.977 | -0.004 | 67.218 | 67.166 | -0.077 | 72.732 | 72.728 | -0.005 |
| Mean of Percent Property Change= | | | -0.029 | | | -0.004 | | | -0.074 | | | -0.004 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.038 | | | 0.001 | | | 0.053 | | | 0.002 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | No | | | No |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 72.413 | 72.406 | -0.010 | 75.350 | 75.351 | 0.001 | 70.751 | 70.723 | -0.040 | 71.077 | 71.069 | -0.011 |
| | 73.417 | 73.425 | 0.011 | 68.194 | 68.187 | -0.010 | 69.972 | 69.976 | 0.006 | 71.092 | 71.083 | -0.013 |
| | 71.530 | 71.534 | 0.006 | 67.902 | 67.908 | 0.009 | 70.610 | 70.604 | -0.008 | 70.405 | 70.401 | -0.006 |
| | 71.542 | 71.534 | -0.011 | 74.401 | 74.411 | 0.013 | 68.916 | 68.917 | 0.001 | 72.300 | 72.306 | 0.008 |
| Mean of Percent Property Change= | | | -0.001 | | | 0.003 | | | -0.010 | | | -0.005 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.011 | | | 0.010 | | | 0.020 | | | 0.010 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

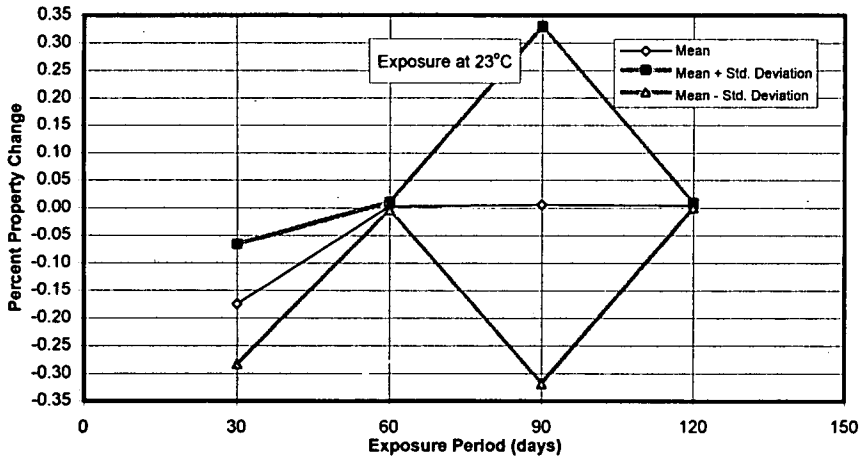
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

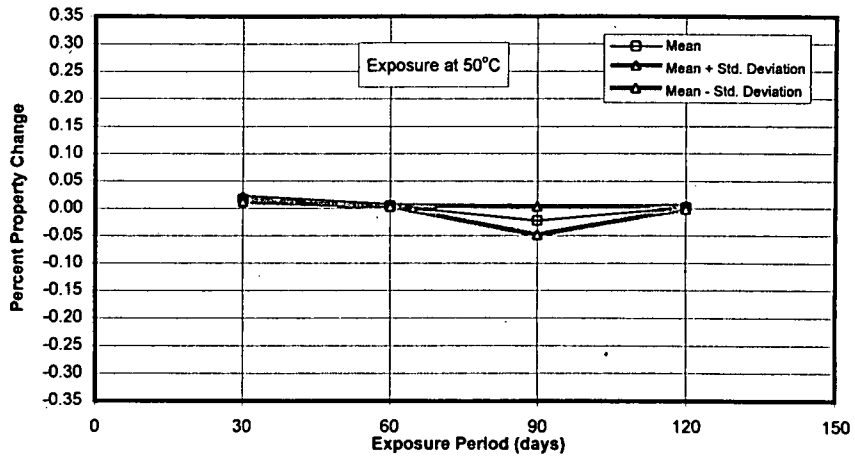
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* GSE Gundle
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** MASS (g)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 72.928 | 72.813 | -0.158 | 73.959 | 73.963 | 0.005 | 70.317 | 70.309 | -0.011 | 71.879 | 71.881 | 0.003 |
| | 74.068 | 73.883 | -0.250 | 72.121 | 72.128 | 0.010 | 73.171 | 73.156 | -0.020 | 72.613 | 72.621 | 0.011 |
| | 74.691 | 74.495 | -0.262 | 75.313 | 75.317 | 0.005 | 73.165 | 72.896 | -0.368 | 73.126 | 73.128 | 0.003 |
| | 72.556 | 72.536 | -0.028 | 69.839 | 69.834 | -0.007 | 73.146 | 73.456 | 0.424 | 72.162 | 72.163 | 0.001 |
| Mean of Percent Property Change= | | | -0.174 | | | 0.003 | | | 0.006 | | | 0.004 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.108 | | | 0.007 | | | 0.324 | | | 0.004 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | No |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 70.117 | 70.133 | 0.023 | 66.909 | 66.911 | 0.003 | 67.288 | 67.286 | -0.003 | 68.190 | 68.193 | 0.004 |
| | 62.572 | 62.583 | 0.018 | 67.512 | 67.515 | 0.004 | 68.599 | 68.589 | -0.015 | 68.288 | 68.288 | 0.000 |
| | 67.462 | 67.472 | 0.015 | 67.438 | 67.441 | 0.004 | 69.478 | 69.436 | -0.060 | 68.535 | 68.534 | -0.001 |
| | 68.682 | 68.691 | 0.013 | 66.744 | 66.748 | 0.006 | 68.217 | 68.209 | -0.012 | 68.738 | 68.741 | 0.004 |
| Mean of Percent Property Change= | | | 0.017 | | | 0.004 | | | -0.022 | | | 0.002 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.004 | | | 0.001 | | | 0.026 | | | 0.003 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | No | | | Yes | | | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

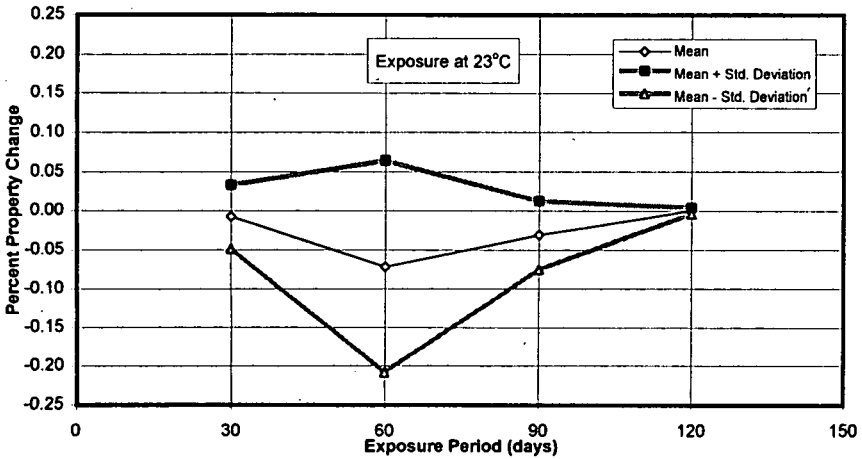
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

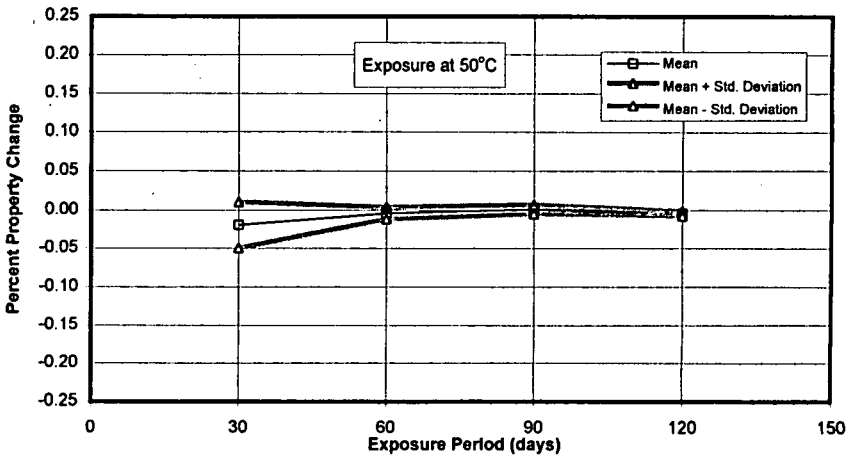
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* POLYFLEX
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** MASS (g)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 67.907 | 67.943 | 0.053 | 71.507 | 71.310 | -0.275 | 65.341 | 65.306 | -0.054 | 62.166 | 62.168 | 0.003 |
| | 67.981 | 67.969 | -0.018 | 69.878 | 69.871 | -0.010 | 61.190 | 61.140 | -0.082 | 63.443 | 63.446 | 0.005 |
| | 71.173 | 71.151 | -0.031 | 63.638 | 63.639 | 0.002 | 62.823 | 62.824 | 0.002 | 64.489 | 64.487 | -0.003 |
| | 65.862 | 65.839 | -0.035 | 70.311 | 70.309 | -0.003 | 63.045 | 63.051 | 0.010 | 60.383 | 60.381 | -0.003 |
| Mean of Percent Property Change= | | | -0.008 | | | -0.072 | | | -0.031 | | | 0.000 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.041 | | | 0.136 | | | 0.044 | | | 0.004 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 65.176 | 65.188 | 0.018 | 70.092 | 70.091 | -0.001 | 61.770 | 61.771 | 0.002 | 65.994 | 65.989 | -0.008 |
| | 64.892 | 64.874 | -0.028 | 66.598 | 66.590 | -0.012 | 62.958 | 62.954 | -0.006 | 67.848 | 67.847 | -0.001 |
| | 63.074 | 63.065 | -0.014 | 68.305 | 68.309 | 0.006 | 62.474 | 62.479 | 0.008 | 67.829 | 67.825 | -0.006 |
| | 66.548 | 66.512 | -0.054 | 65.096 | 65.091 | -0.008 | 61.451 | 61.452 | 0.002 | 69.372 | 69.370 | -0.003 |
| Mean of Percent Property Change= | | | -0.019 | | | -0.004 | | | 0.001 | | | -0.004 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.030 | | | 0.008 | | | 0.006 | | | 0.003 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | No |




000178

906

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

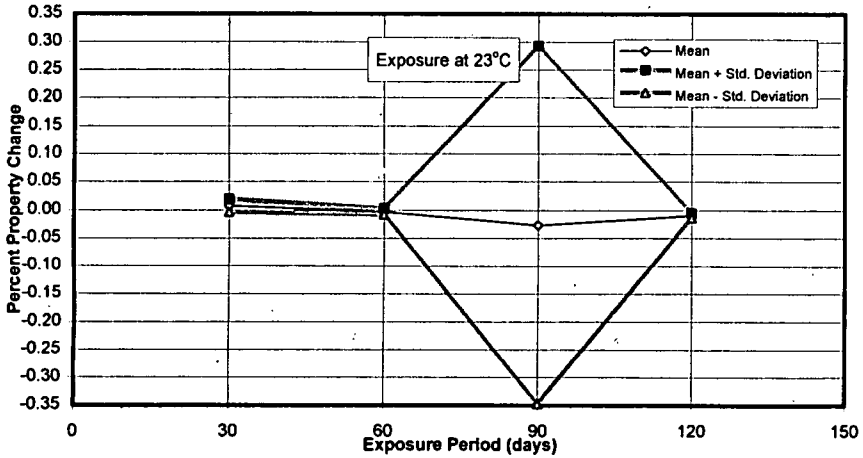
*CLIENT:* *FERMCO*
*METHOD:* *EPA 9090*
*DATE TESTED:* *6/14/96*

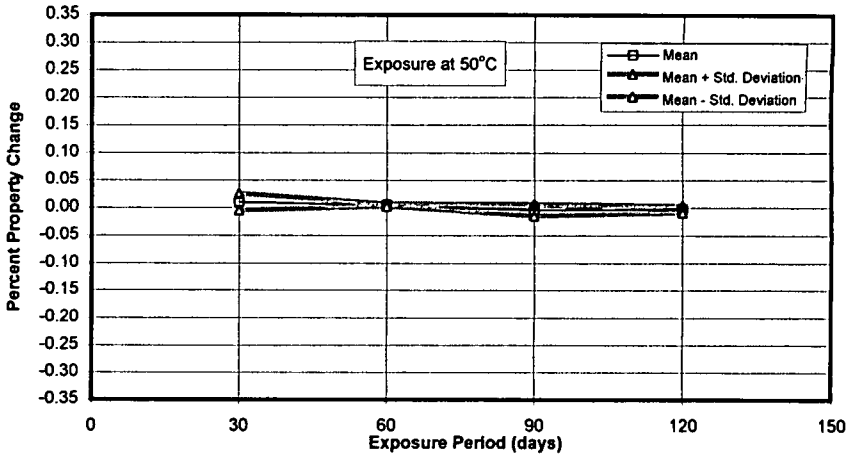
*GEOSYNTEC JOB NO.:* *GE3900*
*MATERIAL TYPE:* *SERROT*
*CHARACTERISTICS:* *80 mil HDPE Geomembrane*
*IMMERSION MEDIUM:* *Perched Ground Water*

**PROPERTY (UNIT):** MASS (g)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 70.285 | 70.302 | 0.024 | 68.739 | 68.741 | 0.003 | 69.361 | 69.348 | -0.019 | 67.596 | 67.590 | -0.009 |
| | 69.309 | 69.313 | 0.006 | 69.747 | 69.741 | -0.009 | 70.004 | 70.245 | 0.344 | 69.035 | 69.028 | -0.010 |
| | 69.543 | 69.543 | 0.000 | 69.998 | 69.998 | 0.000 | 70.267 | 69.960 | -0.437 | 69.892 | 69.889 | -0.004 |
| | 71.467 | 71.468 | 0.001 | 72.173 | 72.169 | -0.006 | 68.929 | 68.931 | 0.003 | 67.841 | 67.832 | -0.013 |
| Mean of Percent Property Change= | | | 0.008 | | | -0.003 | | | -0.027 | | | -0.009 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.011 | | | 0.005 | | | 0.320 | | | 0.004 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | No |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 68.602 | 68.620 | 0.026 | 69.539 | 69.541 | 0.003 | 68.608 | 68.608 | 0.000 | 67.428 | 67.421 | -0.010 |
| | 70.004 | 70.012 | 0.011 | 69.367 | 69.369 | 0.003 | 68.949 | 68.937 | -0.017 | 66.243 | 66.240 | -0.005 |
| | 70.556 | 70.565 | 0.013 | 68.970 | 68.975 | 0.007 | 69.485 | 69.481 | -0.006 | 67.346 | 67.347 | 0.001 |
| | 68.981 | 68.974 | -0.010 | 69.456 | 69.460 | 0.006 | 67.731 | 67.736 | 0.007 | 66.446 | 66.448 | 0.003 |
| Mean of Percent Property Change= | | | 0.010 | | | 0.005 | | | -0.004 | | | -0.003 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.015 | | | 0.002 | | | 0.010 | | | 0.006 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | Yes | | | Yes |



2.2 THICKNESS

## 2.2 Thickness

*Rationale for Test*

Similar 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*

The following observations were made regarding the percent change in thickness of the five geomembranes.

GSE-SLT Geomembrane. The means of percent property changes showed variations of less than 1% for all exposure periods. The line of zero percent property change was within one standard deviation for all the exposure periods except the 60-day and the 90-day exposures at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

NSC Geomembrane. The means of percent property changes showed variations of less than 1% for all exposure periods. The line of zero percent property change was within one standard deviation for all the exposure periods except the 30-day and the 90-day exposures at 23°C, and 30-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

GSE-Gundle Geomembrane. The means of percent property changes showed variations of less than 0.5% for all exposure periods. The line of zero percent property change was within one standard deviation for all the exposure periods except the 60-day exposure at 23°C, and the 120-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

PolyFlex Geomembrane. The means of percent property changes showed variations of less than 2% for all exposure periods. The line of zero percent property change was within one standard deviation for all the exposure periods except the 120-day exposure at 23°C, and the 30-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

Serrot Geomembrane. The means of percent property changes showed variations of less than 0.5% for all exposure periods. The line of zero percent property change was within one standard deviation for all the exposure except the 120-day exposure at 23°C, and the 30-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

*Conclusion*

The test leachate caused mean percent changes in thickness of less than 2%, for all the five geomembranes tested. No detrimental effects on the integrity of the geomembrane are expected due to the small change in the tested property. Furthermore, none of the five geomembranes exhibited a consistent trend for the changes in property with exposure time or temperature.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

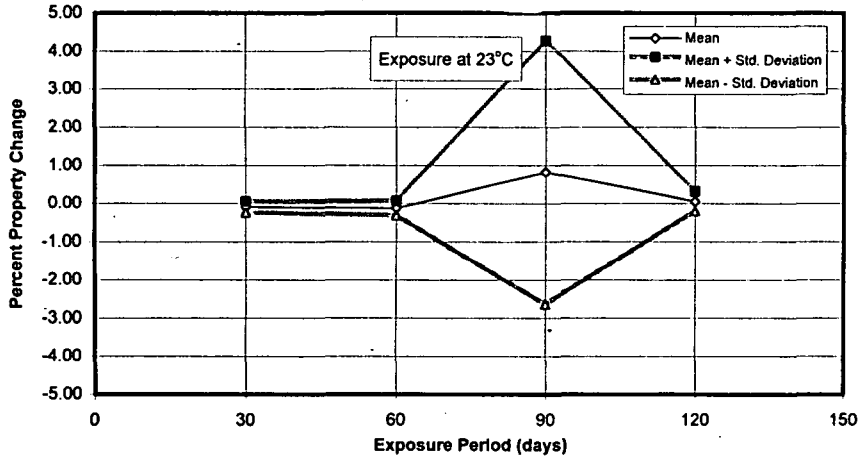
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

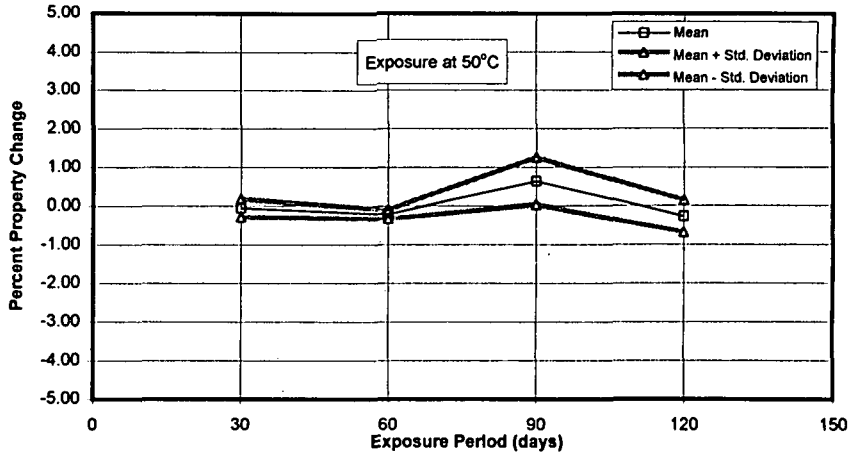
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* GSE-SLT
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** THICKNESS (mil)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 86.900 | 86.700 | -0.230 | 82.800 | 82.900 | 0.121 | 78.100 | 80.600 | 3.201 | 79.400 | 79.500 | 0.126 |
| | 86.400 | 86.300 | -0.116 | 79.900 | 79.800 | -0.125 | 79.000 | 82.000 | 3.797 | 83.900 | 83.900 | 0.000 |
| | 84.100 | 84.200 | 0.119 | 82.500 | 82.400 | -0.121 | 83.900 | 83.900 | 0.000 | 80.200 | 80.000 | -0.249 |
| | 77.900 | 77.800 | -0.128 | 84.800 | 84.500 | -0.354 | 83.500 | 80.400 | -3.713 | 86.000 | 86.300 | 0.349 |
| Mean of Percent Property Change= | | | -0.089 | | | -0.120 | | | 0.821 | | | 0.056 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.148 | | | 0.194 | | | 3.452 | | | 0.250 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 83.000 | 83.100 | 0.120 | 77.500 | 77.400 | -0.129 | 87.200 | 88.400 | 1.376 | 81.700 | 81.600 | -0.122 |
| | 78.400 | 78.500 | 0.128 | 77.700 | 77.500 | -0.257 | 83.000 | 83.600 | 0.723 | 84.100 | 84.300 | 0.238 |
| | 85.200 | 85.100 | -0.117 | 84.400 | 84.100 | -0.355 | 82.700 | 83.200 | 0.605 | 83.400 | 83.000 | -0.480 |
| | 82.300 | 82.000 | -0.365 | 83.900 | 83.800 | -0.119 | 80.700 | 80.600 | -0.124 | 83.600 | 83.000 | -0.718 |
| Mean of Percent Property Change= | | | -0.058 | | | -0.215 | | | 0.645 | | | -0.270 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.234 | | | 0.113 | | | 0.615 | | | 0.418 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | No | | | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

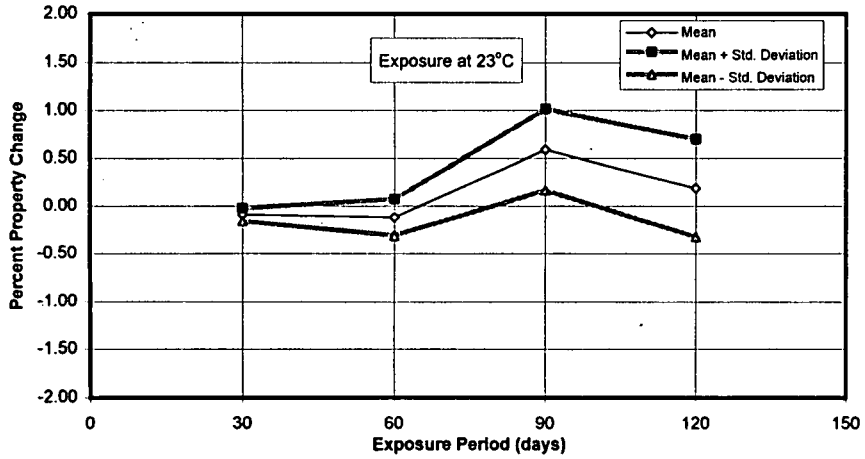
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

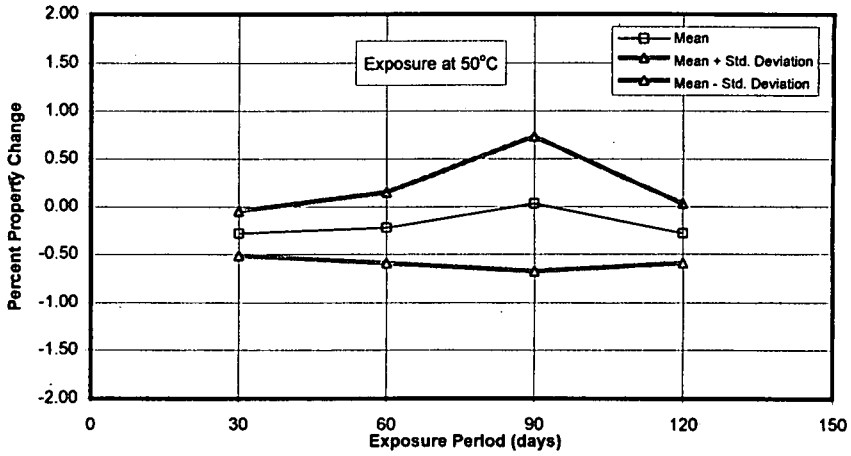
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* NSC
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** THICKNESS (mil)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 80.700 | 80.600 | -0.124 | 82.800 | 82.900 | 0.121 | 80.800 | 81.000 | 0.248 | 80.800 | 80.500 | -0.371 |
| | 80.600 | 80.500 | -0.124 | 79.900 | 79.800 | -0.125 | 81.000 | 81.200 | 0.247 | 79.600 | 79.500 | -0.126 |
| | 80.400 | 80.300 | -0.124 | 82.500 | 82.400 | -0.121 | 79.600 | 80.200 | 0.754 | 79.500 | 80.000 | 0.629 |
| | 80.000 | 80.010 | 0.013 | 84.800 | 84.500 | -0.354 | 80.400 | 81.300 | 1.119 | 80.500 | 81.000 | 0.621 |
| Mean of Percent Property Change= | | | -0.090 | | | -0.120 | | | 0.592 | | | 0.188 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.068 | | | 0.194 | | | 0.425 | | | 0.514 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | No | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 79.900 | 79.800 | -0.125 | 79.400 | 79.100 | -0.378 | 81.500 | 81.900 | 0.491 | 80.500 | 80.000 | -0.621 |
| | 81.600 | 81.500 | -0.123 | 81.000 | 81.200 | 0.247 | 80.200 | 80.600 | 0.499 | 80.200 | 80.000 | -0.249 |
| | 79.800 | 79.600 | -0.251 | 80.800 | 80.300 | -0.619 | 80.800 | 80.000 | -0.990 | 80.400 | 80.500 | 0.124 |
| | 80.900 | 80.400 | -0.618 | 80.600 | 80.500 | -0.124 | 80.700 | 80.800 | 0.124 | 81.300 | 81.000 | -0.369 |
| Mean of Percent Property Change= | | | -0.279 | | | -0.218 | | | 0.031 | | | -0.279 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.234 | | | 0.370 | | | 0.703 | | | 0.310 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

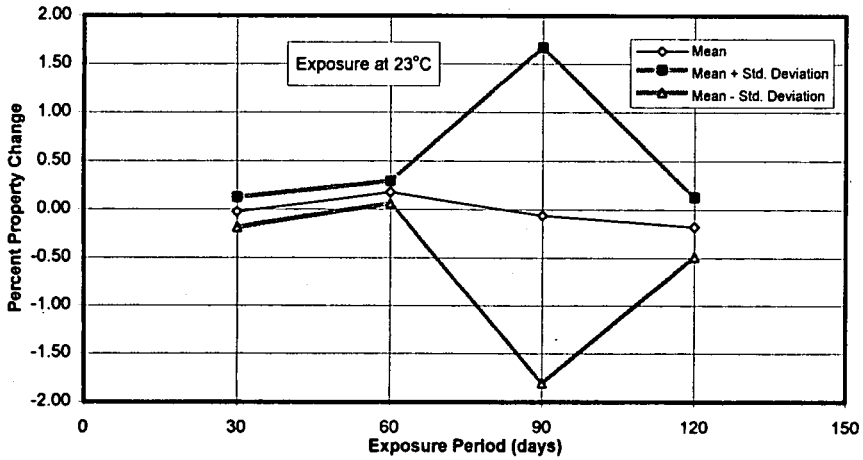
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

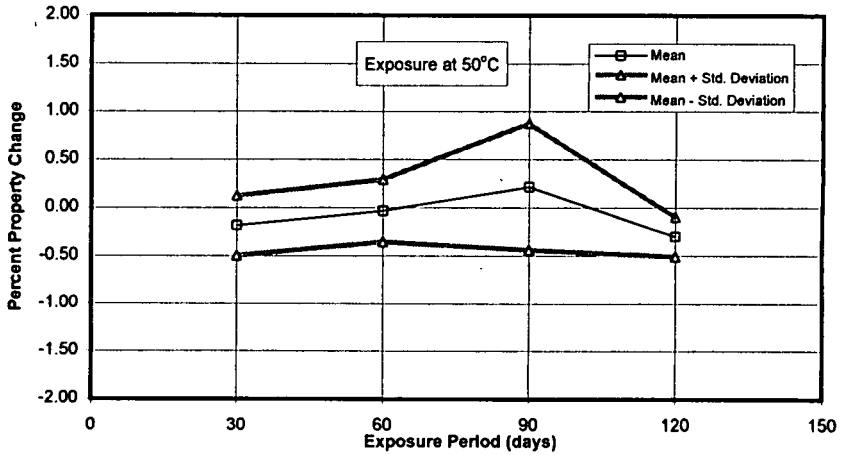
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* GSE Gundle
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** THICKNESS (mil)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 80.500 | 80.600 | 0.124 | 86.800 | 86.900 | 0.115 | 78.500 | 79.700 | 1.529 | 82.400 | 82.500 | 0.121 |
| | 80.900 | 80.900 | 0.000 | 80.400 | 80.500 | 0.124 | 81.700 | 82.200 | 0.612 | 82.500 | 82.000 | -0.606 |
| | 80.600 | 80.600 | 0.000 | 85.300 | 85.600 | 0.352 | 83.200 | 81.100 | -2.524 | 84.600 | 84.500 | -0.118 |
| | 81.900 | 81.700 | -0.244 | 83.600 | 83.700 | 0.120 | 82.400 | 82.500 | 0.121 | 83.100 | 83.000 | -0.120 |
| Mean of Percent Property Change= | | | -0.030 | | | 0.178 | | | -0.066 | | | -0.181 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.154 | | | 0.116 | | | 1.740 | | | 0.305 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 80.900 | 80.400 | -0.618 | 79.900 | 79.900 | 0.000 | 79.800 | 80.600 | 1.003 | 82.100 | 82.000 | -0.122 |
| | 80.100 | 80.200 | 0.125 | 80.900 | 80.500 | -0.494 | 81.700 | 81.300 | -0.490 | 82.900 | 82.500 | -0.483 |
| | 79.400 | 79.300 | -0.126 | 77.400 | 77.500 | 0.129 | 83.500 | 83.900 | 0.479 | 83.100 | 83.000 | -0.120 |
| | 78.900 | 78.800 | -0.127 | 80.400 | 80.600 | 0.249 | 82.300 | 82.200 | -0.122 | 83.700 | 83.300 | -0.478 |
| Mean of Percent Property Change= | | | -0.186 | | | -0.029 | | | 0.218 | | | -0.301 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.311 | | | 0.326 | | | 0.658 | | | 0.207 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

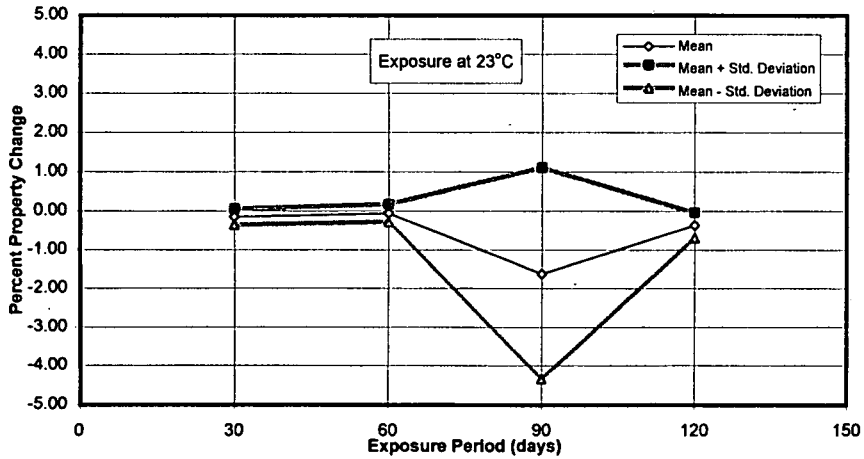
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

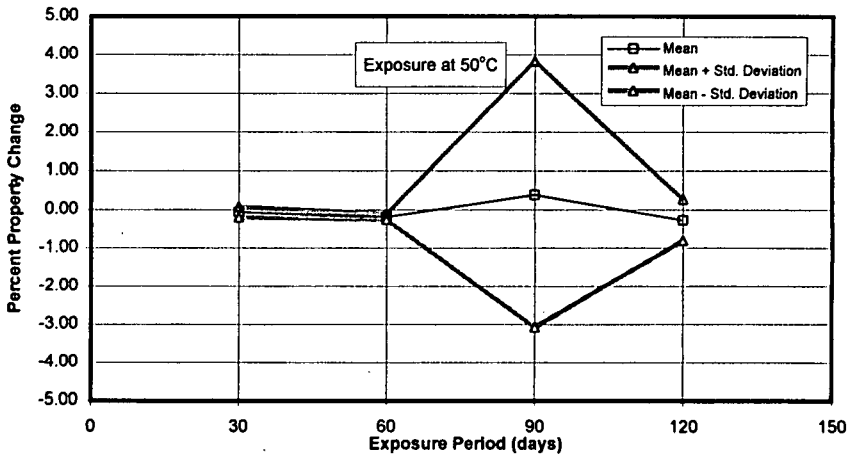
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* POLYFLEX
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** THICKNESS (mil)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 76.400 | 76.500 | 0.131 | 80.100 | 80.000 | -0.125 | 80.200 | 76.000 | -5.237 | 75.000 | 75.000 | 0.000 |
| | 81.500 | 81.300 | -0.245 | 80.400 | 80.200 | -0.249 | 71.700 | 70.200 | -2.092 | 76.300 | 76.100 | -0.262 |
| | 83.400 | 83.100 | -0.360 | 73.200 | 73.400 | 0.273 | 70.100 | 70.800 | 0.999 | 76.600 | 76.000 | -0.783 |
| | 83.300 | 83.200 | -0.120 | 86.300 | 86.200 | -0.116 | 71.400 | 71.300 | -0.140 | 75.300 | 75.000 | -0.398 |
| Mean of Percent Property Change= | | | -0.149 | | | -0.054 | | | -1.618 | | | -0.361 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.210 | | | 0.226 | | | 2.730 | | | 0.327 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | No |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 75.300 | 75.200 | -0.133 | 86.700 | 86.500 | -0.231 | 70.900 | 73.400 | 3.526 | 75.600 | 75.000 | -0.794 |
| | 72.700 | 72.600 | -0.138 | 77.800 | 77.600 | -0.257 | 75.200 | 77.400 | 2.926 | 77.800 | 77.500 | -0.386 |
| | 73.700 | 73.800 | 0.136 | 78.300 | 78.200 | -0.128 | 75.900 | 75.000 | -1.186 | 75.900 | 75.600 | -0.395 |
| | 81.100 | 81.000 | -0.123 | 80.900 | 80.800 | -0.124 | 75.000 | 72.200 | -3.733 | 81.200 | 81.600 | 0.493 |
| Mean of Percent Property Change= | | | -0.064 | | | -0.185 | | | 0.383 | | | -0.270 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.134 | | | 0.069 | | | 3.452 | | | 0.543 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | Yes | | | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

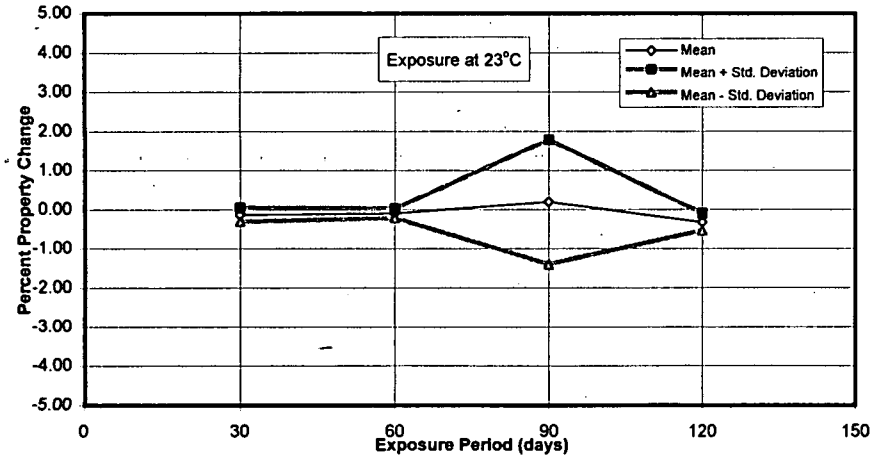
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

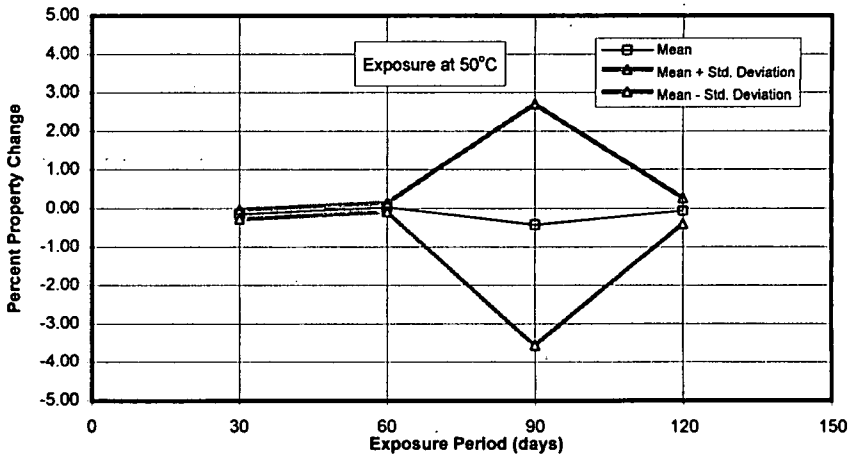
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* SERROT
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** THICKNESS (mil)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 79.700 | 79.800 | 0.125 | 81.100 | 81.100 | 0.000 | 80.900 | 81.500 | 0.742 | 80.900 | 80.500 | -0.494 |
| | 79.500 | 79.400 | -0.126 | 82.300 | 82.300 | 0.000 | 82.200 | 80.900 | -1.582 | 81.100 | 81.000 | -0.123 |
| | 80.200 | 80.000 | -0.249 | 81.500 | 81.400 | -0.123 | 82.400 | 82.000 | -0.485 | 82.400 | 82.300 | -0.121 |
| | 81.600 | 81.400 | -0.245 | 83.300 | 83.100 | -0.240 | 80.700 | 82.400 | 2.107 | 79.900 | 79.500 | -0.501 |
| Mean of Percent Property Change= | | | -0.124 | | | -0.091 | | | 0.195 | | | -0.310 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.176 | | | 0.115 | | | 1.589 | | | 0.217 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | No |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 79.900 | 79.800 | -0.125 | 81.100 | 81.100 | 0.000 | 81.300 | 80.300 | -1.230 | 78.000 | 78.000 | 0.000 |
| | 80.600 | 80.400 | -0.248 | 81.100 | 81.000 | -0.123 | 82.100 | 78.800 | -4.019 | 77.800 | 77.600 | -0.257 |
| | 82.200 | 82.000 | -0.243 | 81.300 | 81.400 | 0.123 | 82.000 | 82.000 | 0.000 | 78.000 | 78.300 | 0.385 |
| | 82.000 | 82.000 | 0.000 | 82.300 | 82.400 | 0.122 | 78.700 | 81.500 | 3.558 | 78.800 | 78.500 | -0.381 |
| Mean of Percent Property Change= | | | -0.154 | | | 0.030 | | | -0.423 | | | -0.063 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.117 | | | 0.118 | | | 3.142 | | | 0.338 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | Yes |




000186

206

## 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*

The following observations were made regarding the percent change in length of the five geomembranes.

GSE-SLT Geomembrane. The means of percent property changes showed variations of less than 0.5% for all exposures. The line of zero percent property change was within one standard deviation for all the exposures except the 30-day exposure at 23°C, and the 30-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

NSC Geomembrane. The means of percent property changes showed variations of less than 0.3% for all exposures. The line of zero percent property change was within one standard deviation for all exposures except the 30-day exposure at 23°C, and the 60-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

GSE-Gundle Geomembrane. The means of percent property changes showed variations of less than 0.1% for all exposures. The line of zero percent property change was within one standard deviation for all exposures except the 90-day and the 120-day exposures at 23°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

PolyFlex Geomembrane. The means of percent property changes showed variations of less than 0.5% for all exposures. The line of zero percent property change was within one standard deviation for all exposures except the 60-day exposure at 23°C, and the 60-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

Serrot Geomembrane. The means of percent property changes showed variations of less than 0.5% for all exposures. The line of zero percent property change was within one standard deviation for all exposures except the 30-day and the 120-day exposures at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

The following observations were made regarding the percent change in width of the five geomembranes.

GSE-SLT Geomembrane. The means of percent property changes showed variations of less than 0.2% for all exposures. The line of zero percent property change was within one standard deviation for all exposures except the 30-day exposure at 23°C, and the 60-day and the 120-day exposures at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

NSC Geomembrane. The means of percent property changes showed variations of less than 0.2% for all exposures. The line of zero percent property change was within one standard deviation for all exposures except the 30-day exposure at 23°C, and the 120-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

GSE-Gundle Geomembrane. The means of percent property changes showed variations of less than 0.1% for all exposures. The line of zero percent property change was within one standard deviation for the 90-day and the 120-day exposures at 23°C, and the 90-day and the 120-day exposures at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

PolyFlex Geomembrane. The means of percent property changes showed variations of less than 0.1% for all exposures. The line of zero percent property change was within one standard deviation for the 30-day and the 90-day exposures at 23°C, and the 30-day and the 60-day exposures at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

Serrot Geomembrane. The means of percent property changes showed variations of less than 0.1% for all exposures. The line of zero percent property change was within one standard deviation for all the exposures except the 60-day exposure at 23°C, and the 30-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

*Conclusion*

The test leachate caused mean percent changes in lengths and widths of less than 0.5%, for all the five geomembranes tested. No detrimental effects on the integrity of the geomembrane are expected due to the small change in the tested properties. Furthermore, none of the five geomembranes exhibited a consistent trend for the changes in properties with exposure time or temperature.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

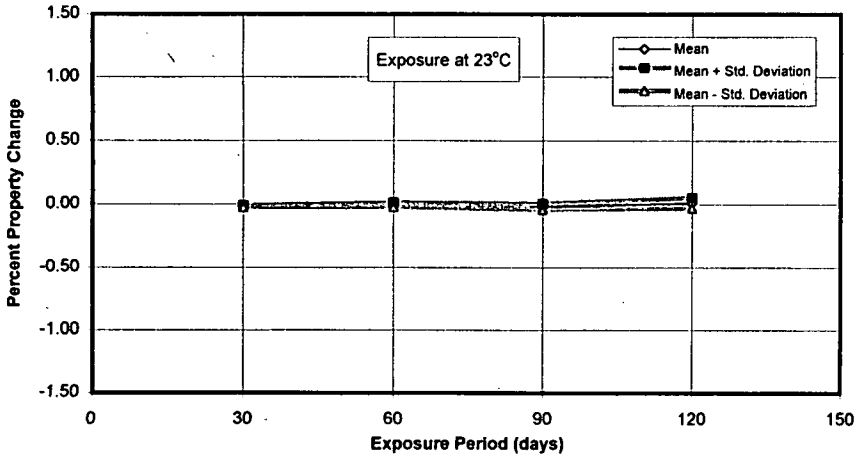
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

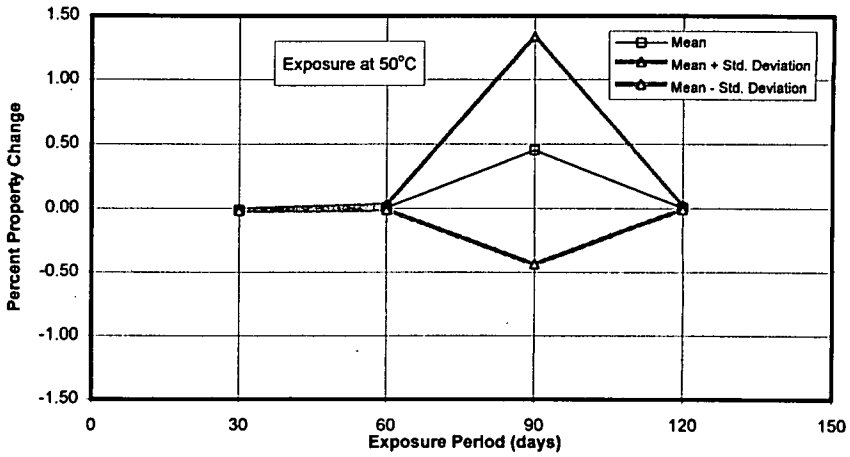
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* GSE-SLT
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** DIMENSIONS (mm)
**DIRECTION:** LENGTH

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 268.400 | 268.380 | -0.007 | 267.350 | 267.310 | -0.015 | 271.640 | 271.600 | -0.015 | 268.710 | 268.680 | -0.011 |
| | 268.780 | 268.720 | -0.022 | 272.040 | 272.090 | 0.018 | 271.200 | 271.190 | -0.004 | 271.040 | 271.210 | 0.063 |
| | 267.350 | 267.300 | -0.019 | 272.750 | 272.710 | -0.015 | 272.460 | 272.320 | -0.051 | 269.650 | 269.720 | 0.026 |
| | 269.690 | 269.640 | -0.019 | 271.370 | 271.350 | -0.007 | 270.900 | 270.880 | -0.007 | 271.470 | 271.390 | -0.029 |
| Mean of Percent Property Change= | | | -0.017 | | | -0.005 | | | -0.019 | | | 0.012 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.006 | | | 0.016 | | | 0.022 | | | 0.041 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 269.660 | 269.620 | -0.015 | 270.120 | 270.150 | 0.011 | 272.300 | 272.300 | 0.000 | 272.590 | 272.580 | -0.004 |
| | 270.960 | 270.910 | -0.018 | 269.000 | 269.040 | 0.015 | 273.190 | 273.290 | 0.037 | 272.340 | 272.380 | 0.015 |
| | 273.650 | 273.610 | -0.015 | 269.060 | 269.120 | 0.022 | 274.300 | 279.180 | 1.779 | 275.530 | 275.510 | -0.007 |
| | 272.160 | 272.130 | -0.011 | 270.660 | 270.610 | -0.018 | 269.490 | 269.460 | -0.011 | 271.040 | 271.100 | 0.022 |
| Mean of Percent Property Change= | | | -0.015 | | | 0.007 | | | 0.451 | | | 0.006 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.003 | | | 0.018 | | | 0.886 | | | 0.014 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | Yes |




0001130

706

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

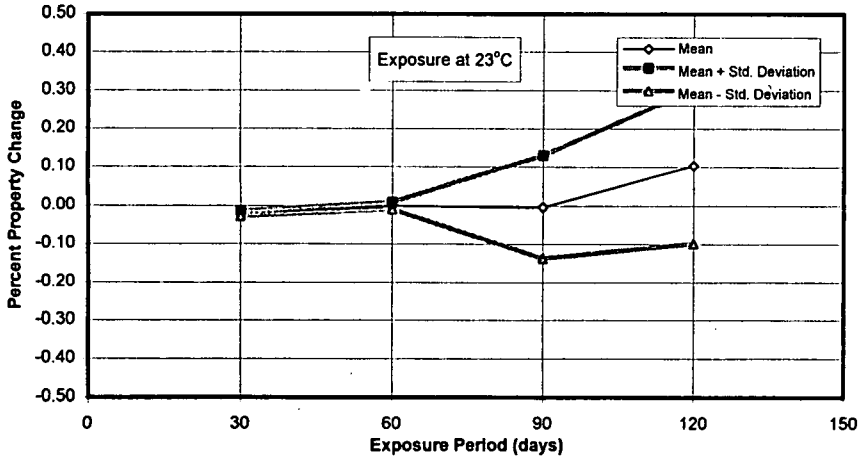
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

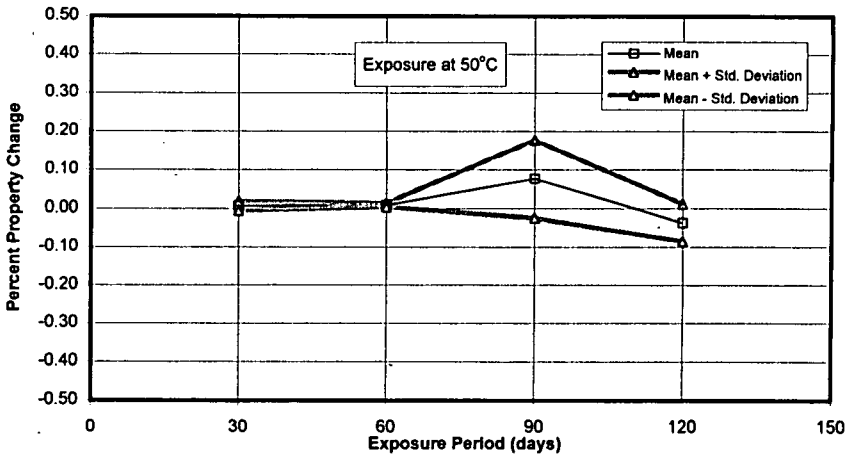
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* NSC
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** DIMENSIONS (mm)
**DIRECTION:** LENGTH

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 267.520 | 267.480 | -0.015 | 264.020 | 264.010 | -0.004 | 270.900 | 270.490 | -0.151 | 270.350 | 270.380 | 0.011 |
| | 267.070 | 267.010 | -0.022 | 273.160 | 273.180 | 0.007 | 276.980 | 276.860 | -0.043 | 276.440 | 276.410 | -0.011 |
| | 267.070 | 267.030 | -0.015 | 266.120 | 266.090 | -0.011 | 269.670 | 270.130 | 0.171 | 276.510 | 276.530 | 0.007 |
| | 267.290 | 267.210 | -0.030 | 273.840 | 273.860 | 0.007 | 273.330 | 273.360 | 0.011 | 271.220 | 272.320 | 0.406 |
| Mean of Percent Property Change= | | | -0.021 | | | 0.000 | | | -0.003 | | | 0.103 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.007 | | | 0.009 | | | 0.134 | | | 0.202 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 274.740 | 274.780 | 0.015 | 280.770 | 280.790 | 0.007 | 276.270 | 276.660 | 0.141 | 269.840 | 269.580 | -0.096 |
| | 267.320 | 267.350 | 0.011 | 268.700 | 268.740 | 0.015 | 272.060 | 272.560 | 0.184 | 273.870 | 273.910 | 0.015 |
| | 263.940 | 263.910 | -0.011 | 272.030 | 272.050 | 0.007 | 271.970 | 271.950 | -0.007 | 272.870 | 272.730 | -0.051 |
| | 269.070 | 269.100 | 0.011 | 270.050 | 270.060 | 0.004 | 269.410 | 269.380 | -0.011 | 275.320 | 275.280 | -0.015 |
| Mean of Percent Property Change= | | | 0.006 | | | 0.008 | | | 0.077 | | | -0.037 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.012 | | | 0.005 | | | 0.101 | | | 0.048 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | Yes | | | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

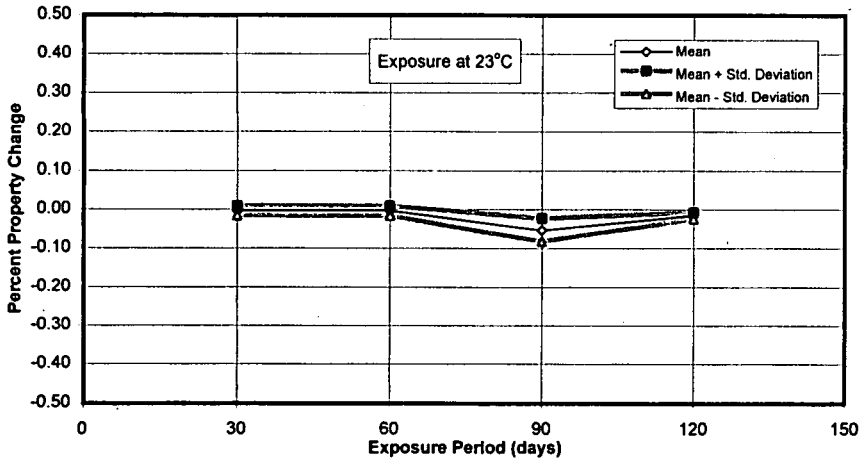
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

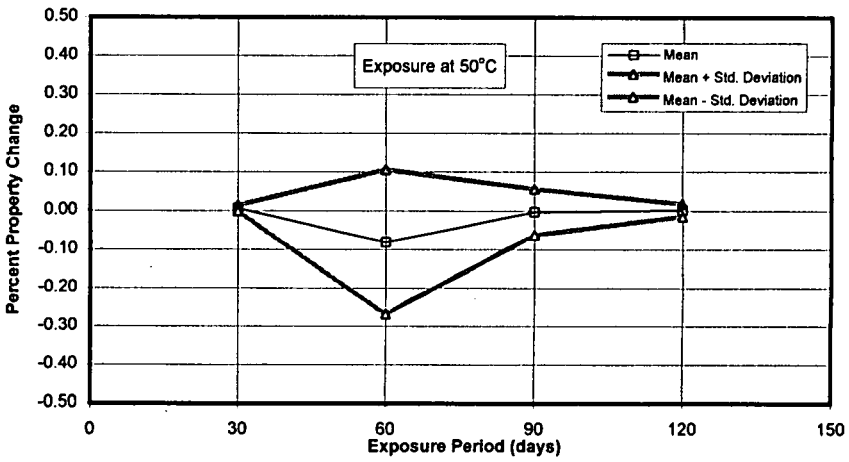
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* GSE Gundle
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** DIMENSIONS (mm)
**DIRECTION:** LENGTH

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 256.960 | 256.980 | 0.008 | 267.520 | 267.540 | 0.007 | 270.200 | 270.170 | -0.011 | 269.320 | 269.280 | -0.015 |
| | 266.280 | 266.300 | 0.008 | 267.480 | 267.500 | 0.007 | 269.460 | 269.240 | -0.082 | 268.120 | 268.100 | -0.007 |
| | 266.740 | 266.700 | -0.015 | 268.730 | 268.710 | -0.007 | 267.870 | 267.720 | -0.056 | 268.960 | 268.890 | -0.026 |
| | 266.840 | 266.810 | -0.011 | 267.460 | 267.410 | -0.019 | 269.070 | 268.910 | -0.059 | 268.820 | 268.790 | -0.011 |
| Mean of Percent Property Change= | | | -0.003 | | | -0.003 | | | -0.052 | | | -0.015 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.012 | | | 0.013 | | | 0.030 | | | 0.008 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | No | | | No |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 267.760 | 267.800 | 0.015 | 265.060 | 265.100 | 0.015 | 266.130 | 266.180 | 0.019 | 268.460 | 268.480 | 0.007 |
| | 266.980 | 266.970 | -0.004 | 266.900 | 266.930 | 0.011 | 268.060 | 268.100 | 0.015 | 267.580 | 267.610 | 0.011 |
| | 268.110 | 268.130 | 0.007 | 266.750 | 266.780 | 0.011 | 268.550 | 268.310 | -0.089 | 267.950 | 267.980 | 0.011 |
| | 267.230 | 267.250 | 0.007 | 266.000 | 265.040 | -0.361 | 268.900 | 269.020 | 0.045 | 266.970 | 266.910 | -0.022 |
| Mean of Percent Property Change= | | | 0.007 | | | -0.081 | | | -0.003 | | | 0.002 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.008 | | | 0.187 | | | 0.059 | | | 0.018 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

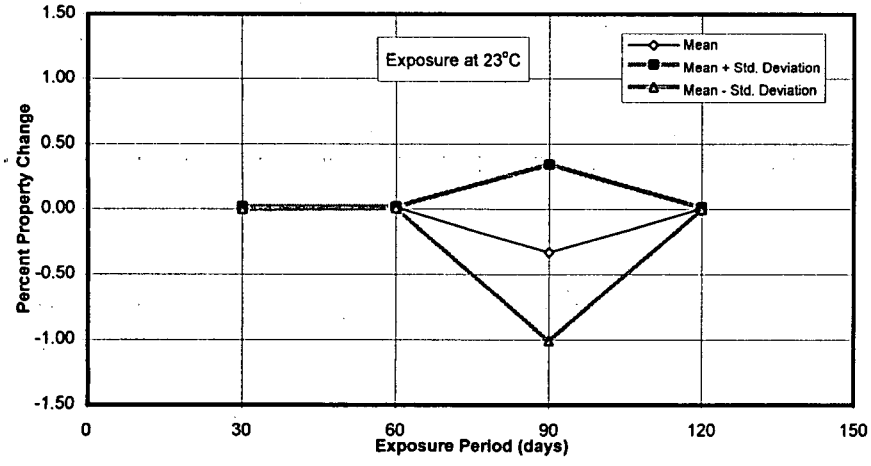
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

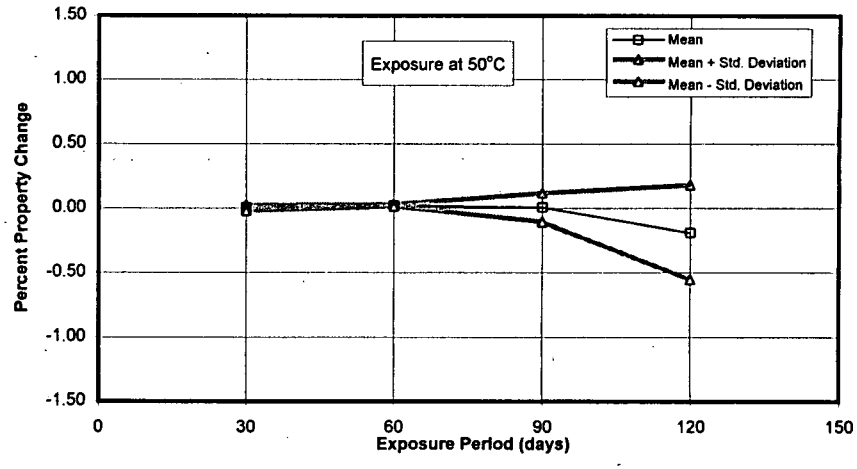
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* POLYFLEX
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** DIMENSIONS (mm)
**DIRECTION:** LENGTH

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 266.590 | 266.580 | -0.004 | 264.000 | 264.010 | 0.004 | 266.450 | 266.240 | -0.079 | 267.910 | 267.930 | 0.007 |
| | 265.870 | 265.910 | 0.015 | 266.670 | 266.710 | 0.015 | 266.710 | 263.140 | -1.339 | 267.910 | 267.940 | 0.011 |
| | 266.650 | 266.670 | 0.008 | 265.650 | 265.690 | 0.015 | 267.590 | 267.600 | 0.004 | 266.760 | 266.780 | 0.007 |
| | 267.350 | 267.390 | 0.015 | 266.270 | 266.310 | 0.015 | 268.770 | 269.000 | 0.086 | 266.760 | 266.740 | -0.007 |
| Mean of Percent Property Change= | | | 0.008 | | | 0.012 | | | -0.332 | | | 0.005 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.009 | | | 0.006 | | | 0.674 | | | 0.008 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 266.060 | 266.080 | 0.008 | 267.890 | 267.930 | 0.015 | 267.410 | 267.810 | 0.150 | 267.920 | 267.900 | -0.007 |
| | 265.040 | 265.100 | 0.023 | 266.040 | 266.110 | 0.026 | 267.160 | 267.120 | -0.015 | 265.840 | 265.600 | -0.015 |
| | 266.990 | 266.980 | -0.004 | 268.100 | 268.140 | 0.015 | 266.670 | 266.690 | 0.007 | 268.120 | 268.150 | -0.735 |
| | 265.380 | 265.310 | -0.026 | 267.420 | 267.480 | 0.022 | 266.670 | 266.350 | -0.120 | 268.120 | 268.150 | 0.011 |
| Mean of Percent Property Change= | | | 0.000 | | | 0.020 | | | 0.006 | | | -0.187 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.021 | | | 0.006 | | | 0.111 | | | 0.366 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | Yes | | | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

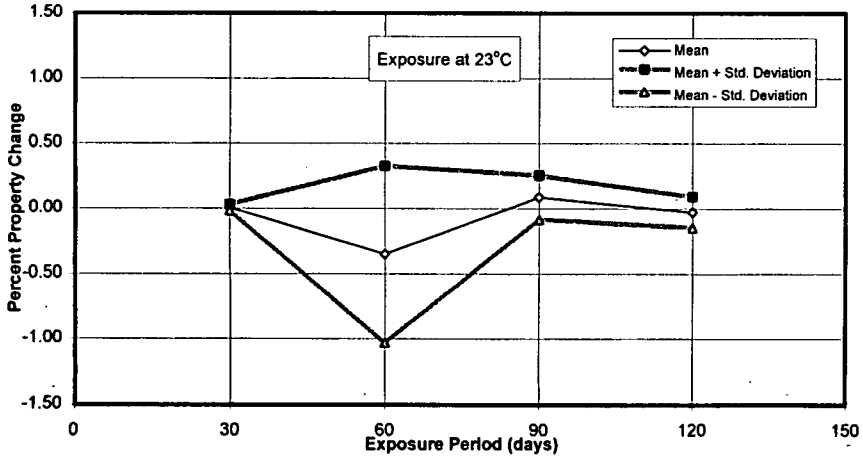
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

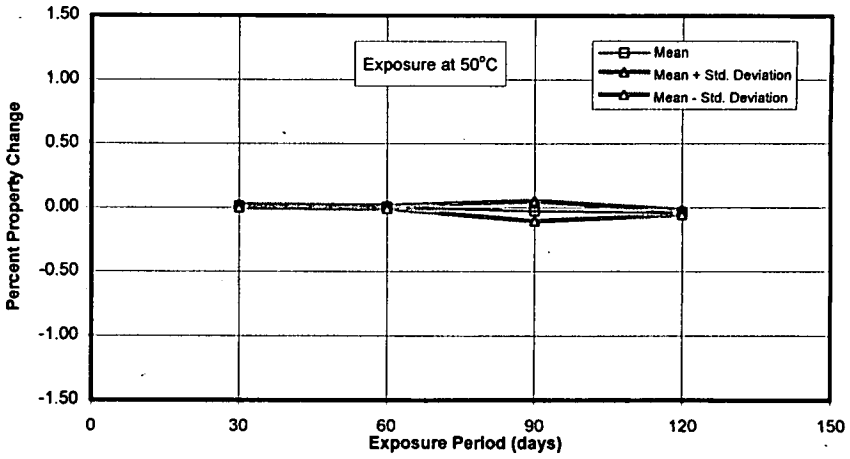
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* SERROT
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** DIMENSIONS (mm)
**DIRECTION:** LENGTH

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 269.730 | 269.710 | -0.007 | 267.970 | 267.980 | 0.004 | 271.090 | 271.460 | 0.136 | 267.050 | 267.110 | 0.022 |
| | 268.890 | 268.840 | -0.019 | 270.190 | 270.140 | -0.019 | 268.260 | 268.990 | 0.272 | 268.830 | 268.890 | 0.022 |
| | 269.050 | 269.110 | 0.022 | 268.690 | 265.010 | -1.370 | 268.260 | 267.900 | -0.134 | 270.660 | 270.110 | -0.203 |
| | 271.900 | 271.980 | 0.029 | 269.600 | 269.540 | -0.022 | 267.800 | 267.980 | 0.067 | 268.320 | 268.460 | 0.052 |
| Mean of Percent Property Change= | | | 0.006 | | | -0.352 | | | 0.085 | | | -0.027 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.023 | | | 0.679 | | | 0.169 | | | 0.119 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 267.780 | 267.790 | 0.004 | 269.600 | 269.580 | -0.007 | 266.790 | 266.420 | -0.139 | 270.480 | 270.410 | -0.026 |
| | 269.060 | 269.070 | 0.004 | 267.480 | 267.520 | 0.015 | 267.920 | 267.980 | 0.022 | 270.660 | 270.490 | -0.063 |
| | 269.360 | 269.410 | 0.019 | 268.160 | 268.150 | -0.004 | 267.080 | 267.040 | -0.015 | 270.770 | 270.680 | -0.033 |
| | 266.830 | 266.890 | 0.022 | 268.140 | 268.160 | 0.007 | 269.180 | 269.250 | 0.026 | 267.970 | 267.910 | -0.022 |
| Mean of Percent Property Change= | | | 0.012 | | | 0.003 | | | -0.026 | | | -0.036 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.010 | | | 0.010 | | | 0.077 | | | 0.018 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

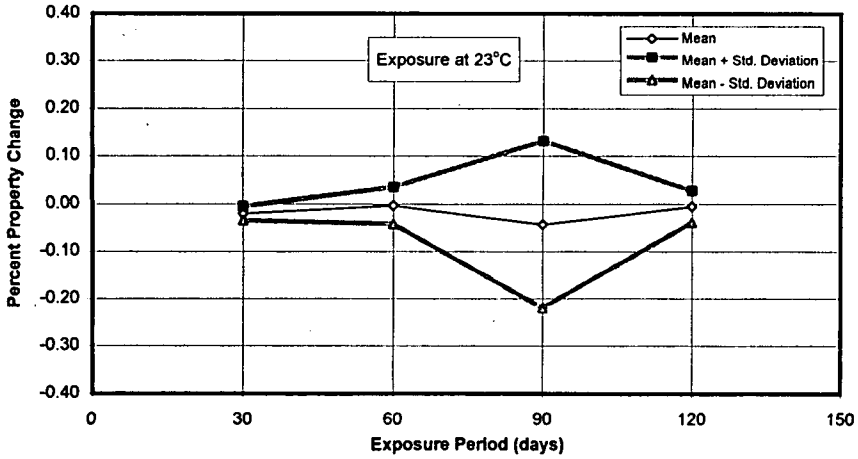
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

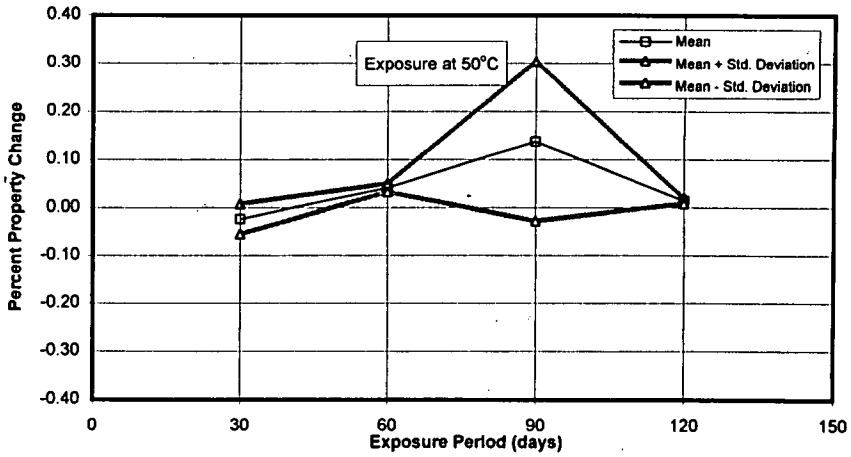
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* GSE-SLT
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** DIMENSIONS (mm)
**DIRECTION:** WIDTH

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 139.420 | 139.380 | -0.029 | 139.260 | 139.200 | -0.043 | 139.350 | 139.540 | 0.136 | 140.340 | 140.310 | -0.021 |
| | 133.410 | 133.400 | -0.007 | 132.950 | 132.980 | 0.023 | 138.940 | 138.840 | -0.072 | 135.860 | 135.820 | -0.029 |
| | 139.260 | 139.210 | -0.036 | 138.260 | 138.310 | 0.036 | 141.390 | 141.440 | 0.035 | 137.620 | 137.680 | 0.044 |
| | 138.220 | 138.210 | -0.007 | 138.230 | 138.190 | -0.029 | 138.840 | 138.460 | -0.274 | 138.730 | 138.710 | -0.014 |
| Mean of Percent Property Change= | | | -0.020 | | | -0.003 | | | -0.043 | | | -0.005 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.015 | | | 0.039 | | | 0.175 | | | 0.033 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 137.810 | 137.800 | -0.007 | 138.710 | 138.750 | 0.029 | 139.150 | 139.410 | 0.187 | 138.460 | 138.490 | 0.022 |
| | 136.510 | 136.520 | 0.007 | 140.540 | 140.610 | 0.050 | 137.670 | 137.550 | -0.087 | 137.900 | 137.920 | 0.015 |
| | 139.490 | 139.400 | -0.065 | 137.220 | 137.280 | 0.044 | 139.290 | 139.720 | 0.309 | 138.670 | 138.680 | 0.007 |
| | 138.750 | 138.710 | -0.029 | 138.850 | 138.910 | 0.043 | 139.000 | 139.200 | 0.144 | 139.890 | 139.910 | 0.014 |
| Mean of Percent Property Change= | | | -0.023 | | | 0.041 | | | 0.138 | | | 0.014 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.031 | | | 0.009 | | | 0.166 | | | 0.008 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | Yes | | | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

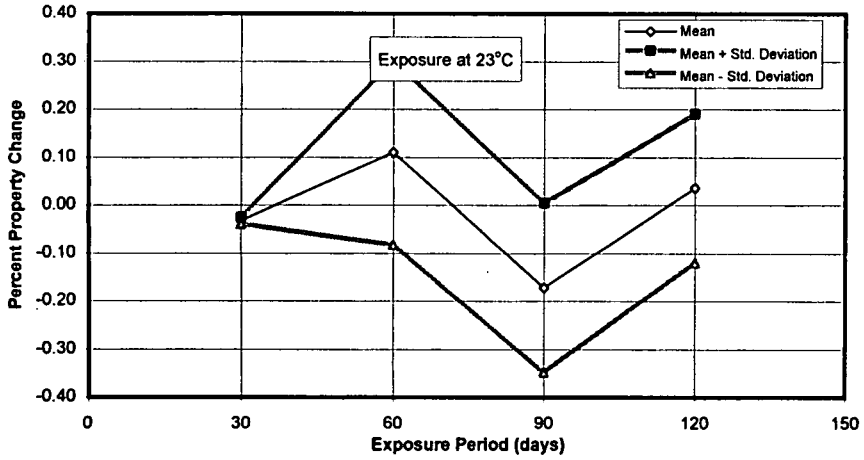
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

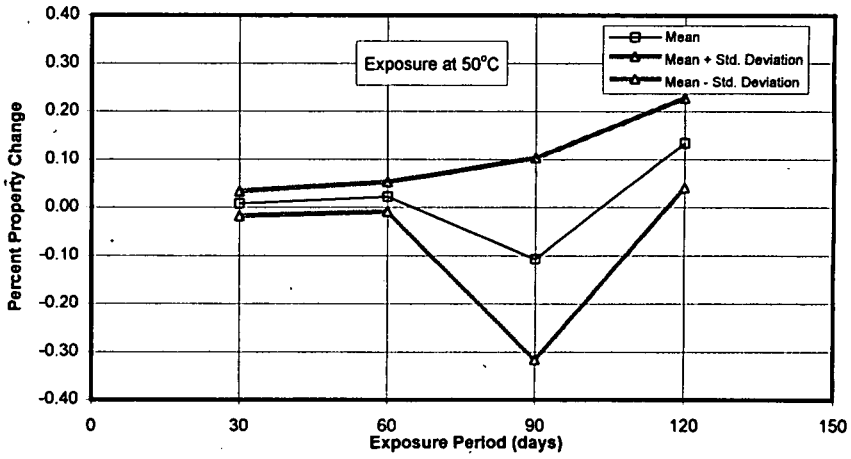
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* NSC
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** DIMENSIONS (mm)
**DIRECTION:** WIDTH

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 141.150 | 141.110 | -0.028 | 141.100 | 141.080 | -0.014 | 135.280 | 135.300 | 0.015 | 132.800 | 132.860 | 0.045 |
| | 141.560 | 141.520 | -0.028 | 131.170 | 131.690 | 0.396 | 131.840 | 131.680 | -0.121 | 145.270 | 145.600 | 0.227 |
| | 144.260 | 144.200 | -0.042 | 136.060 | 136.090 | 0.022 | 127.940 | 127.420 | -0.406 | 141.650 | 141.680 | 0.021 |
| | 140.050 | 140.010 | -0.029 | 132.700 | 132.750 | 0.038 | 128.340 | 128.120 | -0.171 | 138.500 | 138.290 | -0.152 |
| Mean of Percent Property Change= | | | -0.032 | | | 0.110 | | | -0.171 | | | 0.035 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.007 | | | 0.192 | | | 0.176 | | | 0.155 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 141.920 | 141.900 | -0.014 | 140.000 | 140.090 | 0.064 | 133.290 | 133.080 | -0.158 | 140.010 | 140.210 | 0.143 |
| | 143.700 | 143.680 | -0.014 | 132.000 | 132.010 | 0.008 | 134.570 | 134.080 | -0.364 | 135.480 | 135.490 | 0.007 |
| | 139.010 | 139.060 | 0.036 | 131.200 | 131.230 | 0.023 | 133.700 | 133.650 | -0.037 | 133.300 | 133.610 | 0.233 |
| | 133.900 | 133.930 | 0.022 | 144.040 | 144.030 | -0.007 | 134.000 | 134.180 | 0.134 | 136.000 | 136.210 | 0.154 |
| Mean of Percent Property Change= | | | 0.008 | | | 0.022 | | | -0.106 | | | 0.134 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.026 | | | 0.031 | | | 0.210 | | | 0.094 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | No |




000195

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

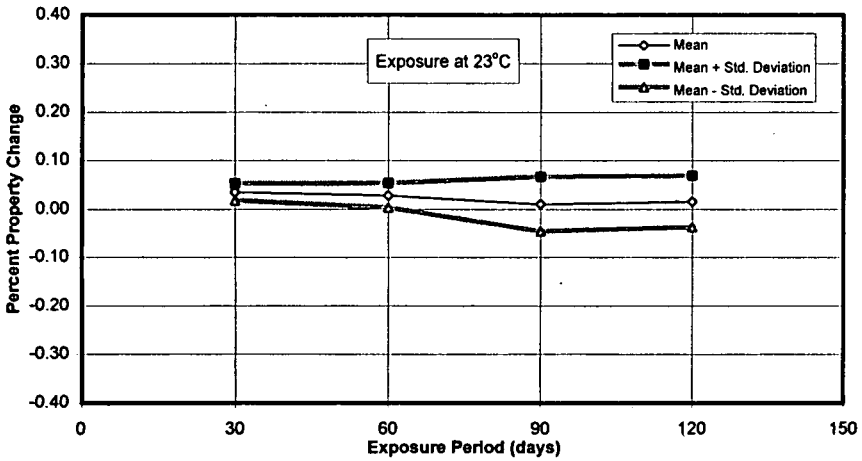
*CLIENT:* *FERMCO*
*METHOD:* *EPA 9090*
*DATE TESTED:* *6/14/96*

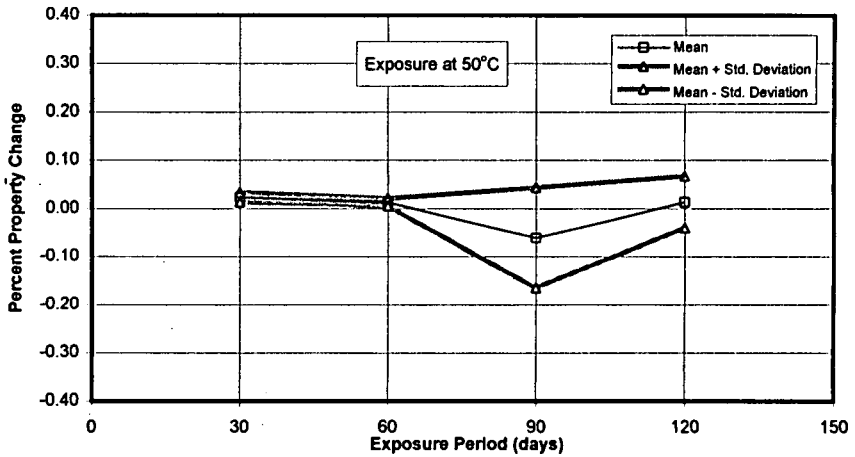
*GEOSYNTEC JOB NO.:* *GE3900*
*MATERIAL TYPE:* *GSE Gundle*
*CHARACTERISTICS:* *80 mil HDPE Geomembrane*
*IMMERSION MEDIUM:* *Perched Ground Water*

**PROPERTY (UNIT):** DIMENSIONS (mm)
**DIRECTION:** WIDTH

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 140.260 | 140.290 | 0.021 | 140.760 | 140.790 | 0.021 | 140.200 | 140.150 | -0.036 | 139.790 | 139.710 | -0.057 |
| | 142.460 | 142.490 | 0.021 | 140.200 | 140.290 | 0.064 | 141.510 | 141.460 | -0.035 | 141.160 | 141.180 | 0.014 |
| | 142.420 | 142.500 | 0.056 | 142.920 | 142.930 | 0.007 | 140.630 | 140.740 | 0.078 | 141.150 | 141.210 | 0.043 |
| | 140.620 | 140.680 | 0.043 | 137.080 | 137.110 | 0.022 | 142.650 | 142.700 | 0.035 | 142.120 | 142.210 | 0.063 |
| Mean of Percent Property Change= | | | 0.035 | | | 0.029 | | | 0.011 | | | 0.016 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.017 | | | 0.025 | | | 0.056 | | | 0.053 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | No | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 132.060 | 132.080 | 0.015 | 133.140 | 133.150 | 0.008 | 131.610 | 131.610 | 0.000 | 133.290 | 133.210 | -0.060 |
| | 123.520 | 123.560 | 0.032 | 133.690 | 133.710 | 0.015 | 134.360 | 134.080 | -0.208 | 132.020 | 132.110 | 0.068 |
| | 131.750 | 131.790 | 0.030 | 133.800 | 133.830 | 0.022 | 133.300 | 133.220 | -0.060 | 132.000 | 132.030 | 0.023 |
| | 135.180 | 135.200 | 0.015 | 130.860 | 130.870 | 0.008 | 132.930 | 132.960 | 0.023 | 131.710 | 131.740 | 0.023 |
| Mean of Percent Property Change= | | | 0.023 | | | 0.013 | | | -0.061 | | | 0.013 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.010 | | | 0.007 | | | 0.104 | | | 0.053 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | No | | | Yes | | | Yes |




000197

206

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

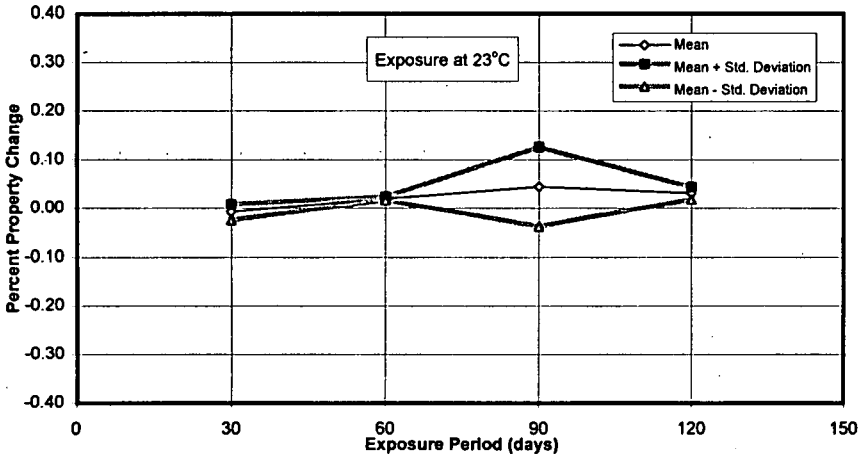
*CLIENT:* *FERMCO*
*METHOD:* *EPA 9090*
*DATE TESTED:* *6/14/96*

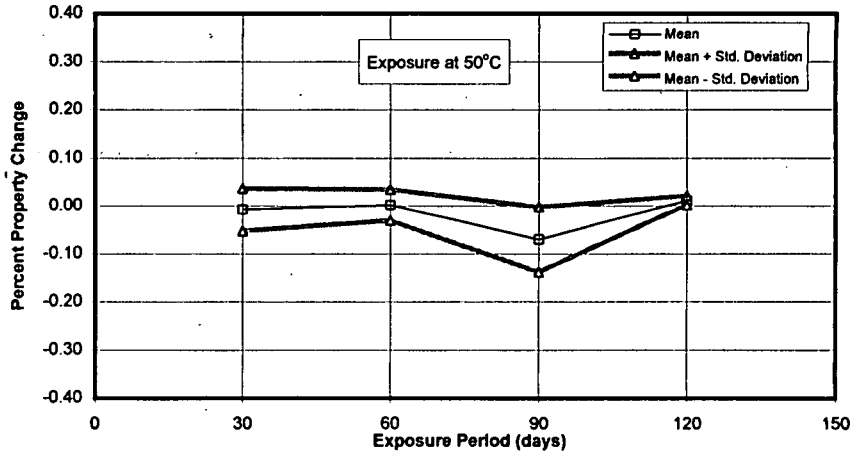
*GEOSYNTEC JOB NO.:* *GE3900*
*MATERIAL TYPE:* *POLYFLEX*
*CHARACTERISTICS:* *80 mil HDPE Geomembrane*
*IMMERSION MEDIUM:* *Perched Ground Water*

**PROPERTY (UNIT):** DIMENSIONS (mm)
**DIRECTION:** WIDTH

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 134.320 | 134.340 | 0.015 | 132.560 | 132.590 | 0.023 | 131.420 | 131.420 | 0.000 | 134.010 | 134.060 | 0.037 |
| | 131.200 | 131.180 | -0.015 | 132.960 | 132.990 | 0.023 | 134.290 | 134.490 | 0.149 | 134.340 | 134.380 | 0.030 |
| | 132.620 | 132.610 | -0.008 | 133.920 | 133.940 | 0.015 | 132.690 | 132.640 | -0.038 | 134.140 | 134.200 | 0.045 |
| | 132.670 | 132.640 | -0.023 | 133.320 | 133.350 | 0.023 | 131.790 | 131.880 | 0.068 | 134.790 | 134.810 | 0.015 |
| Mean of Percent Property Change= | | | -0.008 | | | 0.021 | | | 0.045 | | | 0.032 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.016 | | | 0.004 | | | 0.082 | | | 0.013 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | Yes | | | No |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 132.250 | 132.240 | -0.008 | 134.990 | 134.950 | -0.030 | 132.100 | 132.100 | 0.000 | 132.090 | 132.110 | 0.015 |
| | 133.350 | 133.320 | -0.022 | 130.920 | 130.900 | -0.015 | 132.030 | 131.900 | -0.098 | 133.500 | 133.510 | 0.007 |
| | 132.280 | 132.210 | -0.053 | 133.080 | 133.140 | 0.045 | 131.600 | 131.560 | -0.030 | 133.510 | 133.510 | 0.000 |
| | 133.210 | 133.280 | 0.053 | 130.670 | 130.680 | 0.008 | 133.700 | 133.500 | -0.150 | 133.230 | 133.260 | 0.023 |
| Mean of Percent Property Change= | | | -0.008 | | | 0.002 | | | -0.070 | | | 0.011 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.044 | | | 0.033 | | | 0.067 | | | 0.010 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | No | | | No |




000198

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

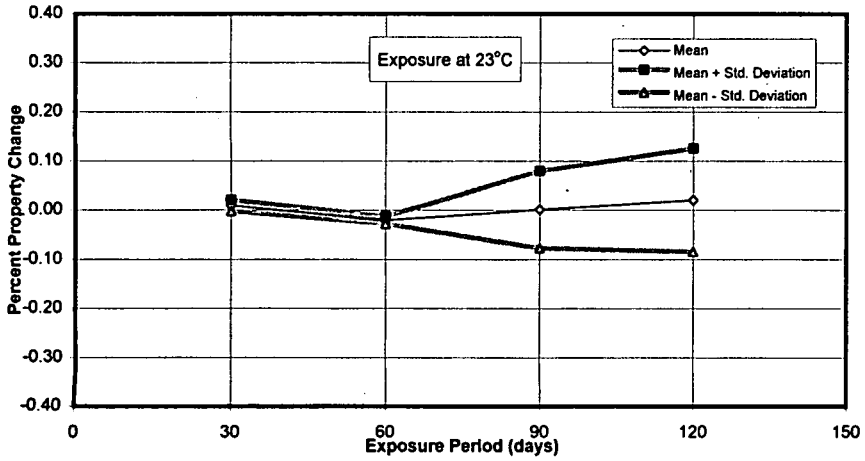
*CLIENT:* FERMCO
*METHOD:* EPA 9090
*DATE TESTED:* 6/14/96

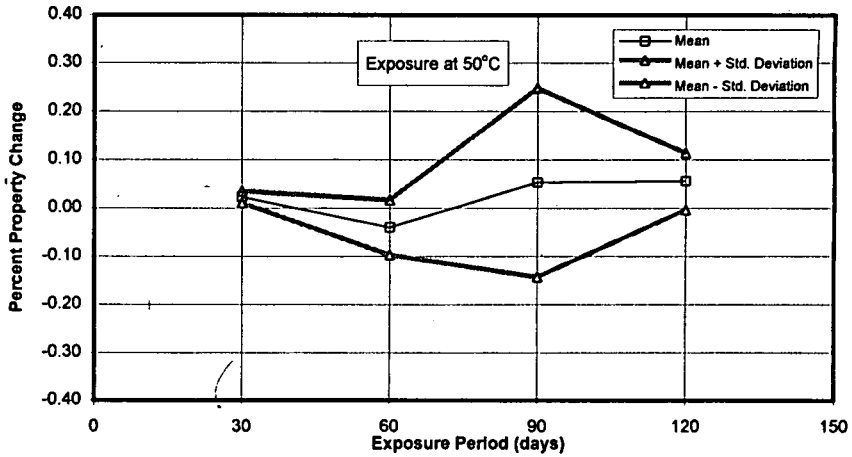
*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* SERROT
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** DIMENSIONS (mm)
**DIRECTION:** WIDTH

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 134.210 | 134.230 | 0.015 | 131.640 | 131.600 | -0.030 | 132.510 | 132.360 | -0.113 | 131.430 | 131.520 | 0.068 |
| | 131.820 | 131.840 | 0.015 | 133.100 | 133.080 | -0.015 | 133.400 | 133.450 | 0.037 | 133.320 | 133.510 | 0.143 |
| | 132.510 | 132.500 | -0.008 | 133.810 | 133.780 | -0.022 | 133.720 | 133.750 | 0.022 | 133.230 | 133.180 | -0.038 |
| | 133.870 | 133.890 | 0.015 | 133.210 | 133.190 | -0.015 | 135.280 | 135.360 | 0.059 | 132.830 | 132.710 | -0.090 |
| Mean of Percent Property Change= | | | 0.009 | | | -0.021 | | | 0.001 | | | 0.021 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.011 | | | 0.007 | | | 0.078 | | | 0.105 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | No | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30-day | | | 60-day | | | 90-day | | | 120-day | | |
| | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 130.730 | 130.740 | 0.008 | 133.150 | 133.120 | -0.023 | 133.760 | 133.740 | -0.015 | 133.440 | 133.480 | 0.030 |
| | 133.440 | 133.470 | 0.022 | 134.440 | 134.410 | -0.022 | 133.500 | 133.300 | -0.150 | 131.130 | 131.250 | 0.092 |
| | 132.140 | 132.190 | 0.038 | 132.780 | 132.790 | 0.008 | 133.140 | 133.560 | 0.315 | 133.330 | 133.310 | -0.015 |
| | 134.160 | 134.190 | 0.022 | 131.200 | 131.040 | -0.122 | 132.000 | 132.080 | 0.061 | 131.540 | 131.690 | 0.114 |
| Mean of Percent Property Change= | | | 0.023 | | | -0.040 | | | 0.053 | | | 0.055 |
| Std. Deviation of Percent Property Change (+/-)= | | | 0.012 | | | 0.057 | | | 0.198 | | | 0.059 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | Yes |




000199

706

## 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*

The following observations were made regarding the percent change in specific gravity of the five geomembranes.

GSE-SLT Geomembrane. The percent changes were not within one standard deviation of the control means for any of the exposures except the 120-day exposure at 23°C. A general reduction in percent changes was exhibited with exposure time; however, this trend was contradicted by less percent changes during exposures at the higher temperature.

NSC Geomembrane. The percent changes were not within one standard deviation of the control means for any of the exposures except the 120-day exposure at 23°C. A general reduction in percent changes was exhibited with exposure time; however, this trend was contradicted by less percent changes during exposures at the higher temperature.

GSE-Gundle Geomembrane. The percent changes were not within one standard deviation of the control means for any of the exposures except the 120-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

PolyFlex Geomembrane. The percent changes were not within one standard deviation of the control means for any of the exposures except the 120-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

Serrot Geomembrane. The percent changes were not within one standard deviation of the control means for any of the exposures except the 30-day and the 90-day exposures at 23°C, the 30-day exposure at 50°C. A general reduction in percent changes was exhibited with exposure time; however, this trend was contradicted by less percent changes during exposures at the higher temperature.

*Conclusion*

The test leachate caused percent changes in the means of specific gravity of the exposed samples from the means of specific gravity of the control samples of less than 0.50%, for all the five geomembranes tested for all the exposure periods. No detrimental effects on the integrity of the geomembrane are expected due to the small change in the tested property. Furthermore, none of the five geomembranes exhibited a consistent trend for the changes in property with exposure time and temperature.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

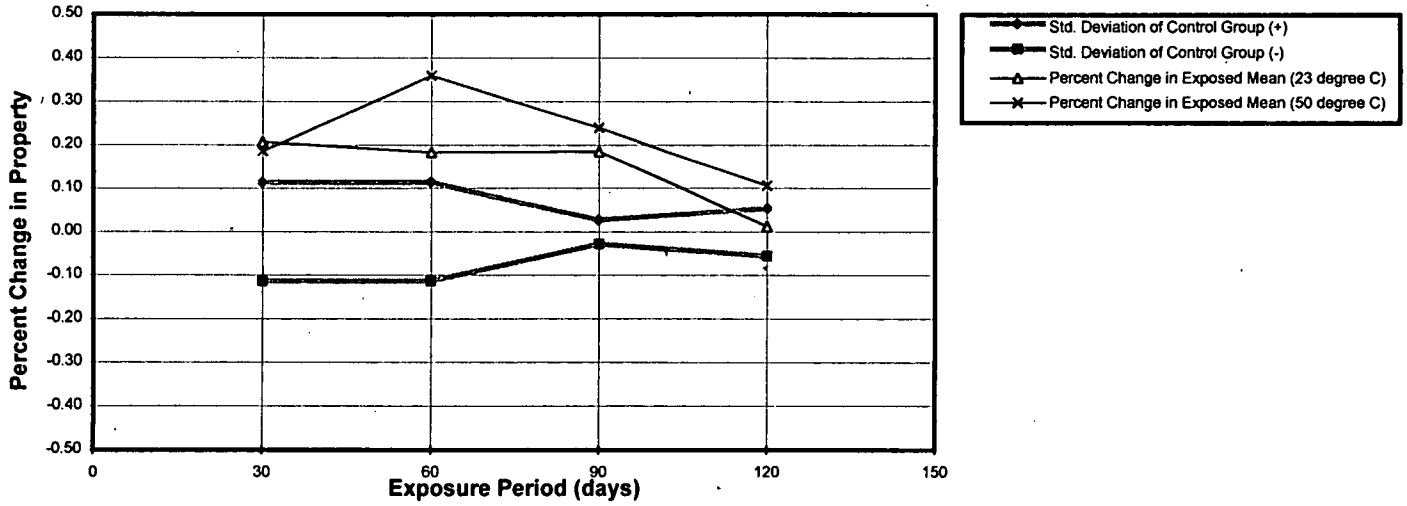
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D792*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** SPECIFIC GRAVITY (N/A)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 0.9442 | 0.9451 | 0.9452 | 0.9469 | 0.9475 | 0.9436 | 0.9462 | 0.9465 | 0.9456 | 0.9450 | 0.9460 |
| | 0.9431 | 0.9472 | 0.9461 | 0.9453 | 0.9472 | 0.9439 | 0.9457 | 0.9467 | 0.9454 | 0.9450 | 0.9459 |
| | 0.9444 | 0.9464 | 0.9458 | 0.9455 | 0.9476 | 0.9442 | 0.9457 | 0.9443 | 0.9444 | 0.9459 | 0.9462 |
| | 0.9458 | 0.9461 | 0.9463 | 0.9450 | 0.9481 | 0.9438 | 0.9450 | 0.9469 | 0.9448 | 0.9453 | 0.9462 |
| | 0.9433 | 0.9458 | 0.9462 | 0.9468 | 0.9473 | 0.9442 | 0.9459 | 0.9466 | 0.9455 | 0.9451 | 0.9464 |
| Mean of Control Group= | 0.9442 | | | | | 0.9439 | | | 0.9451 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0011 | | | | | 0.0003 | | | 0.0005 | | |
| Std. Deviation of Mean of Control Group as % = | 0.11 | | | | | 0.03 | | | 0.05 | | |
| Mean of Exposed Group= | | 0.9461 | 0.9459 | 0.9459 | 0.9475 | | 0.9457 | 0.9462 | | 0.9453 | 0.9461 |
| Change in Exposed Mean from Control Mean= | | 0.0020 | 0.0018 | 0.0017 | 0.0034 | | 0.0018 | 0.0023 | | 0.0001 | 0.0010 |
| Percent change in Exposed Mean from Control Mean= | | 0.21 | 0.19 | 0.18 | 0.36 | | 0.19 | 0.24 | | 0.01 | 0.11 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | No | No | | Yes | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

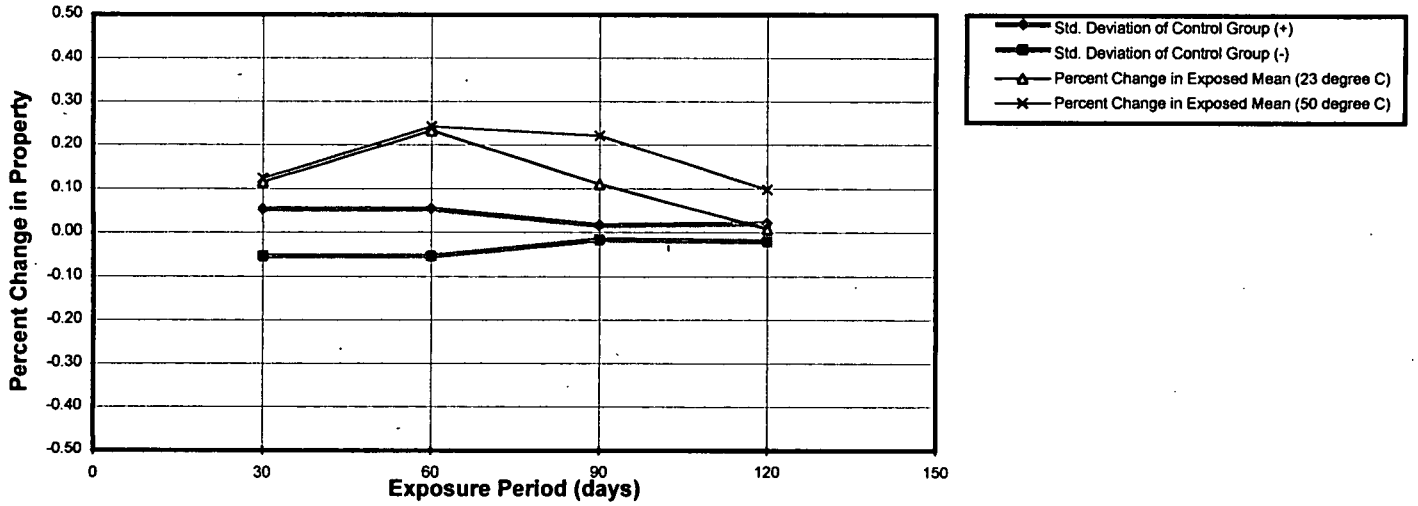
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D792*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** SPECIFIC GRAVITY (N/A)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 0.9511 | 0.9518 | 0.9519 | 0.9546 | 0.9543 | 0.9510 | 0.9524 | 0.9535 | 0.9515 | 0.9512 | 0.9524 |
| | 0.9521 | 0.9537 | 0.9531 | 0.9533 | 0.9547 | 0.9511 | 0.9521 | 0.9530 | 0.9510 | 0.9514 | 0.9521 |
| | 0.9522 | 0.9522 | 0.9521 | 0.9534 | 0.9536 | 0.9509 | 0.9525 | 0.9529 | 0.9514 | 0.9516 | 0.9525 |
| | 0.9513 | 0.9531 | 0.9534 | 0.9548 | 0.9531 | 0.9508 | 0.9517 | 0.9531 | 0.9514 | 0.9515 | 0.9519 |
| | 0.9513 | 0.9527 | 0.9534 | 0.9530 | 0.9538 | 0.9512 | 0.9516 | 0.9530 | 0.9514 | 0.9514 | 0.9525 |
| Mean of Control Group= | 0.9516 | | | | | 0.9510 | | | 0.9513 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0005 | | | | | 0.0002 | | | 0.0002 | | |
| Std. Deviation of Mean of Control Group as % = | 0.05 | | | | | 0.02 | | | 0.02 | | |
| Mean of Exposed Group= | | 0.9527 | 0.9528 | 0.9538 | 0.9539 | | 0.9521 | 0.9531 | | 0.9514 | 0.9523 |
| Change in Exposed Mean from Control Mean= | | 0.0011 | 0.0012 | 0.0022 | 0.0023 | | 0.0011 | 0.0021 | | 0.0001 | 0.0009 |
| Percent change in Exposed Mean from Control Mean= | | 0.12 | 0.12 | 0.23 | 0.24 | | 0.11 | 0.22 | | 0.01 | 0.10 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | No | No | | Yes | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

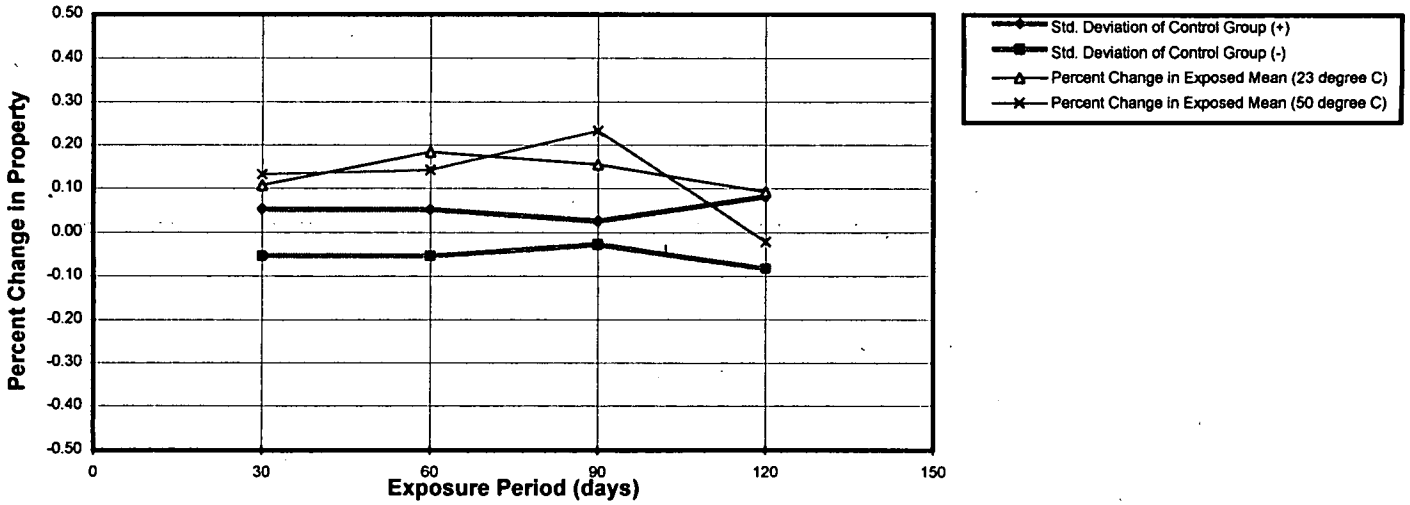
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D792*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** SPECIFIC GRAVITY (N/A)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 0.9506 | 0.9514 | 0.9521 | 0.9522 | 0.9519 | 0.9497 | 0.9517 | 0.9520 | 0.9522 | 0.9599 | 0.9514 |
| | 0.9514 | 0.9523 | 0.9525 | 0.9532 | 0.9521 | 0.9500 | 0.9514 | 0.9522 | 0.9521 | 0.9507 | 0.9512 |
| | 0.9510 | 0.9525 | 0.9527 | 0.9530 | 0.9532 | 0.9499 | 0.9512 | 0.9525 | 0.9509 | 0.9501 | 0.9517 |
| | 0.9507 | 0.9521 | 0.9527 | 0.9530 | 0.9517 | 0.9500 | 0.9509 | 0.9517 | 0.9516 | 0.9505 | 0.9511 |
| | 0.9518 | 0.9523 | 0.9518 | 0.9529 | 0.9534 | 0.9494 | 0.9512 | 0.9517 | 0.9504 | 0.9504 | 0.9508 |
| Mean of Control Group= | 0.9511 | | | | | 0.9498 | | | 0.9514 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0005 | | | | | 0.0003 | | | 0.0008 | | |
| Std. Deviation of Mean of Control Group as % = | 0.05 | | | | | 0.03 | | | 0.08 | | |
| Mean of Exposed Group= | | 0.9521 | 0.9524 | 0.9529 | 0.9525 | | 0.9513 | 0.9520 | | 0.9523 | 0.9512 |
| Change in Exposed Mean from Control Mean= | | 0.0010 | 0.0013 | 0.0018 | 0.0014 | | 0.0015 | 0.0022 | | 0.0009 | -0.0002 |
| Percent change in Exposed Mean from Control Mean= | | 0.11 | 0.13 | 0.19 | 0.14 | | 0.16 | 0.23 | | 0.09 | -0.02 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | No | No | | No | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

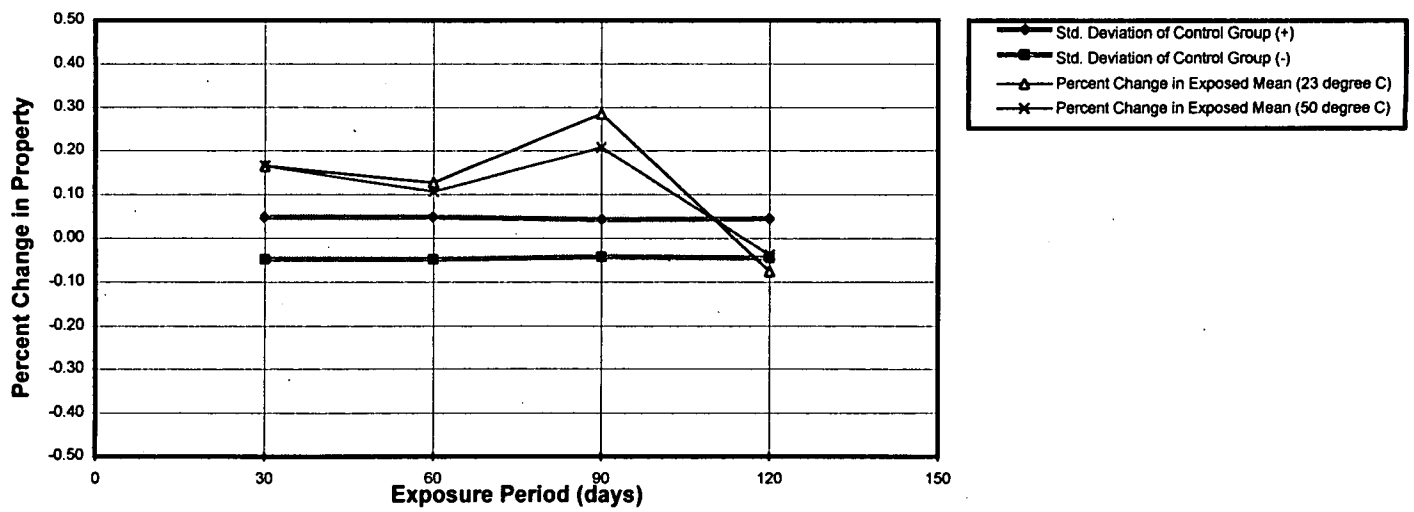
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D792*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** SPECIFIC GRAVITY (N/A)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 0.9549 | 0.9571 | 0.9570 | 0.9572 | 0.9560 | 0.9545 | 0.9574 | 0.9563 | 0.9561 | 0.9549 | 0.9556 |
| | 0.9548 | 0.9568 | 0.9569 | 0.9563 | 0.9560 | 0.9547 | 0.9559 | 0.9562 | 0.9555 | 0.9544 | 0.9551 |
| | 0.9549 | 0.9556 | 0.9574 | 0.9561 | 0.9561 | 0.9539 | 0.9556 | 0.9563 | 0.9554 | 0.9548 | 0.9550 |
| | 0.9556 | 0.9569 | 0.9574 | 0.9562 | 0.9561 | 0.9545 | 0.9559 | 0.9560 | 0.9554 | 0.9546 | 0.9547 |
| | 0.9558 | 0.9575 | 0.9552 | 0.9563 | 0.9569 | 0.9538 | 0.9602 | 0.9565 | 0.9549 | 0.9550 | 0.9551 |
| Mean of Control Group= | 0.9552 | | | | | 0.9543 | | | 0.9555 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0005 | | | | | 0.0004 | | | 0.0004 | | |
| Std. Deviation of Mean of Control Group as % = | 0.05 | | | | | 0.04 | | | 0.04 | | |
| Mean of Exposed Group= | | 0.9568 | 0.9568 | 0.9564 | 0.9562 | | 0.9570 | 0.9563 | | 0.9547 | 0.9551 |
| Change in Exposed Mean from Control Mean= | | 0.0016 | 0.0016 | 0.0012 | 0.0010 | | 0.0027 | 0.0020 | | -0.0007 | -0.0004 |
| Percent change in Exposed Mean from Control Mean= | | 0.17 | 0.17 | 0.13 | 0.11 | | 0.29 | 0.21 | | -0.08 | -0.04 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | No | No | | No | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

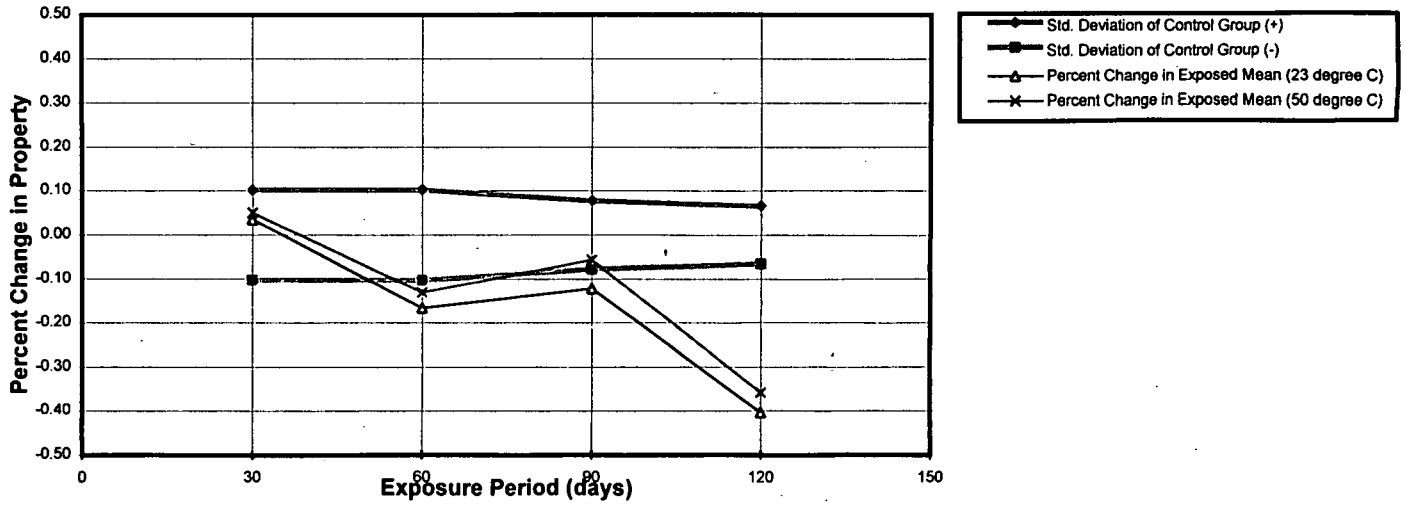
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D792*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** SPECIFIC GRAVITY (N/A)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 0.9540 | 0.9554 | 0.9549 | 0.9532 | 0.9535 | 0.9552 | 0.9533 | 0.9535 | 0.9563 | 0.9527 | 0.9531 |
| | 0.9548 | 0.9550 | 0.9550 | 0.9526 | 0.9525 | 0.9532 | 0.9529 | 0.9538 | 0.9556 | 0.9523 | 0.9524 |
| | 0.9537 | 0.9551 | 0.9550 | 0.9528 | 0.9533 | 0.9542 | 0.9526 | 0.9538 | 0.9571 | 0.9519 | 0.9526 |
| | 0.9556 | 0.9534 | 0.9545 | 0.9520 | 0.9529 | 0.9539 | 0.9529 | 0.9535 | 0.9556 | 0.9520 | 0.9527 |
| | 0.9531 | 0.9540 | 0.9542 | 0.9527 | 0.9528 | 0.9545 | 0.9535 | 0.9537 | 0.9559 | 0.9523 | 0.9526 |
| Mean of Control Group= | 0.9542 | | | | | 0.9542 | | | 0.9561 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0010 | | | | | 0.0007 | | | 0.0006 | | |
| Std. Deviation of Mean of Control Group as % = | 0.10 | | | | | 0.08 | | | 0.07 | | |
| Mean of Exposed Group= | | 0.9546 | 0.9547 | 0.9527 | 0.9530 | | 0.9530 | 0.9537 | | 0.9522 | 0.9527 |
| Change in Exposed Mean from Control Mean= | | 0.0003 | 0.0005 | -0.0016 | -0.0012 | | -0.0012 | -0.0005 | | -0.0039 | -0.0034 |
| Percent change in Exposed Mean from Control Mean= | | 0.04 | 0.05 | -0.17 | -0.13 | | -0.12 | -0.06 | | -0.40 | -0.36 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | No | No | | No | Yes | | No | No |



2.5 VOLATILES LOSS

## 2.5 Volatiles Losses

*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 following observations were made regarding the percent change in volatiles loss of the five geomembranes.

GSE-SLT Geomembrane. The means of the volatiles loss values of the exposed samples were higher than the corresponding means of the control samples. The percent changes in the volatiles loss due to exposure were not within one standard deviation of the control means for any of the exposures. An increase in percent change in volatiles loss was observed with exposure time; this trend was magnified at the higher temperature.

NSC Geomembrane. The means of the volatiles loss values of the exposed samples were higher than the corresponding means of the control samples. The percent changes in the volatiles loss due to exposure were within one standard deviation of the control means for the 60-day exposure at 50°C, and the 90-day exposures at 23°C and 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

GSE-Gundle Geomembrane. The means of the volatiles loss values of the exposed samples were higher than the corresponding means of the control samples. The percent changes in the volatiles loss due to exposure were not within one standard deviation of the control means for any of the exposures. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

PolyFlex Geomembrane. The means of the volatiles loss values of the exposed samples were higher than the corresponding means of the control samples. The percent changes in the volatiles loss due to exposure were not within one standard deviation of the control means for any of the exposures. In general, a decrease in percent change in volatiles loss was observed with exposure time; however, this trend was contradicted at the higher temperature.

Serrot Geomembrane. The means of the volatiles loss values of the exposed samples were higher than the corresponding means of the control samples. The percent changes in the volatiles loss due to exposure were not within one standard deviation of the control means for any of the exposures. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

The observations given above suggest that there was an increase in volatiles loss values of the exposed specimens as compared to the control values of the five geomembranes. The increased volatiles loss due to exposure 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 on the surface of the sample that cannot be removed until the test drying begins. It is possible that the loss of moisture or residual detergent is misrepresented as volatiles loss in the test results. Also, since the test leachate has low concentrations of organic constituents (as shown Appendix A), it is unlikely that the increase in volatiles loss is due to absorption of organic leachate constituents. In addition, previous experience has shown that volatiles loss values typically display significant variability due to experimental variation and material variability.

*Conclusion*

The means of the volatiles loss values of the exposed samples were higher than the corresponding means of the control samples for all the five geomembranes. In general, the percent changes in the volatiles loss due to exposure were not within one standard deviation of the control means for any of the exposures for the five geomembranes. No consistent trends were observed with exposure time and temperature for four of the five geomembranes. Test results of GSE-SLT geomembrane exhibit consistent temporal and thermal trends; however, no detrimental effects are expected due to inconsistencies observed between related properties.

**GEOSYNTEC CONSULTANTS**

Materials Testing Laboratory

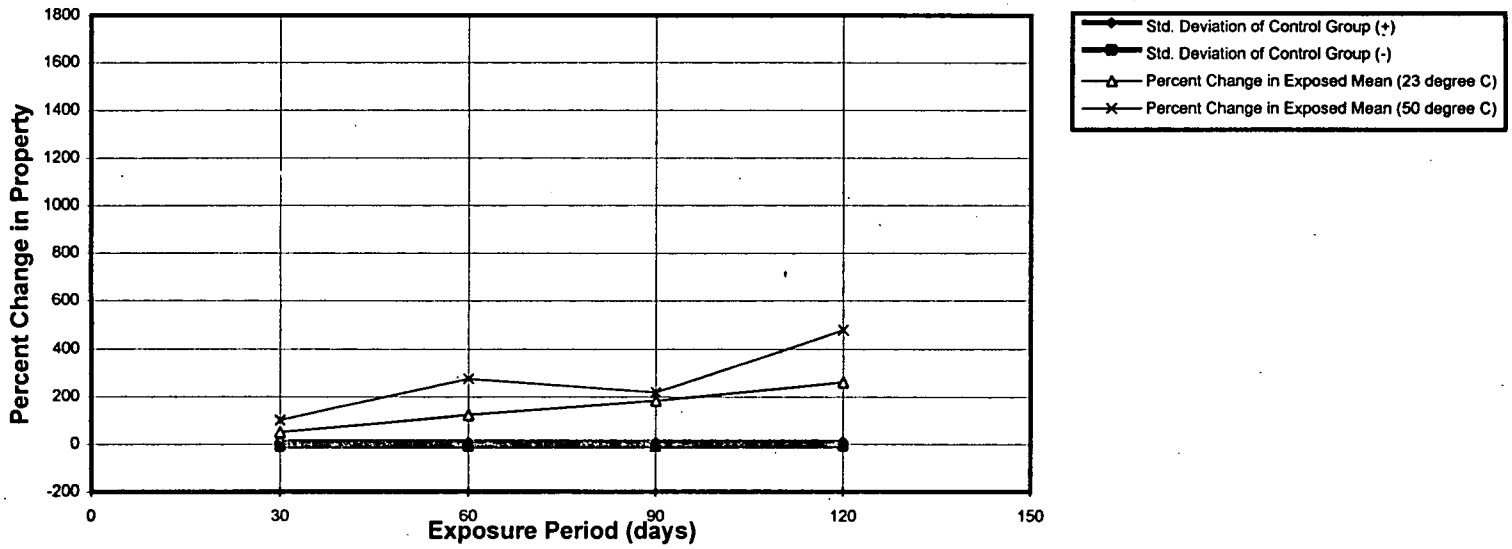
# CHEMICAL COMPATIBILITY TEST RESULTS

*CLIENT:* FERMCO
*METHOD:* ASTM D3030
*DATE TESTED:* 6/14/96

*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* GSE-SLT.
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** VOLATILES LOSS (%)
**DIRECTION:** N/A

| | CONTROL GROUP | EXPOSED GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30-day | | 60-day | | 90-day | | 120-day | |
| | | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C |
| | 0.0525<br>0.0589 | 0.0800<br>0.0880 | 0.1010<br>0.1250 | 0.1230<br>0.1260 | 0.2080<br>0.2110 | 0.1930<br>0.1230 | 0.2000<br>0.1560 | 0.2100<br>0.1940 | 0.3260<br>0.3180 |
| Mean of Control Group= | 0.0557 | | | | | | | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0045 | | | | | | | | |
| Std. Deviation of Mean of Control Group as % = | 8.1 | | | | | | | | |
| Mean of Exposed Group= | | 0.0840 | 0.1130 | 0.1245 | 0.2095 | 0.1580 | 0.1780 | 0.2020 | 0.3220 |
| Change in Exposed Mean from Control Mean= | | 0.0283 | 0.0573 | 0.0688 | 0.1538 | 0.1023 | 0.1223 | 0.1463 | 0.2663 |
| Percent change in Exposed Mean from Control Mean= | | 50.81 | 102.87 | 123.52 | 276.12 | 183.66 | 219.57 | 262.66 | 478.10 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | No | No | No | No |



**GEOSYNTEC CONSULTANTS**

Materials Testing Laboratory

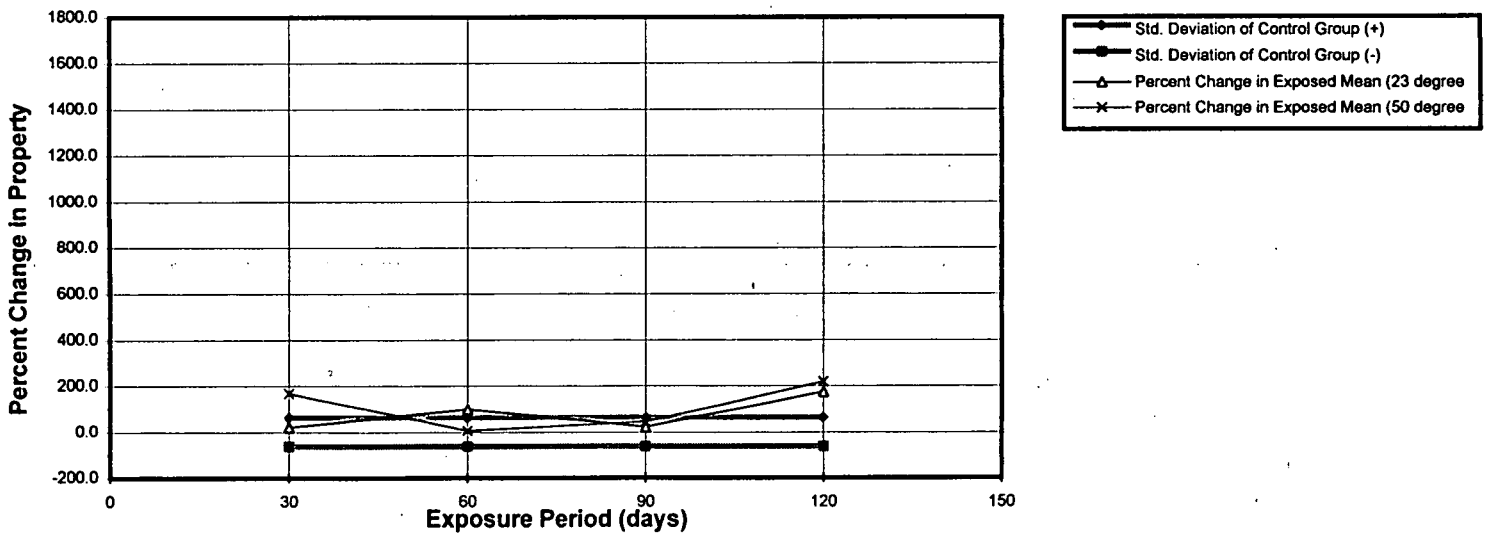
# CHEMICAL COMPATIBILITY TEST RESULTS

*CLIENT:* FERMCO
*METHOD:* ASTM D3030
*DATE TESTED:* 6/14/96

*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* NSC
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** VOLATILES LOSS (%)
**DIRECTION:** N/A

| | CONTROL GROUP | EXPOSED GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30-day | | 60-day | | 90-day | | 120-day | |
| | | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C |
| | 0.0316<br>0.0814 | 0.0760<br>0.0610 | 0.1840<br>0.1210 | 0.1140<br>0.1110 | 0.0590<br>0.0610 | 0.0580<br>0.0820 | 0.0720<br>0.0920 | 0.1230<br>0.1870 | 0.1900<br>0.1700 |
| Mean of Control Group= | 0.0565 | | | | | | | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0352 | | | | | | | | |
| Std. Deviation of Mean of Control Group as % = | 62.3 | | | | | | | | |
| Mean of Exposed Group= | | 0.0685 | 0.1525 | 0.1125 | 0.0600 | 0.0700 | 0.0820 | 0.1550 | 0.1800 |
| Change in Exposed Mean from Control Mean= | | 0.0120 | 0.0960 | 0.0560 | 0.0035 | 0.0135 | 0.0255 | 0.0985 | 0.1235 |
| Percent change in Exposed Mean from Control Mean= | | 21.24 | 169.91 | 99.12 | 6.19 | 23.89 | 45.13 | 174.34 | 218.58 |
| Is change less than one Std. Deviation of Control Group? | | Yes | No | No | Yes | Yes | Yes | No | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

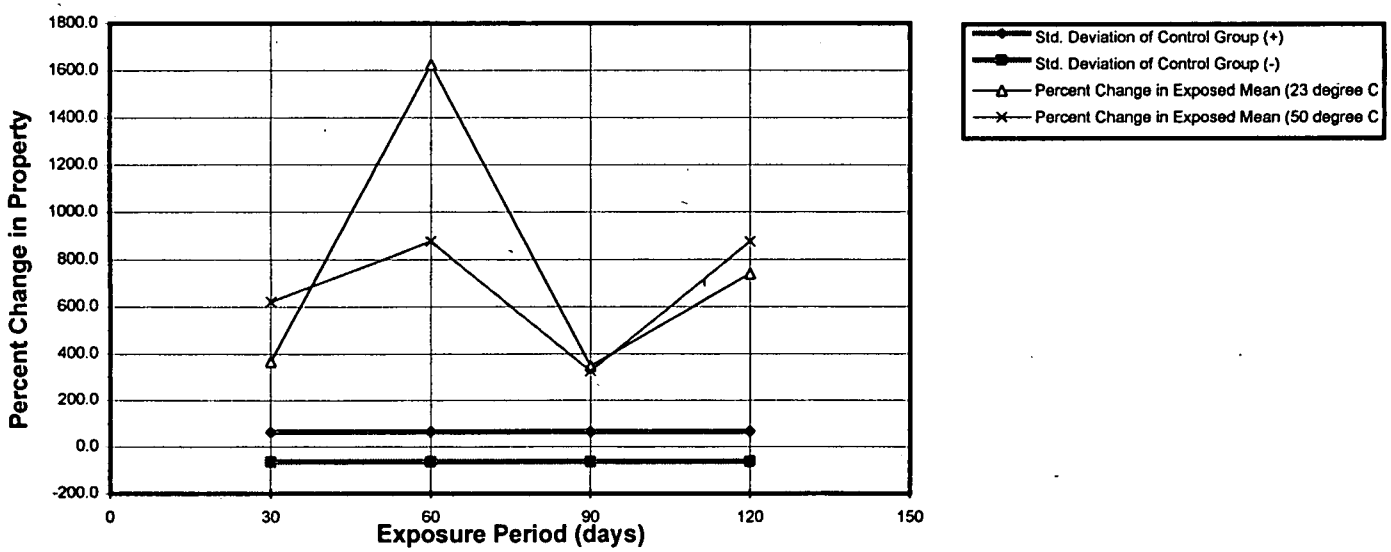
# CHEMICAL COMPATIBILITY TEST RESULTS

*CLIENT:* FERMCO
*METHOD:* ASTM D3030
*DATE TESTED:* 6/14/96

*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* GSE-Gundle
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** VOLATILES LOSS (%)
**DIRECTION:** N/A

| | CONTROL GROUP | EXPOSED GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30-day | | 60-day | | 90-day | | 120-day | |
| | | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C |
| | 0.0098<br>0.0260 | 0.0910<br>0.0760 | 0.1380<br>0.1200 | 0.3120<br>0.3050 | 0.1770<br>0.1720 | 0.0880<br>0.0720 | 0.0830<br>0.0690 | 0.1450<br>0.1560 | 0.1750<br>0.1740 |
| Mean of Control Group= | 0.0179 | | | | | | | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0115 | | | | | | | | |
| Std. Deviation of Mean of Control Group as % = | 64.0 | | | | | | | | |
| Mean of Exposed Group= | | 0.0835 | 0.1290 | 0.3085 | 0.1745 | 0.0800 | 0.0760 | 0.1505 | 0.1745 |
| Change in Exposed Mean from Control Mean= | | 0.0656 | 0.1111 | 0.2906 | 0.1566 | 0.0621 | 0.0581 | 0.1326 | 0.1566 |
| Percent change in Exposed Mean from Control Mean= | | 366.48 | 620.67 | 1623.46 | 874.86 | 346.93 | 324.58 | 740.78 | 874.86 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | No | No | No | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

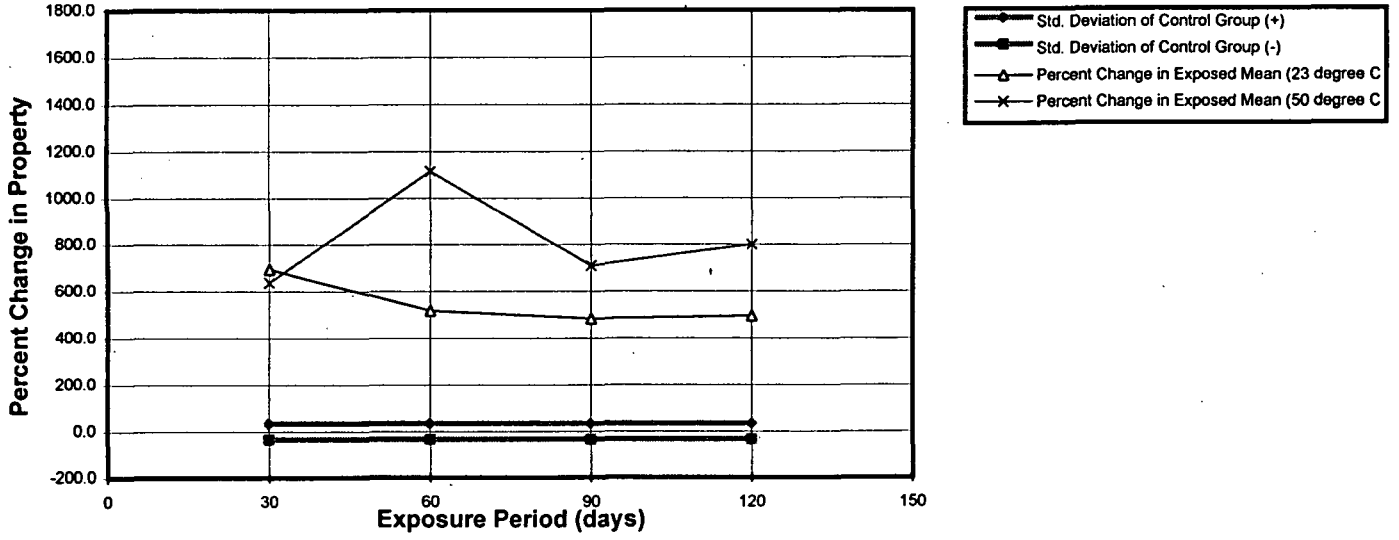
# CHEMICAL COMPATIBILITY TEST RESULTS

*CLIENT:* FERMCO
*METHOD:* ASTM D3030
*DATE TESTED:* 6/14/96

*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* POLYFLEX
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** VOLATILES LOSS (%)
**DIRECTION:** N/A

| | CONTROL GROUP | EXPOSED GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30-day | | 60-day | | 90-day | | 120-day | |
| | | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C |
| | 0.0129<br>0.0211 | 0.1390<br>0.1310 | 0.1230<br>0.1280 | 0.1010<br>0.1090 | 0.2030<br>0.2100 | 0.0990<br>0.0990 | 0.1360<br>0.1390 | 0.0970<br>0.1050 | 0.1610<br>0.1450 |
| Mean of Control Group= | 0.0170 | | | | | | | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0058 | | | | | | | | |
| Std. Deviation of Mean of Control Group as % = | 34.1 | | | | | | | | |
| Mean of Exposed Group= | | 0.1350 | 0.1255 | 0.1050 | 0.2065 | 0.0990 | 0.1375 | 0.1010 | 0.1530 |
| Change in Exposed Mean from Control Mean= | | 0.1180 | 0.1085 | 0.0880 | 0.1895 | 0.0820 | 0.1205 | 0.0840 | 0.1360 |
| Percent change in Exposed Mean from Control Mean= | | 694.12 | 638.24 | 517.65 | 1114.71 | 482.35 | 708.82 | 494.12 | 800.00 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | No | No | No | No |




000213

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

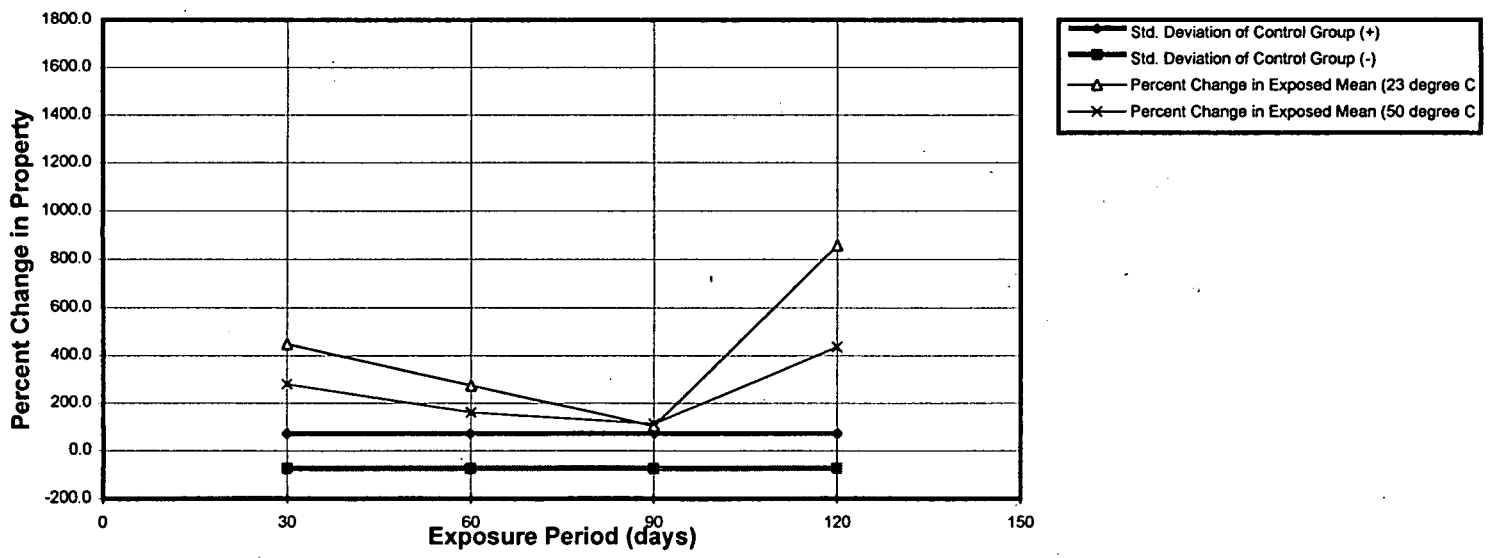
# CHEMICAL COMPATIBILITY TEST RESULTS

*CLIENT:* FERMCO
*METHOD:* ASTM D3030
*DATE TESTED:* 6/14/96

*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* SERROT
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** VOLATILES LOSS (%)
**DIRECTION:** N/A

| | CONTROL GROUP | EXPOSED GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30-day | | 60-day | | 90-day | | 120-day | |
| | | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C |
| | 0.0162<br>0.0500 | 0.1830<br>0.1800 | 0.1030<br>0.1490 | 0.1230<br>0.1250 | 0.0810<br>0.0920 | 0.0730<br>0.0620 | 0.0880<br>0.0540 | 0.2990<br>0.3350 | 0.2410<br>0.1140 |
| Mean of Control Group= | 0.0331 | | | | | | | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0239 | | | | | | | | |
| Std. Deviation of Mean of Control Group as % = | 72.2 | | | | | | | | |
| Mean of Exposed Group= | | 0.1815 | 0.1260 | 0.1240 | 0.0865 | 0.0675 | 0.0710 | 0.3170 | 0.1775 |
| Change in Exposed Mean from Control Mean= | | 0.1484 | 0.0929 | 0.0909 | 0.0534 | 0.0344 | 0.0379 | 0.2839 | 0.1444 |
| Percent change in Exposed Mean from Control Mean= | | 448.34 | 280.66 | 274.62 | 161.33 | 103.93 | 114.50 | 857.70 | 436.25 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | No | No | No | No |



## 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 percent change in extractables content of the five geomembranes.

- GSE-SLT Geomembrane. The means of the extractables content values of the exposed samples were higher than the corresponding means of the control samples (i.e., a noticeable increase in the extractables content with exposure). The percent changes in the extractables content due to exposure were not within one standard deviation of the control means for any of the exposures. The results exhibited randomness, and no consistent trends were observed for the changes in property

with exposure time. In general, the exposures at 23°C resulted in higher extractables contents as compared to the exposures 50°C.

NSC Geomembrane. The means of the extractables content values of the exposed samples were higher than the corresponding means of the control samples (i.e., a noticeable increase in the extractables content with exposure). The percent changes in the extractables content due to exposure were not within one standard deviation of the control means for any of the exposures. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

GSE-Gundle Geomembrane. The means of the extractables content values of the exposed samples were higher than the corresponding means of the control samples (i.e., a noticeable increase in the extractables content with exposure). The percent changes in the extractables content due to exposure were not within one standard deviation of the control means for any of the exposures except the 120-day exposures at 23°C and 50°C. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

PolyFlex Geomembrane. The means of the extractables content values of the exposed samples were higher than the corresponding means of the control samples (i.e., a noticeable increase in the extractables content with exposure). The percent changes in the extractables content due to exposure were not within one standard deviation of the control means for any of the exposures. A general reduction in percent changes was exhibited with exposure time; however, this trend was contradicted by less percent changes during exposures at the higher temperature.

Serrot Geomembrane. The means of the extractables content values of the exposed samples were higher than the corresponding means of the control samples (i.e., a noticeable increase in the extractables content with exposure). The percent changes in the extractables content due to exposure were not within one standard deviation of the control means for any of the exposures. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

The observations given above suggest that there was a significant increase in extractables content values of the exposed specimens as compared to the control values of all the five geomembranes. The findings of percent changes of extractables content values of HDPE geomembranes tested is typical of USEPA Method 9090 test programs. However, several comments can be made regarding the higher values of the exposed samples relative to the control samples.

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 means of the extractables content values of the exposed samples were higher than the corresponding means of the control samples for all the five geomembranes. In general, the percent changes in the extractables content due to exposure were not within one standard deviation of the control means for any of the exposures for all the five geomembranes. However, as explained earlier, 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.

This page intentionally left blank.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

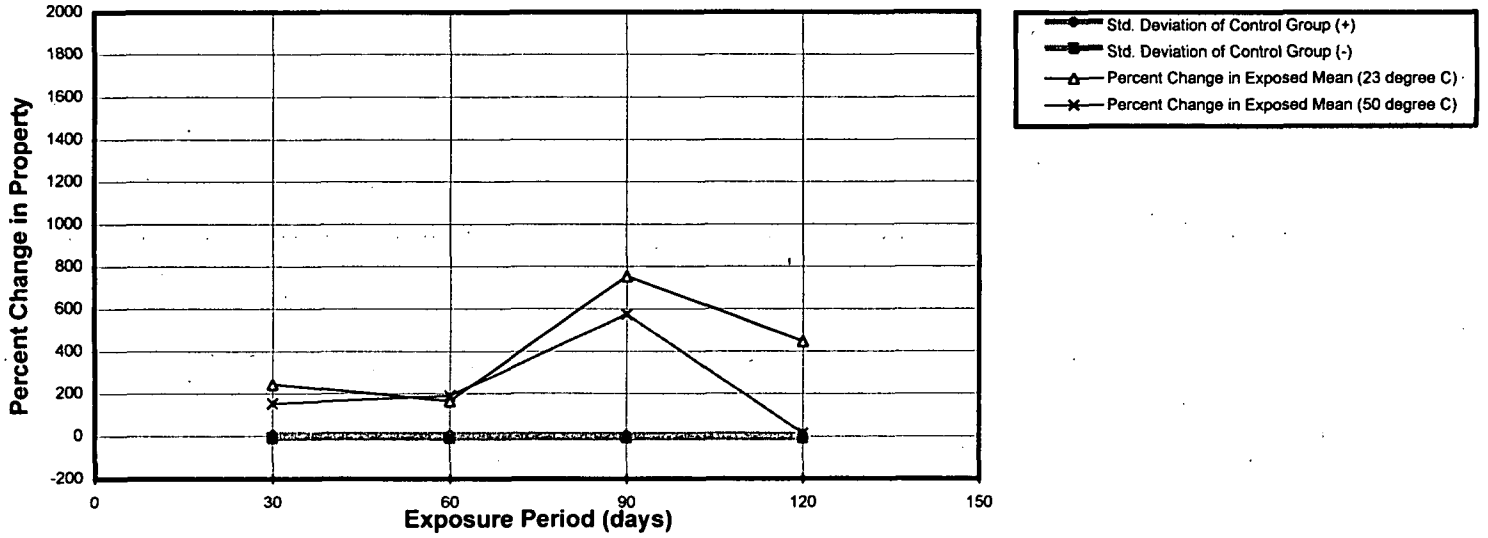
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D3421*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** EXTRACTABLES CONTENT (%)
**DIRECTION:** N/A

| | CONTROL GROUP | EXPOSED GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30-day | | 60-day | | 90-day | | 120-day | |
| | | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C |
| | 0.0350<br>0.0390 | 0.1310<br>0.1240 | 0.1050<br>0.0840 | 0.1020<br>0.0960 | 0.1120<br>0.1030 | 0.2150<br>0.4180 | 0.1290<br>0.3700 | 0.2630<br>0.1420 | 0.0110<br>0.0740 |
| Mean of Control Group= | 0.0370 | | | | | | | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0028 | | | | | | | | |
| Std. Deviation of Mean of Control Group as % = | 7.6 | | | | | | | | |
| Mean of Exposed Group= | | 0.1275 | 0.0945 | 0.0990 | 0.1075 | 0.3165 | 0.2495 | 0.2025 | 0.0425 |
| Change in Exposed Mean from Control Mean= | | 0.0905 | 0.0575 | 0.0620 | 0.0705 | 0.2795 | 0.2125 | 0.1655 | 0.0055 |
| Percent change in Exposed Mean from Control Mean= | | 244.59 | 155.41 | 167.57 | 190.54 | 755.41 | 574.32 | 447.30 | 14.86 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | No | No | No | No |



# GEOSYNTEC CONSULTANTS

Materials Testing Laboratory

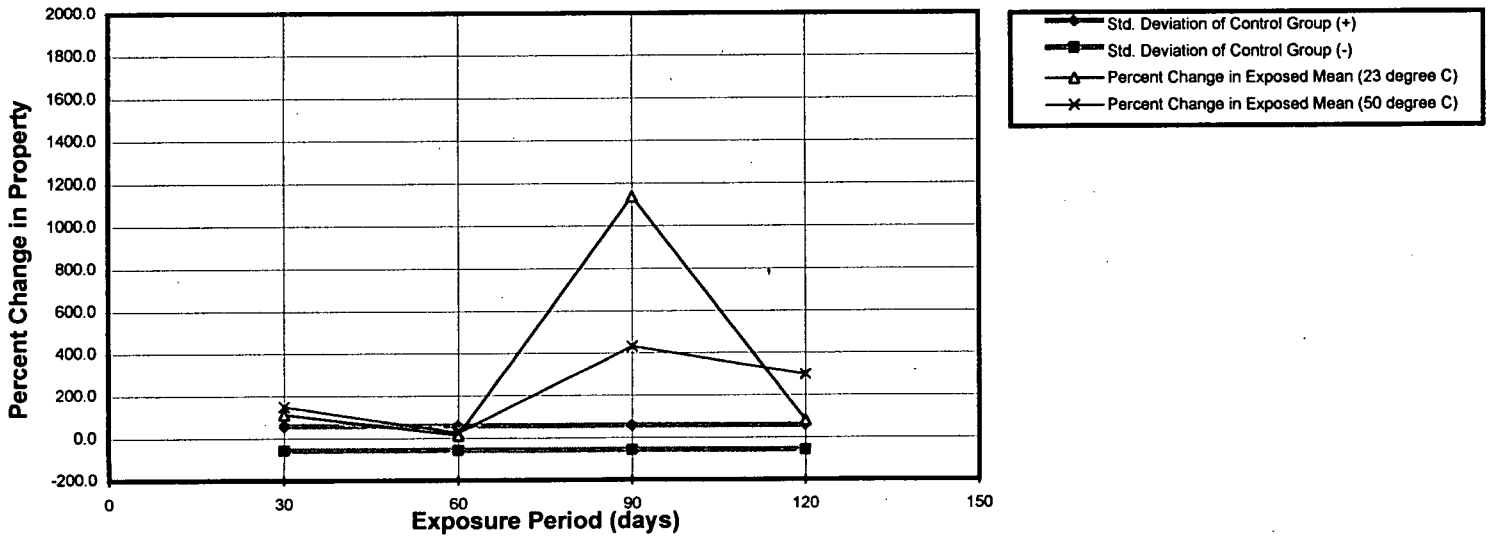
## CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D3421
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** NSC
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** EXTRACTABLES CONTENT (%)
**DIRECTION:** N/A

| | CONTROL GROUP | EXPOSED GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30-day | | 60-day | | 90-day | | 120-day | |
| | | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C |
| | 0.0410<br>0.0970 | 0.1480<br>0.1450 | 0.1840<br>0.1600 | 0.0750<br>0.0810 | 0.0820<br>0.0890 | 0.7680<br>0.9430 | 0.3500<br>0.3850 | 0.1330<br>0.1160 | 0.3090<br>0.2410 |
| Mean of Control Group= | 0.0690 | | | | | | | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0396 | | | | | | | | |
| Std. Deviation of Mean of Control Group as % = | 57.4 | | | | | | | | |
| Mean of Exposed Group= | | 0.1465 | 0.1720 | 0.0780 | 0.0855 | 0.8555 | 0.3675 | 0.1245 | 0.2750 |
| Change in Exposed Mean from Control Mean= | | 0.0775 | 0.1030 | 0.0090 | 0.0165 | 0.7865 | 0.2985 | 0.0555 | 0.2060 |
| Percent change in Exposed Mean from Control Mean= | | 112.32 | 149.28 | 13.04 | 23.91 | 1139.86 | 432.61 | 80.43 | 298.55 |
| Is change less than one Std. Deviation of Control Group? | | No | No | Yes | Yes | No | No | No | No |




000220

706

**GEOSYNTEC CONSULTANTS**

Materials Testing Laboratory

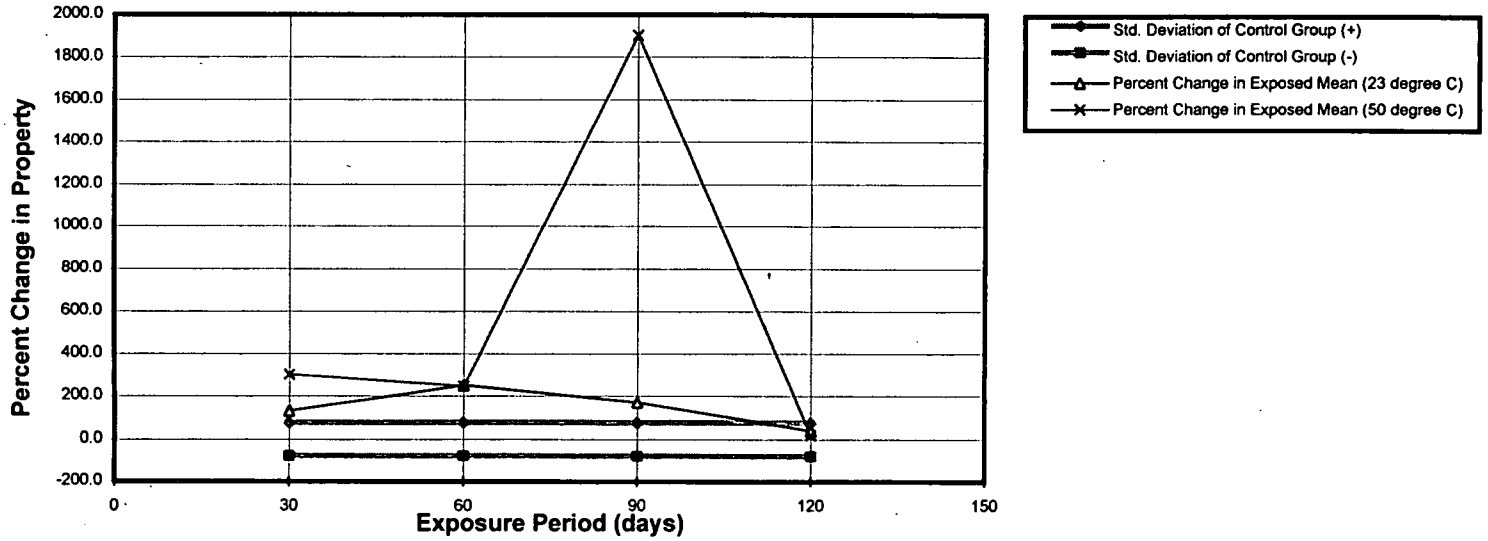
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D3421*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** EXTRACTABLES CONTENT (%)
**DIRECTION:** N/A

| | CONTROL GROUP | EXPOSED GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30-day | | 60-day | | 90-day | | 120-day | |
| | | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C |
| | 0.1240<br>0.0360 | 0.1830<br>0.1880 | 0.3320<br>0.3110 | 0.2850<br>0.2760 | 0.2910<br>0.2630 | 0.1690<br>0.2670 | 0.2670<br>2.9400 | 0.1080<br>0.1180 | 0.0630<br>0.1290 |
| Mean of Control Group= | 0.0800 | | | | | | | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0622 | | | | | | | | |
| Std. Deviation of Mean of Control Group as % = | 77.8 | | | | | | | | |
| Mean of Exposed Group= | | 0.1855 | 0.3215 | 0.2805 | 0.2770 | 0.2180 | 1.6035 | 0.1130 | 0.0960 |
| Change in Exposed Mean from Control Mean= | | 0.1055 | 0.2415 | 0.2005 | 0.1970 | 0.1380 | 1.5235 | 0.0330 | 0.0160 |
| Percent change in Exposed Mean from Control Mean= | | 131.88 | 301.88 | 250.63 | 246.25 | 172.50 | 1904.38 | 41.25 | 20.00 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | No | No | Yes | Yes |




000221

906

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

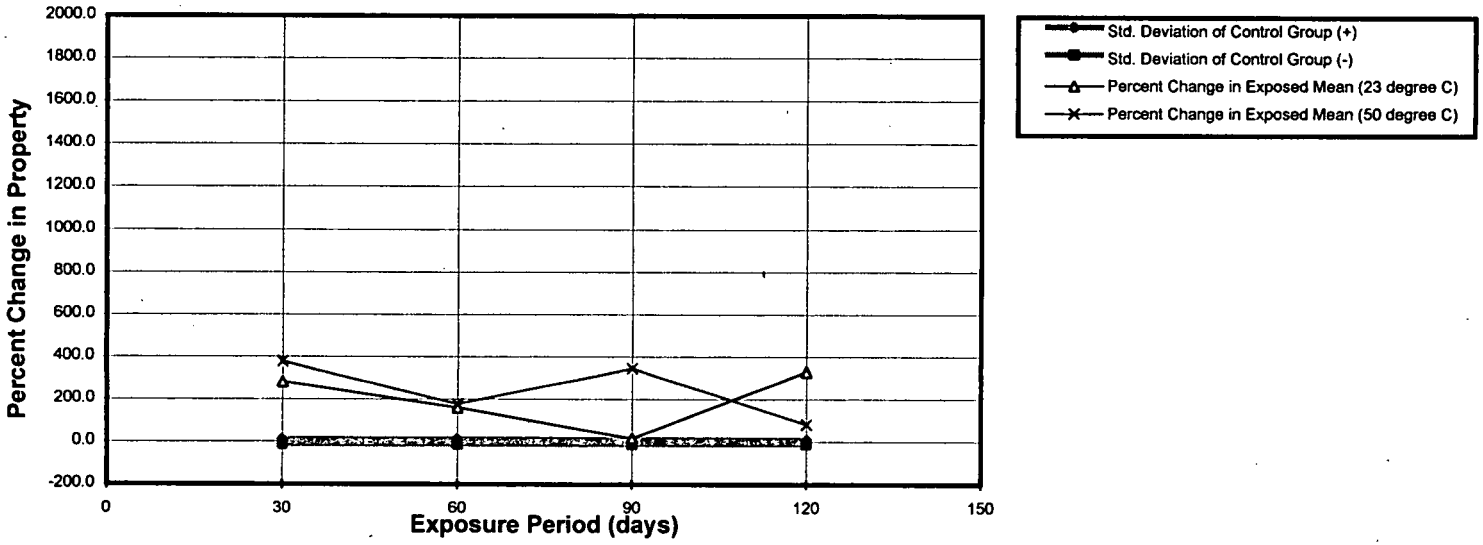
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D3421
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** POLYFLEX
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** EXTRACTABLES CONTENT (%)
**DIRECTION:** N/A

| | CONTROL GROUP | EXPOSED GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30-day | | 60-day | | 90-day | | 120-day | |
| | | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C |
| | 0.0710<br>0.0610 | 0.2350<br>0.2700 | 0.3420<br>0.2890 | 0.1750<br>0.1690 | 0.1790<br>0.1870 | 0.0610<br>0.0930 | 0.1640<br>0.4250 | 0.2560<br>0.3130 | 0.2090<br>0.0320 |
| Mean of Control Group= | 0.0660 | | | | | | | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0071 | | | | | | | | |
| Std. Deviation of Mean of Control Group as % = | 10.7 | | | | | | | | |
| Mean of Exposed Group= | | 0.2525 | 0.3155 | 0.1720 | 0.1830 | 0.0770 | 0.2945 | 0.2845 | 0.1205 |
| Change in Exposed Mean from Control Mean= | | 0.1865 | 0.2495 | 0.1060 | 0.1170 | 0.0110 | 0.2285 | 0.2185 | 0.0545 |
| Percent change in Exposed Mean from Control Mean= | | 282.58 | 378.03 | 160.61 | 177.27 | 16.67 | 346.21 | 331.06 | 82.58 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | No | No | No | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

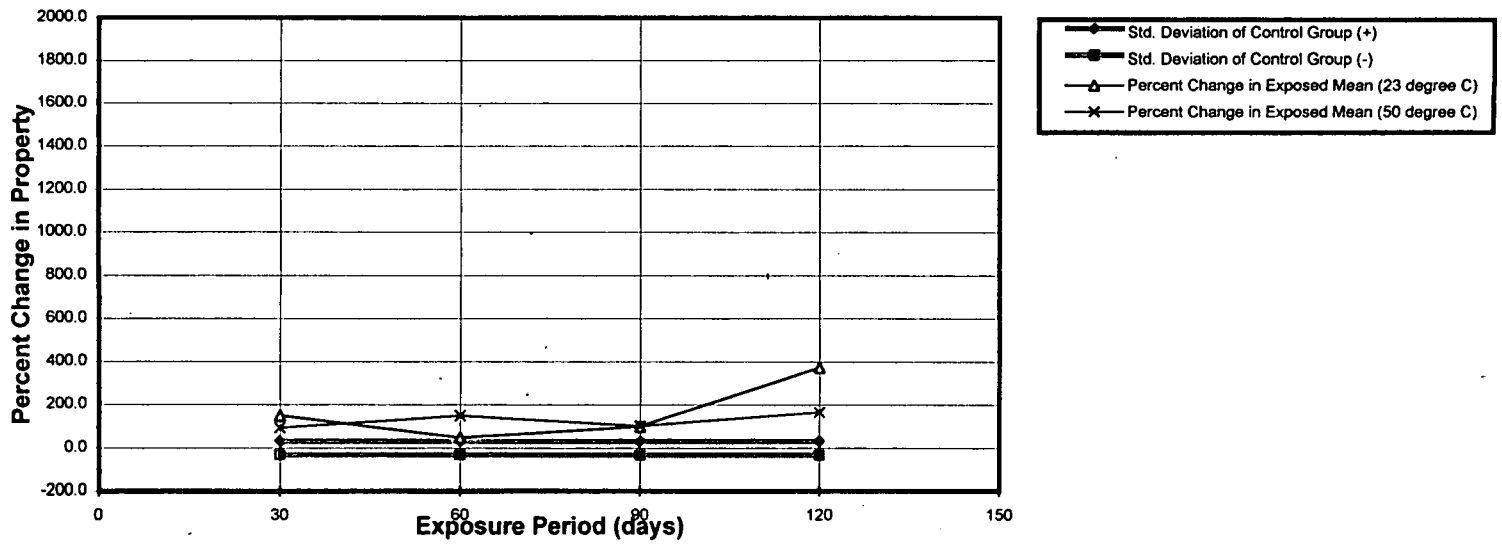
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D3421*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** EXTRACTABLES CONTENT (%)
**DIRECTION:** N/A

| | CONTROL GROUP | EXPOSED GROUPS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30-day | | 60-day | | 90-day | | 120-day | |
| | | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C | @ 23°C | @ 50°C |
| | 0.0520<br>0.0820 | 0.1710<br>0.1640 | 0.1370<br>0.1230 | 0.1030<br>0.0980 | 0.1620<br>0.1710 | 0.1310<br>0.1380 | 0.1370<br>0.1350 | 0.2990<br>0.3350 | 0.2410<br>0.1140 |
| Mean of Control Group= | 0.0670 | | | | | | | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.0212 | | | | | | | | |
| Std. Deviation of Mean of Control Group as % = | 31.7 | | | | | | | | |
| Mean of Exposed Group= | | 0.1675 | 0.1300 | 0.1005 | 0.1665 | 0.1345 | 0.1360 | 0.3170 | 0.1775 |
| Change in Exposed Mean from Control Mean= | | 0.1005 | 0.0630 | 0.0335 | 0.0995 | 0.0675 | 0.0690 | 0.2500 | 0.1105 |
| Percent change in Exposed Mean from Control Mean= | | 150.00 | 94.03 | 50.00 | 148.51 | 100.75 | 102.99 | 373.13 | 164.93 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | No | No | No | No |



## 2.7 STRESS AND STRAIN AT YIELD

## 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 for 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 percent changes in stress and strain at yield of the five geomembranes.

GSE-SLT Geomembrane. The percent change in stress at yield due to exposure were not within one standard deviation of the control means for any of the exposures except the 60-day exposures at 23°C and 50°C in the roll direction, and the 60-day exposure at 50°C in the cross-roll direction. In general, the percent changes in property decreased with exposure time in both roll and cross-roll

directions; however, this trend was not consistent between exposures at the two temperatures.

The percent change in strain at yield due to exposure were within one standard deviation of the control means for all exposures except the 30-day and 120-day exposures at 23°C in the roll direction, and the 30-day and the 60-day exposures at 23°C, and 120-day exposure at 50°C in the cross-roll direction. In the roll direction, the change in property increased with exposure time; this was consistent between temperatures. In the cross-roll direction, an increase in property change with exposure time was noted for exposures at 50°C; exposures at 23°C showed randomness, and no consistent trend was observed.

NSC Geomembrane. In the roll direction, the percent changes in stress at yield due to exposure were within one standard deviation of the control means for all of the exposures except the 30-day and the 90-day exposures at 23°C. In the cross-roll direction, the percent changes in stress at yield due to exposure were not within one standard deviation of the control means for all of the exposures except the 90-day exposures at 23°C and 50°C. In the roll direction, the property changes remained relatively constant with exposure time and temperature. In the cross-roll direction, the property changes decreased with exposure time; however, this trend was not consistent between temperatures.

In the roll direction, the percent changes in strain at yield due to exposure were within one standard deviation of the control means for all of the exposures except the 120-day exposure at 23°C, and the 60-day and the 90-day exposures at 50°C. In the cross-roll direction, the percent changes in strain at yield due to exposure were not within one standard deviation of the control means for all of the exposures except the 120-day exposures at 23°C and 50°C. In roll direction, the percent changes remained fairly constant with exposure time; the exposures at the higher temperature resulted in larger percent changes. In the cross-roll direction, a general increase in percent property change with exposure time was observed; however, this trend was not consistent between the two temperatures.

GSE-Gundle Geomembrane. In the roll direction, the percent changes in stress at yield due to exposure were not within one standard deviation of the control means for any of the exposures except the 60-day exposure at 23°C and the 30-day exposure at 50°C. In the cross-roll direction, the percent changes in stress at yield

due to exposure were not within one standard deviation of the control means for any of the exposures except the 60-day, the 90-day, and 120-day exposures at 50°C. In general, percent changes decreased in the roll direction and increased in the cross-roll direction with exposure time; the trends were not consistent between temperatures.

In the roll direction, the percent changes in strain at yield due to exposure were within one standard deviation of the control means for all the exposures except the 30-day and 60-day exposures at 23°C, and the 60-day exposure at 50°C. In the cross-roll direction, the percent change in strain at yield due to exposure were not within one standard deviation of the control means for any of the exposures except the 120-day exposure at 23°C and the 90-day exposure at 50°C. In the roll direction, the results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature. In the cross-roll direction, the percent changes decreased with exposure time; however, this trend was not consistent between temperatures.

PolyFlex Geomembrane. The percent changes in stress at yield due to exposure were not within one standard deviation of the control means for any of the exposures except the 30-day and the 90-day exposures at 23°C in the roll direction, and the 60-day exposure at 23°C in the cross-roll direction. The results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature in either direction.

In the roll direction, the percent changes in strain at yield due to exposure were within one standard deviation of the control means for all of the exposures except the 60-day exposure at 23°C and the 30-day exposure at 50°C. In the cross-roll direction, the percent changes in strain at yield due to exposure were within one standard deviation of the control means for all the exposures except the 30-day and the 60-day exposures 23°C and 50°C. In the roll direction, the percent changes remained relatively constant with exposure time and temperature. In the cross-roll direction, the results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

Serrot Geomembrane. In the roll direction, the percent changes in stress at yield due to exposure were within one standard deviation of the control means for all of the exposures except the 60-day exposure at 50°C. In the cross-roll direction, the

percent changes in stress at yield due to exposure were not within one standard deviation of the control means for any of the exposures except the 90-day exposures at 23°C and 50°C. In the roll direction, the percent change remained relatively constant with exposure time and temperature. In the cross-roll direction, the percent property change decreased with exposure time; however, this trend was contradicted between temperatures.

In the roll direction, the percent changes in strain at yield due to exposure were within one standard deviation of the control means for all of the exposures except the 60-day and the 90-day exposures at 23°C, and the 90-day exposure at 50°C. In the cross-roll direction, the percent change in strain at yield due to exposure were not within one standard deviation of the control means for any of the exposures except the 60-day exposures 23°C, and the 120-day exposure at 50°C. In both directions, the results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

*Conclusion*

The means of the percent changes in stress at yield were less than one standard deviation of the control means for at least 5 out of 8 exposures for NSC and Serrot geomembranes in the roll direction. The means of the percent changes in strain at yield were less than one standard deviation of the control means for at least 5 out of 8 exposures for all the geomembranes in the roll direction and GSE-SLT geomembrane in the cross-roll direction. No consistent trends between exposure time and temperature were observed for the five geomembranes for stress or strain at yield in either direction. Therefore, no detrimental effects are expected to the tested property due to exposure to the leachate.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

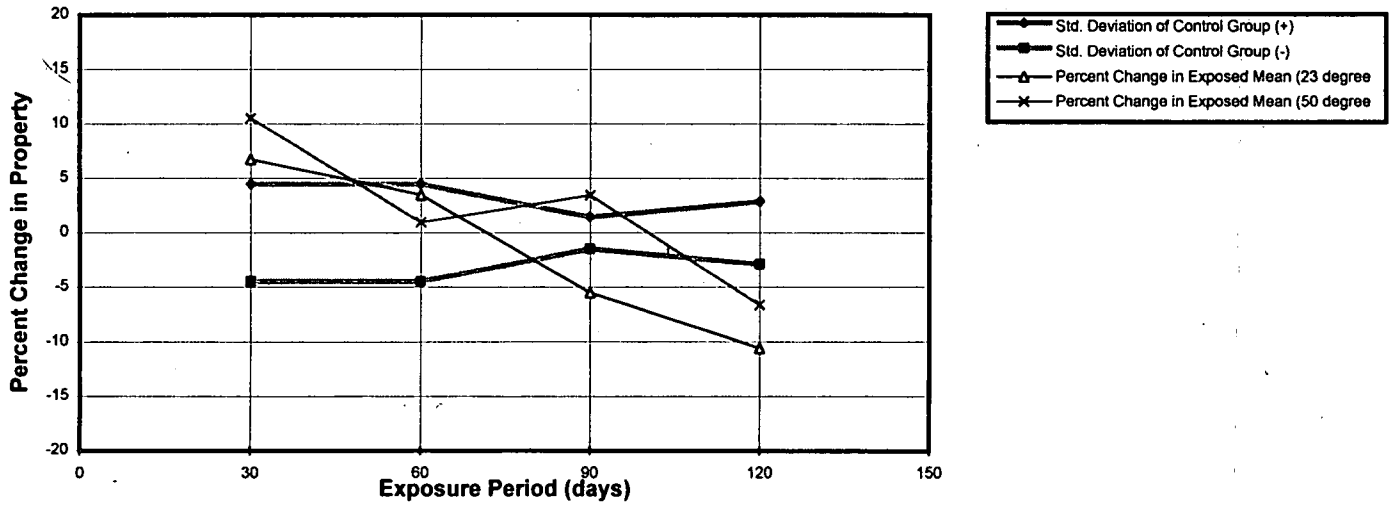
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT YIELD (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 2252.5 | 2492.5 | 2457.5 | 2255.0 | 2250.0 | 2535.0 | 2305.0 | 2652.5 | 2612.5 | 2200.0 | 2350.0 |
| | 2255.0 | 2367.5 | 2482.5 | 2275.0 | 2315.0 | 2595.0 | 2497.5 | 2657.5 | 2556.3 | 2250.0 | 2375.0 |
| | 2162.5 | 2387.5 | 2510.0 | 2322.5 | 2260.0 | 2625.0 | 2445.0 | 2670.0 | 2581.3 | 2300.0 | 2362.5 |
| | 2187.5 | 2370.0 | 2522.5 | 2380.0 | 2245.0 | 2625.0 | 2475.0 | 2665.0 | 2450.0 | 2275.0 | 2375.0 |
| | 2420.0 | 2422.5 | 2495.0 | 2437.5 | 2317.5 | 2572.5 | 2517.5 | 2755.0 | 2462.5 | 2300.0 | 2362.5 |
| Mean of Control Group= | 2255.5 | | | | | 2590.5 | | | 2532.5 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 100.4 | | | | | 38.1 | | | 72.5 | | |
| Std. Deviation of Mean of Control Group as % = | 4.5 | | | | | 1.5 | | | 2.9 | | |
| Mean of Exposed Group= | | 2408.0 | 2493.5 | 2334.0 | 2277.5 | | 2448.0 | 2680.0 | | 2265.0 | 2365.0 |
| Change in Exposed Mean from Control Mean= | | 152.5 | 238.0 | 78.5 | 22.0 | | -142.5 | 89.5 | | -267.5 | -167.5 |
| Percent change in Exposed Mean from Control Mean= | | 6.76 | 10.55 | 3.48 | 0.98 | | -5.50 | 3.45 | | -10.56 | -6.61 |
| Is change less than one Std. Deviation of Control Group? | | No | No | Yes | Yes | | No | No | | No | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

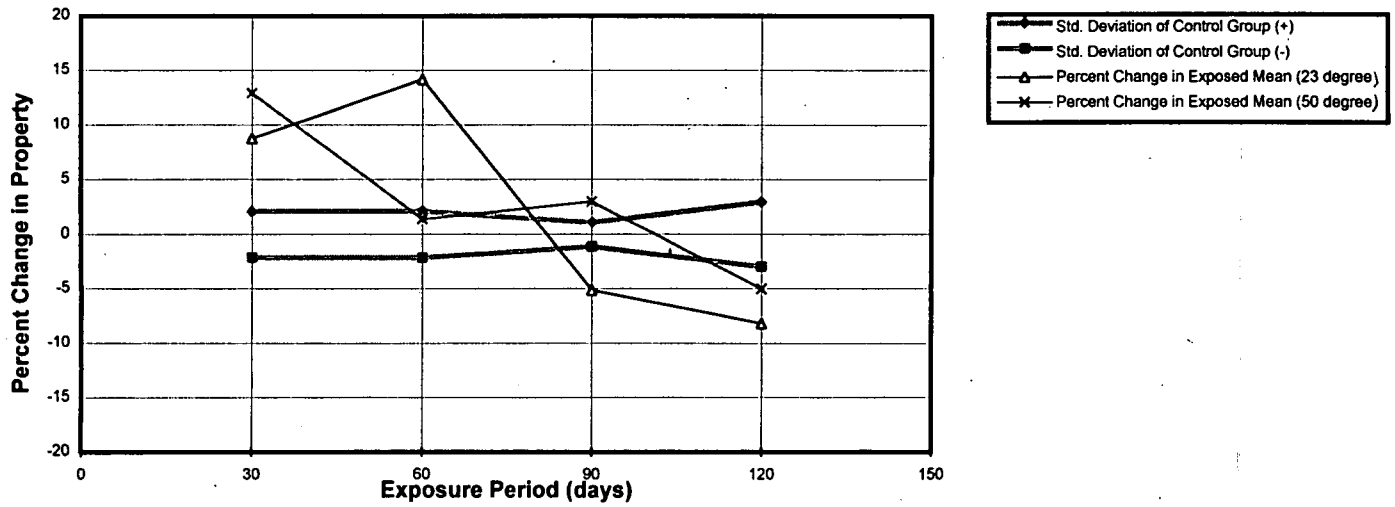
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT YIELD (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 2195.0 | 2365.0 | 2495.0 | 2297.5 | 2220.0 | 2562.5 | 2385.0 | 2662.5 | 2562.5 | 2225.0 | 2375.0 |
| | 2100.0 | 2377.5 | 2597.5 | 2510.0 | 2197.5 | 2632.5 | 2542.5 | 2727.5 | 2481.3 | 2275.0 | 2375.0 |
| | 2207.5 | 2402.5 | 2435.0 | 2590.0 | 2177.5 | 2617.5 | 2425.0 | 2675.0 | 2362.5 | 2262.5 | 2375.0 |
| | 2212.5 | 2360.0 | 2410.0 | 2532.5 | 2222.5 | 2612.5 | 2515.0 | 2720.0 | 2512.5 | 2275.0 | 2362.5 |
| | 2202.5 | 2370.0 | 2390.0 | 2535.0 | 2252.5 | 2635.0 | 2525.0 | 2667.5 | 2481.3 | 2350.0 | 2287.5 |
| Mean of Control Group= | 2183.5 | | | | | 2612.0 | | | 2480.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 47.1 | | | | | 29.3 | | | 73.6 | | |
| Std. Deviation of Mean of Control Group as % = | 2.2 | | | | | 1.1 | | | 3.0 | | |
| Mean of Exposed Group= | | 2375.0 | 2465.5 | 2493.0 | 2214.0 | | 2478.5 | 2690.5 | | 2277.5 | 2355.0 |
| Change in Exposed Mean from Control Mean= | | 191.5 | 282.0 | 309.5 | 30.5 | | -133.5 | 78.5 | | -202.5 | -125.0 |
| Percent change in Exposed Mean from Control Mean= | | 8.77 | 12.92 | 14.17 | 1.40 | | -5.11 | 3.01 | | -8.17 | -5.04 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | Yes | | No | No | | No | No |




002229

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

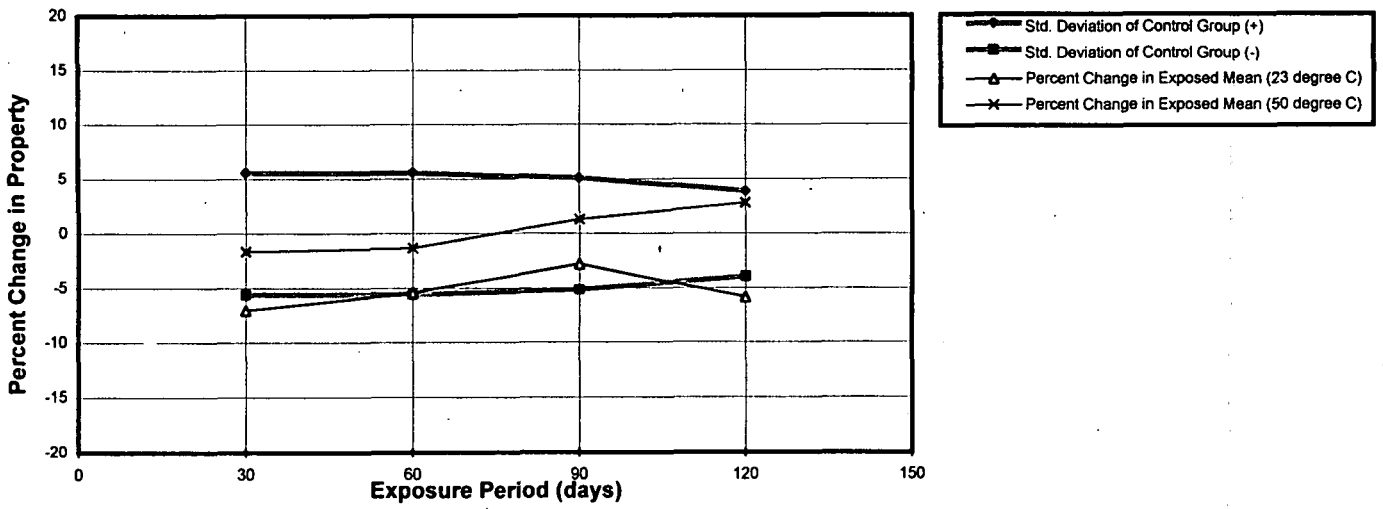
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** GSE-SLT
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** STRAIN AT YIELD (%)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 21.7 | 20.4 | 21.7 | 22.3 | 20.4 | 23.0 | 20.5 | 21.7 | 23.0 | 21.8 | 22.4 |
| | 21.0 | 19.9 | 21.2 | 21.2 | 21.7 | 22.3 | 22.4 | 21.2 | 22.3 | 19.8 | 23.1 |
| | 23.7 | 20.4 | 21.2 | 20.9 | 21.8 | 21.7 | 21.2 | 23.0 | 21.2 | 19.8 | 21.7 |
| | 23.1 | 21.7 | 22.4 | 20.4 | 22.8 | 20.4 | 20.4 | 21.7 | 22.5 | 20.4 | 23.0 |
| | 21.0 | 20.5 | 22.4 | 19.9 | 22.4 | 20.5 | 20.4 | 21.8 | 21.1 | 21.8 | 23.0 |
| Mean of Control Group= | 22.1 | | | | | 21.6 | | | 22.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 1.2 | | | | | 1.1 | | | 0.9 | | |
| Std. Deviation of Mean of Control Group as % = | 5.6 | | | | | 5.1 | | | 3.9 | | |
| Mean of Exposed Group= | | 20.6 | 21.8 | 20.9 | 21.8 | | 21.0 | 21.9 | | 20.7 | 22.6 |
| Change in Exposed Mean from Control Mean= | | -1.6 | -0.4 | -1.2 | -0.3 | | -0.6 | 0.3 | | -1.3 | 0.6 |
| Percent change in Exposed Mean from Control Mean= | | -7.01 | -1.64 | -5.37 | -1.32 | | -2.76 | 1.30 | | -5.83 | 2.79 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | Yes | Yes | | Yes | Yes | | No | Yes |




000230

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

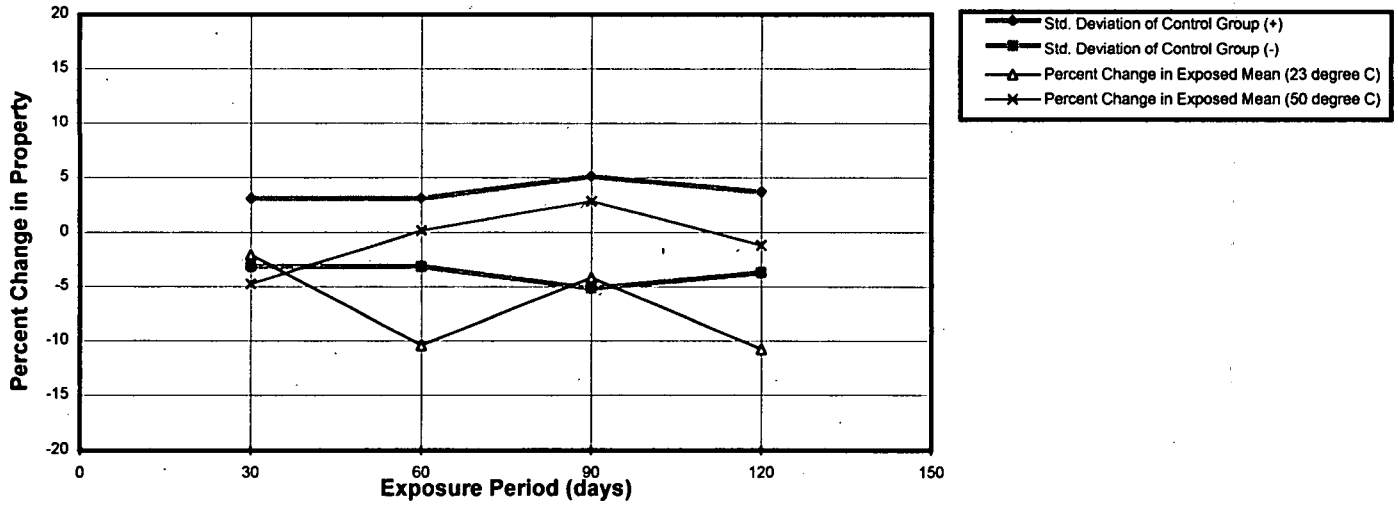
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT YIELD (%)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 22.3 | 21.7 | 20.4 | 19.8 | 21.8 | 21.7 | 19.9 | 23.6 | 22.5 | 19.8 | 22.4 |
| | 23.2 | 21.8 | 20.5 | 19.2 | 22.3 | 20.4 | 22.5 | 20.5 | 21.7 | 20.4 | 23.1 |
| | 21.3 | 21.8 | 20.6 | 19.6 | 22.9 | 21.2 | 19.9 | 23.1 | 23.0 | 20.5 | 22.3 |
| | 22.3 | | 23.7 | 19.1 | 21.8 | 22.9 | 21.8 | 22.4 | 23.7 | 20.4 | 23.0 |
| | 21.8 | 21.7 | 20.5 | 21.8 | 22.4 | 22.9 | 20.6 | 22.6 | 23.6 | 21.0 | 22.4 |
| Mean of Control Group= | 22.2 | | | | | 21.8 | | | 22.9 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.7 | | | | | 1.1 | | | 0.8 | | |
| Std. Deviation of Mean of Control Group as % = | 3.1 | | | | | 5.1 | | | 3.7 | | |
| Mean of Exposed Group= | | 21.7 | 21.1 | 19.9 | 22.2 | | 20.9 | 22.4 | | 20.4 | 22.6 |
| Change in Exposed Mean from Control Mean= | | -0.5 | -1.1 | -2.3 | 0.0 | | -0.9 | 0.6 | | -2.5 | -0.3 |
| Percent change in Exposed Mean from Control Mean= | | -2.05 | -4.74 | -10.41 | 0.16 | | -4.13 | 2.86 | | -10.76 | -1.16 |
| Is change less than one Std. Deviation of Control Group? | | Yes | No | No | Yes | | Yes | Yes | | No | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

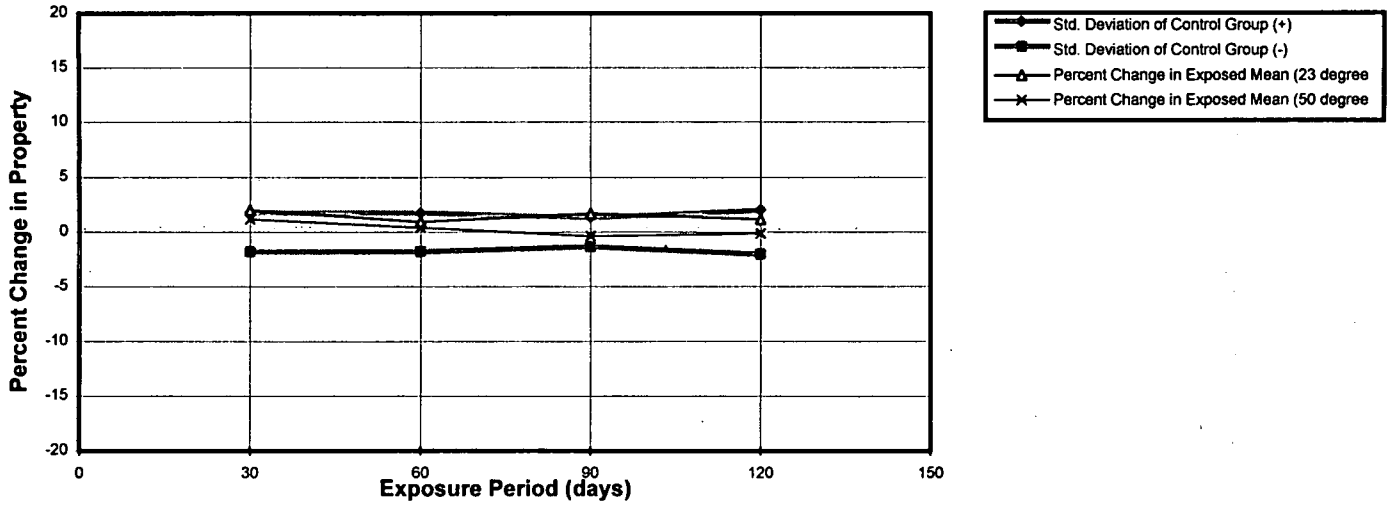
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT YIELD (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 2575.0 | 2562.5 | 2587.5 | 2530.0 | 2495.0 | 2607.5 | 2695.0 | 2640.0 | 2537.5 | 2525.0 | 2545.0 |
| | 2505.0 | 2640.0 | 2575.0 | 2625.0 | 2575.0 | 2642.5 | 2707.5 | 2592.5 | 2562.5 | 2547.5 | 2520.0 |
| | 2495.0 | 2640.0 | 2505.0 | 2545.0 | 2592.5 | 2685.0 | 2717.5 | 2692.5 | 2568.8 | 2572.5 | 2570.0 |
| | 2505.0 | 2505.0 | 2577.5 | 2497.5 | 2520.0 | 2627.5 | 2687.5 | 2557.5 | 2443.8 | 2597.5 | 2537.5 |
| | 2590.0 | 2577.5 | 2572.5 | 2592.5 | 2537.5 | 2685.0 | 2667.5 | 2717.5 | 2543.8 | 2562.5 | 2467.5 |
| Mean of Control Group= | 2534.0 | | | | | 2649.5 | | | 2531.3 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 44.8 | | | | | 34.7 | | | 50.6 | | |
| Std. Deviation of Mean of Control Group as % = | 1.8 | | | | | 1.3 | | | 2.0 | | |
| Mean of Exposed Group= | | 2585.0 | 2563.5 | 2558.0 | 2544.0 | | 2695.0 | 2640.0 | | 2561.0 | 2528.0 |
| Change in Exposed Mean from Control Mean= | | 51.0 | 29.5 | 24.0 | 10.0 | | 45.5 | -9.5 | | 29.8 | -3.3 |
| Percent change in Exposed Mean from Control Mean= | | 2.01 | 1.16 | 0.95 | 0.39 | | 1.72 | -0.36 | | 1.18 | -0.13 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | Yes | Yes | | No | Yes | | Yes | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

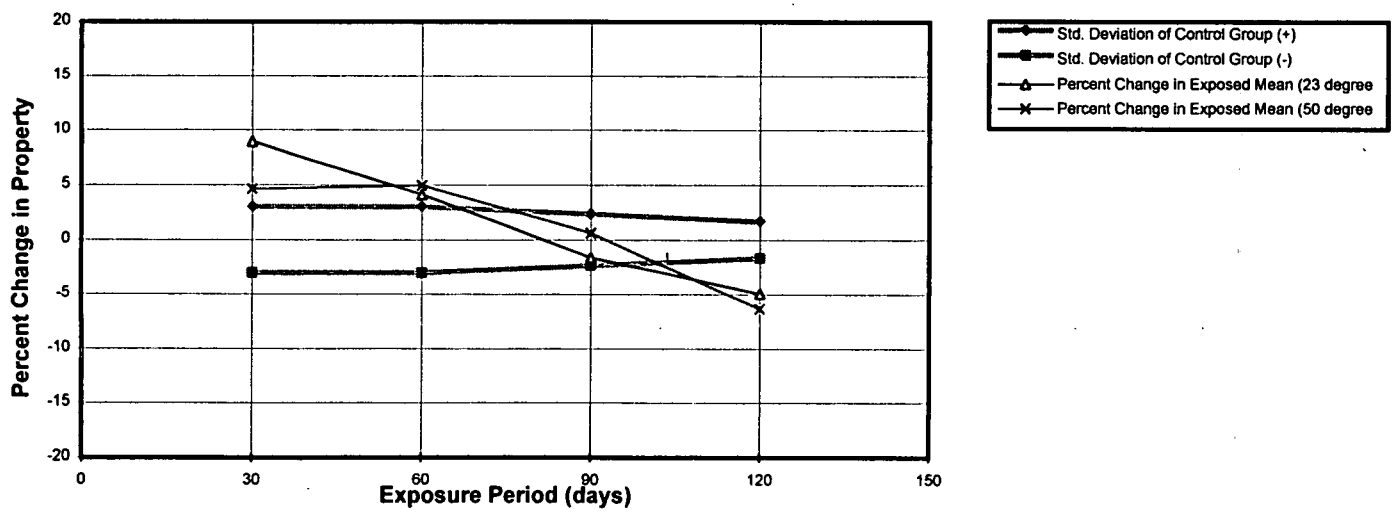
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** NSC
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** STRESS AT YIELD (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 2512.5 | 2605.0 | 2660.0 | 2727.5 | 2562.5 | 2562.5 | 2550.0 | 2627.5 | 2622.5 | 2592.5 | 2470.0 |
| | 2475.0 | 2682.5 | 2590.0 | 2667.5 | 2610.0 | 2625.0 | 2610.0 | 2647.5 | 2642.5 | 2530.0 | 2485.0 |
| | 2487.5 | 2767.5 | 2617.5 | 2520.0 | 2770.0 | 2625.0 | 2572.5 | 2585.0 | 2662.5 | 2550.0 | 2520.0 |
| | 2397.5 | 2825.0 | 2565.0 | 2560.0 | 2595.0 | 2627.5 | 2682.5 | 2730.0 | 2697.5 | 2560.0 | 2520.0 |
| | 2605.0 | 2717.5 | 2622.5 | 2520.0 | 2560.0 | 2735.0 | 2547.5 | 2665.0 | 2732.5 | 2470.0 | 2515.0 |
| Mean of Control Group= | 2495.5 | | | | | 2635.0 | | | 2671.5 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 74.8 | | | | | 62.3 | | | 43.9 | | |
| Std. Deviation of Mean of Control Group as % = | 3.0 | | | | | 2.4 | | | 1.6 | | |
| Mean of Exposed Group= | | 2719.5 | 2611.0 | 2599.0 | 2619.5 | | 2592.5 | 2651.0 | | 2540.5 | 2502.0 |
| Change in Exposed Mean from Control Mean= | | 224.0 | 115.5 | 103.5 | 124.0 | | -42.5 | 16.0 | | -131.0 | -169.5 |
| Percent change in Exposed Mean from Control Mean= | | 8.98 | 4.63 | 4.15 | 4.97 | | -1.61 | 0.61 | | -4.90 | -6.34 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | Yes | Yes | | No | No |




000233

906

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

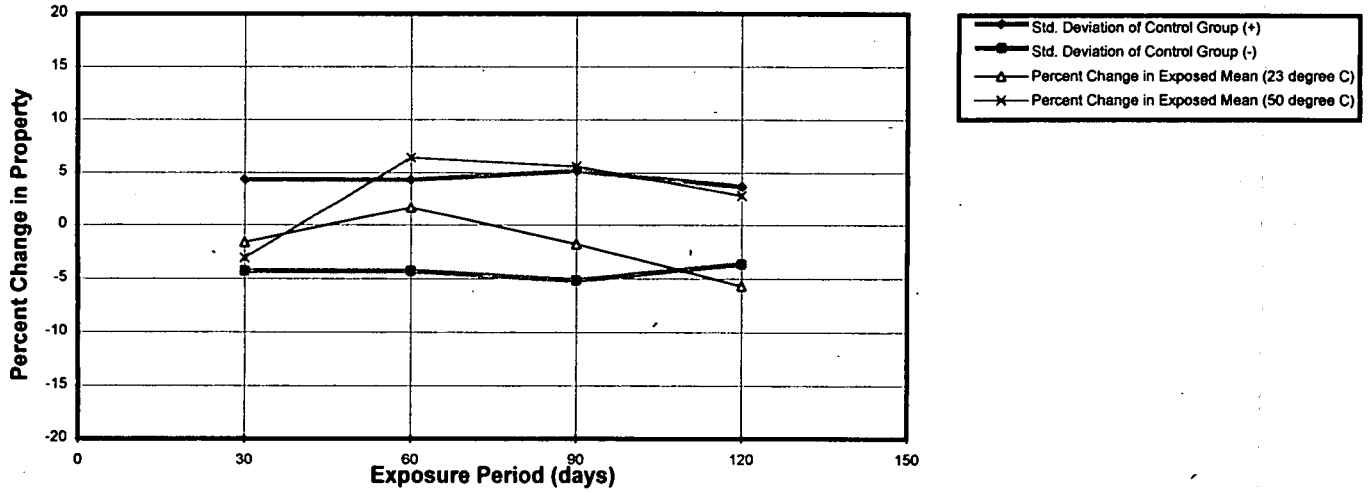
# CHEMICAL COMPATIBILITY TEST RESULTS

*CLIENT:* FERMCO
*METHOD:* ASTM D638
*DATE TESTED:* 6/14/96

*GEOSYNTEC JOB NO.:* GE3900
*MATERIAL TYPE:* NSC
*CHARACTERISTICS:* 80 mil HDPE Geomembrane
*IMMERSION MEDIUM:* Perched Ground Water

**PROPERTY (UNIT):** STRAIN AT YIELD (%)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 21.3 | 20.5 | 20.4 | 21.8 | 22.9 | 19.8 | 20.4 | 22.3 | 21.7 | 20.4 | 23.1 |
| | 21.8 | 20.4 | 20.5 | 20.5 | 21.2 | 20.5 | 20.5 | 21.2 | 23.1 | 22.3 | 23.1 |
| | 21.1 | 20.4 | 20.5 | 22.3 | 22.4 | 21.7 | 21.6 | 22.4 | 22.4 | 21.2 | 23.7 |
| | 19.9 | 20.5 | 19.2 | 19.9 | 21.0 | 22.4 | 20.5 | 22.3 | 23.6 | 22.3 | 23.6 |
| | 19.8 | 20.4 | 20.0 | 21.1 | 23.0 | 20.4 | 19.9 | 22.4 | 23.6 | 21.7 | 24.2 |
| Mean of Control Group= | 20.8 | | | | | 20.9 | | | 22.9 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.9 | | | | | 1.1 | | | 0.8 | | |
| Std. Deviation of Mean of Control Group as % = | 4.3 | | | | | 5.2 | | | 3.7 | | |
| Mean of Exposed Group= | | 20.4 | 20.1 | 21.1 | 22.1 | | 20.6 | 22.1 | | 21.6 | 23.5 |
| Change in Exposed Mean from Control Mean= | | -0.3 | -0.6 | 0.3 | 1.3 | | -0.4 | 1.2 | | -1.3 | 0.6 |
| Percent change in Exposed Mean from Control Mean= | | -1.60 | -3.09 | 1.67 | 6.41 | | -1.77 | 5.59 | | -5.69 | 2.82 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | No | | Yes | No | | No | Yes |




000234

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

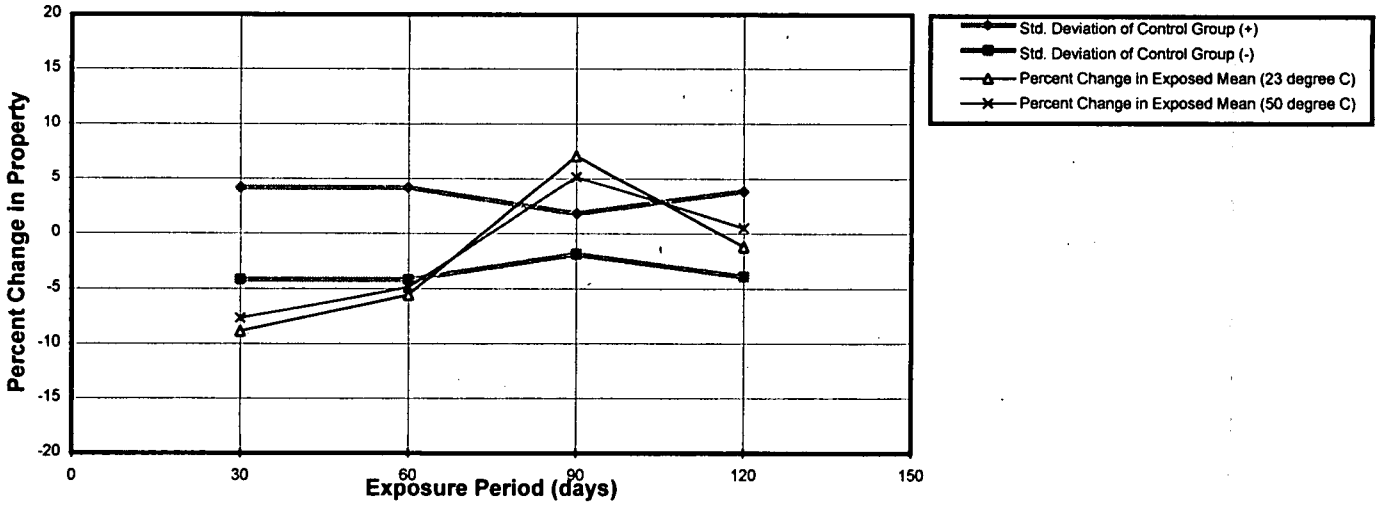
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT YIELD (%)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 21.8 | 20.5 | 20.7 | 20.4 | 20.6 | 20.6 | 22.3 | 21.7 | 21.7 | 21.7 | 21.7 |
| | 20.5 | 19.9 | 20.4 | 19.7 | 20.4 | 19.6 | 19.9 | 21.7 | 21.0 | 22.3 | 22.4 |
| | 21.8 | 19.9 | 19.9 | 20.4 | 20.3 | 20.4 | 22.3 | 19.9 | 23.0 | 21.0 | 21.7 |
| | 22.4 | 19.8 | 20.4 | 21.8 | 21.8 | 20.4 | 22.4 | 22.3 | 21.8 | 21.8 | 22.3 |
| | 23.0 | 19.8 | 19.7 | 21.2 | 21.2 | 20.4 | 21.6 | 21.1 | 23.0 | 22.3 | 23.0 |
| Mean of Control Group= | 21.9 | | | | | 20.3 | | | 22.1 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.9 | | | | | 0.4 | | | 0.9 | | |
| Std. Deviation of Mean of Control Group as % = | 4.2 | | | | | 1.8 | | | 3.9 | | |
| Mean of Exposed Group= | | 20.0 | 20.2 | 20.7 | 20.8 | | 21.7 | 21.3 | | 21.8 | 22.2 |
| Change in Exposed Mean from Control Mean= | | -1.9 | -1.7 | -1.2 | -1.1 | | 1.4 | 1.0 | | -0.3 | 0.1 |
| Percent change in Exposed Mean from Control Mean= | | -8.89 | -7.68 | -5.52 | -4.87 | | 7.03 | 5.17 | | -1.19 | 0.54 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | No | No | | Yes | Yes |




000235

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

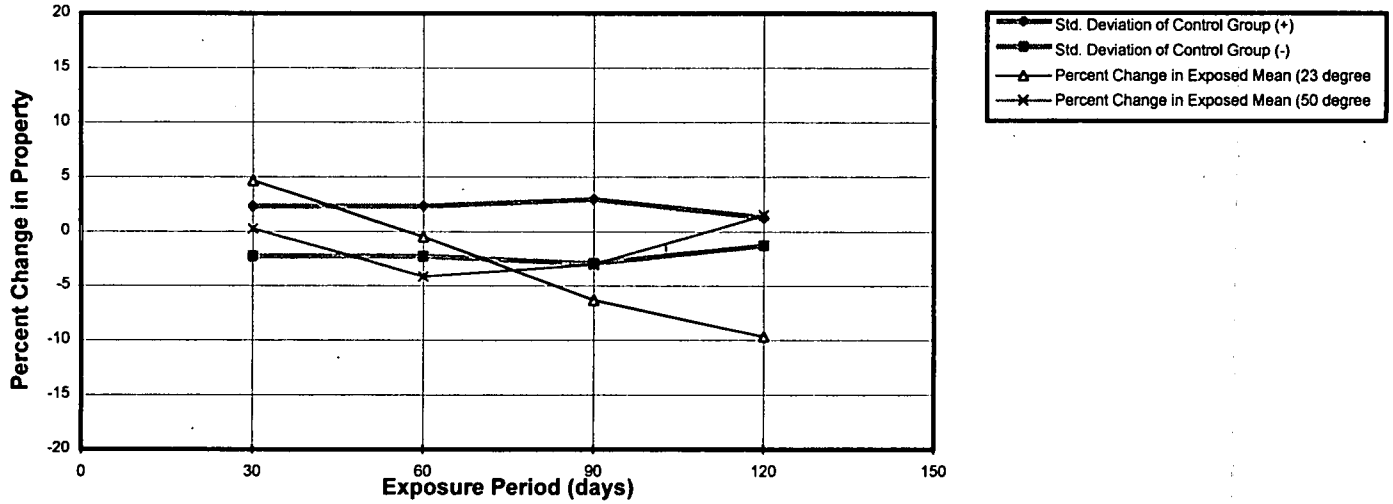
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT YIELD (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 2550.0 | 2610.0 | 2630.0 | 2562.5 | 2525.0 | 2770.0 | 2417.5 | 2695.0 | 2700.0 | 2442.5 | 2787.5 |
| | 2547.5 | 2675.0 | 2487.5 | 2481.3 | 2556.3 | 2885.0 | 2527.5 | 2612.5 | 2690.0 | 2440.0 | 2780.0 |
| | 2617.5 | 2662.5 | 2462.5 | 2462.5 | 2531.3 | 2750.0 | 2670.0 | 2607.5 | 2780.0 | 2462.5 | 2850.0 |
| | 2470.0 | 2615.0 | 2510.0 | 2612.5 | 2000.0 | 2690.0 | 2622.5 | 2715.0 | 2715.0 | 2470.0 | 2680.0 |
| | 2490.0 | 2705.0 | 2617.5 | 2493.8 | 2537.5 | 2682.5 | 2670.0 | 2730.0 | 2725.0 | 2480.0 | 2717.5 |
| Mean of Control Group= | 2535.0 | | | | | 2755.5 | | | 2722.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 58.0 | | | | | 81.6 | | | 35.1 | | |
| Std. Deviation of Mean of Control Group as % = | 2.3 | | | | | 3.0 | | | 1.3 | | |
| Mean of Exposed Group= | | 2653.5 | 2541.5 | 2522.5 | 2430.0 | | 2581.5 | 2672.0 | | 2459.0 | 2763.0 |
| Change in Exposed Mean from Control Mean= | | 118.5 | 6.5 | -12.5 | -105.0 | | -174.0 | -83.5 | | -263.0 | 41.0 |
| Percent change in Exposed Mean from Control Mean= | | 4.67 | 0.26 | -0.49 | -4.14 | | -6.31 | -3.03 | | -9.66 | 1.51 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | Yes | No | | No | No | | No | No |




000236

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

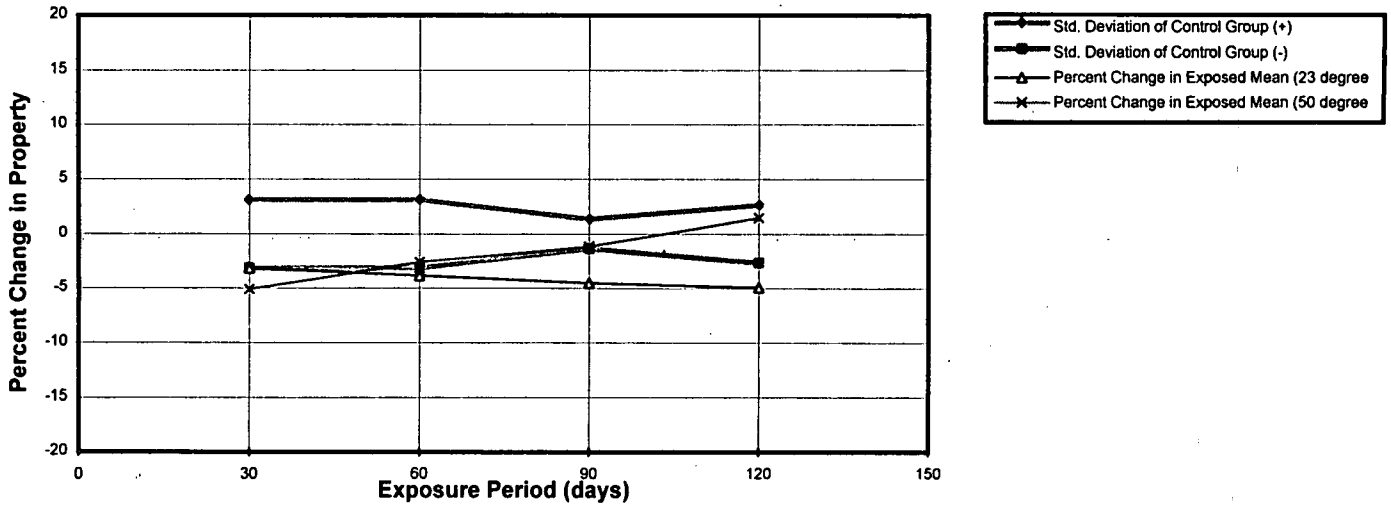
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** GSE-Gundle
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** STRESS AT YIELD (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 2797.0 | 2685.0 | 2560.0 | 2643.8 | 2656.3 | 2785.0 | 2770.0 | 2725.0 | 2707.5 | 2520.0 | 2730.0 |
| | 2870.8 | 2682.5 | 2595.0 | 2687.5 | 2687.5 | 2862.5 | 2667.5 | 2845.0 | 2710.0 | 2527.5 | 2862.5 |
| | 2650.8 | 2735.0 | 2692.5 | 2668.8 | 2756.3 | 2785.0 | 2637.5 | 2650.0 | 2810.0 | 2705.0 | 2845.0 |
| | 2773.1 | 2690.0 | 2667.5 | 2762.5 | 2750.0 | 2850.0 | 2672.5 | 2855.0 | 2877.5 | 2700.0 | 2845.0 |
| | 2853.1 | 2715.0 | 2722.5 | 2650.0 | 2731.3 | 2795.0 | 2697.5 | 2837.5 | 2815.0 | 2782.5 | 2842.5 |
| Mean of Control Group= | 2789.0 | | | | | 2815.5 | | | 2784.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 86.9 | | | | | 37.7 | | | 73.7 | | |
| Std. Deviation of Mean of Control Group as % = | 3.1 | | | | | 1.3 | | | 2.6 | | |
| Mean of Exposed Group= | | 2701.5 | 2647.5 | 2682.5 | 2716.3 | | 2689.0 | 2782.5 | | 2647.0 | 2825.0 |
| Change in Exposed Mean from Control Mean= | | -87.4 | -141.5 | -106.5 | -72.7 | | -126.5 | -33.0 | | -137.0 | 41.0 |
| Percent change in Exposed Mean from Control Mean= | | -3.14 | -5.07 | -3.82 | -2.61 | | -4.49 | -1.17 | | -4.92 | 1.47 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | Yes | | No | Yes | | No | Yes |




000237

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

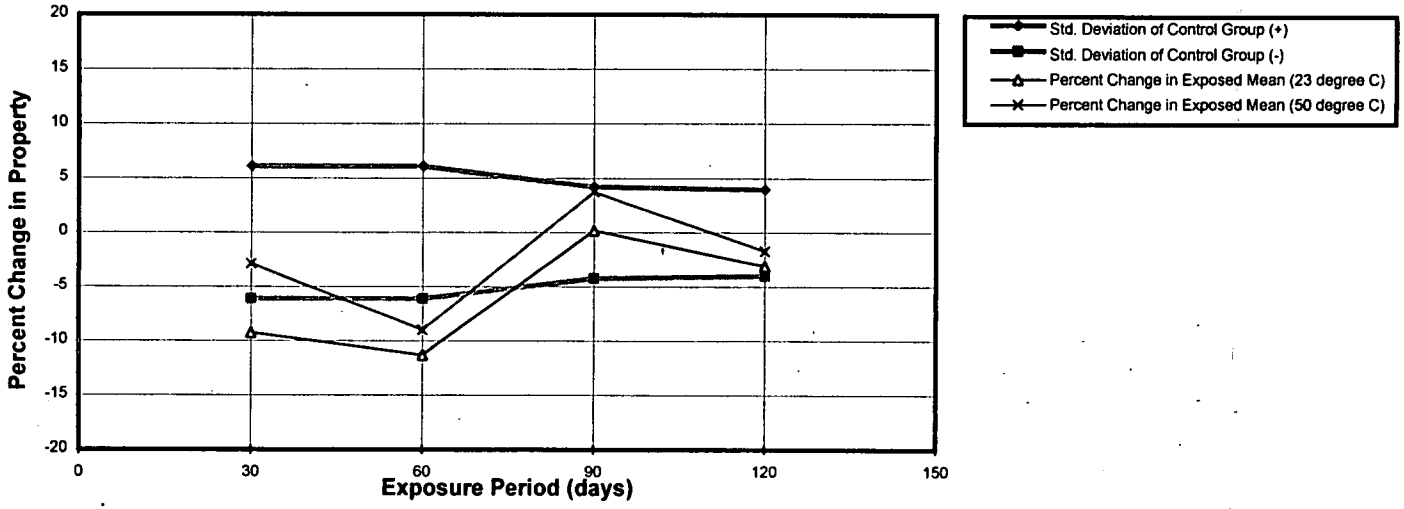
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** GSE-Gundle
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** STRAIN AT YIELD (%)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 21.7 | 18.6 | 19.3 | 20.0 | 19.8 | 20.4 | 21.8 | 20.4 | 21.0 | 19.8 | 20.4 |
| | 19.8 | 19.1 | 20.4 | 19.1 | 18.6 | 18.5 | 19.2 | 21.7 | 19.9 | 21.2 | 19.9 |
| | 19.1 | 19.9 | 20.5 | 18.0 | 19.1 | 20.4 | 19.9 | 21.7 | 21.8 | 20.4 | 21.8 |
| | 21.8 | 18.5 | 21.7 | 18.5 | 18.0 | 20.4 | 19.4 | 19.1 | 20.4 | 19.7 | 20.4 |
| | 21.7 | 18.5 | 19.2 | 16.7 | 19.3 | 19.7 | 19.4 | 20.4 | 21.7 | 20.5 | 20.4 |
| Mean of Control Group= | 20.8 | | | | | 19.9 | | | 20.9 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 1.3 | | | | | 0.8 | | | 0.8 | | |
| Std. Deviation of Mean of Control Group as % = | 6.1 | | | | | 4.2 | | | 4.0 | | |
| Mean of Exposed Group= | | 18.9 | 20.2 | 18.5 | 18.9 | | 19.9 | 20.6 | | 20.3 | 20.6 |
| Change in Exposed Mean from Control Mean= | | -1.9 | -0.6 | -2.3 | -1.9 | | 0.0 | 0.7 | | -0.6 | -0.4 |
| Percent change in Exposed Mean from Control Mean= | | -9.24 | -2.90 | -11.28 | -8.99 | | 0.16 | 3.71 | | -3.06 | -1.72 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | No | No | | Yes | Yes | | Yes | Yes |




002238

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

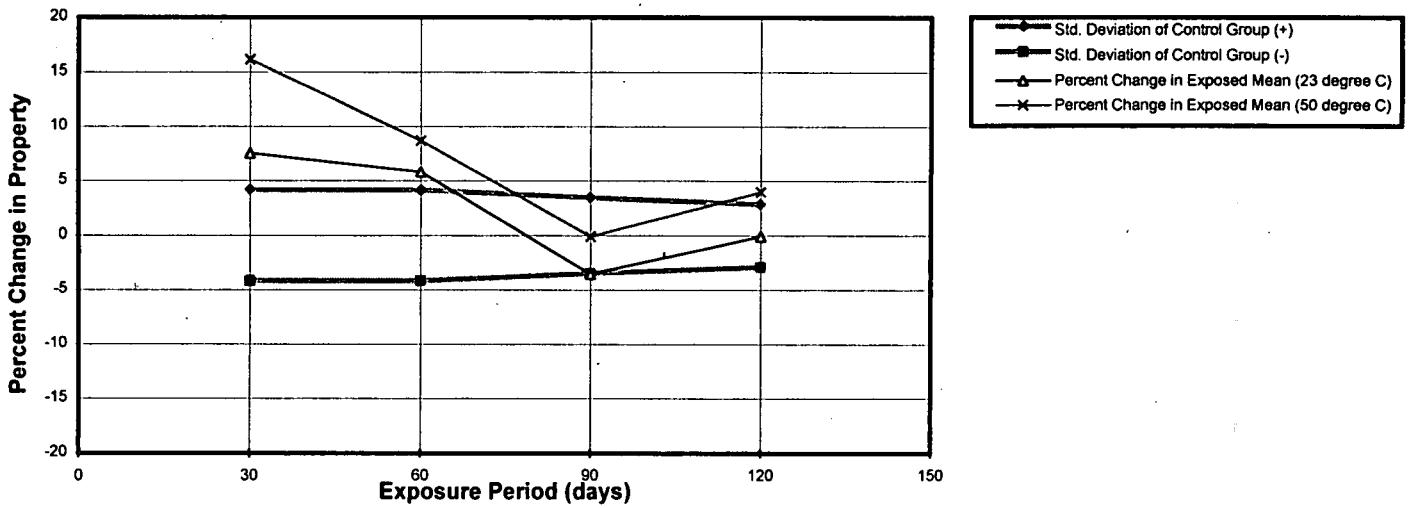
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** GSE-Gundle
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** STRAIN AT YIELD (%)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 16.0 | 18.3 | 21.7 | 18.6 | 17.9 | 20.4 | 19.1 | 19.1 | 19.9 | 20.4 | 20.4 |
| | 16.5 | 17.3 | 16.6 | 17.8 | 18.0 | 19.1 | 19.2 | 20.5 | 18.5 | 19.1 | 19.9 |
| | 17.9 | 19.1 | 19.2 | 18.6 | 17.3 | 19.2 | 19.2 | 20.0 | 19.8 | 19.3 | 20.4 |
| | 16.5 | 16.0 | 18.5 | 17.3 | 19.9 | 19.1 | 18.0 | 19.2 | 19.2 | 18.5 | 19.7 |
| | 16.5 | 19.1 | 21.0 | 16.1 | 17.7 | 20.4 | 19.2 | 19.3 | 19.1 | 19.1 | 19.9 |
| Mean of Control Group= | 16.7 | | | | | 19.6 | | | 19.3 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.7 | | | | | 0.7 | | | 0.6 | | |
| Std. Deviation of Mean of Control Group as % = | 4.2 | | | | | 3.5 | | | 2.9 | | |
| Mean of Exposed Group= | | 18.0 | 19.4 | 17.7 | 18.2 | | 19.0 | 19.6 | | 19.3 | 20.1 |
| Change in Exposed Mean from Control Mean= | | 1.3 | 2.7 | 1.0 | 1.5 | | -0.7 | 0.0 | | 0.0 | 0.8 |
| Percent change in Exposed Mean from Control Mean= | | 7.58 | 16.15 | 5.82 | 8.74 | | -3.53 | -0.10 | | -0.06 | 3.98 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | No | Yes | | Yes | No |




000239

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

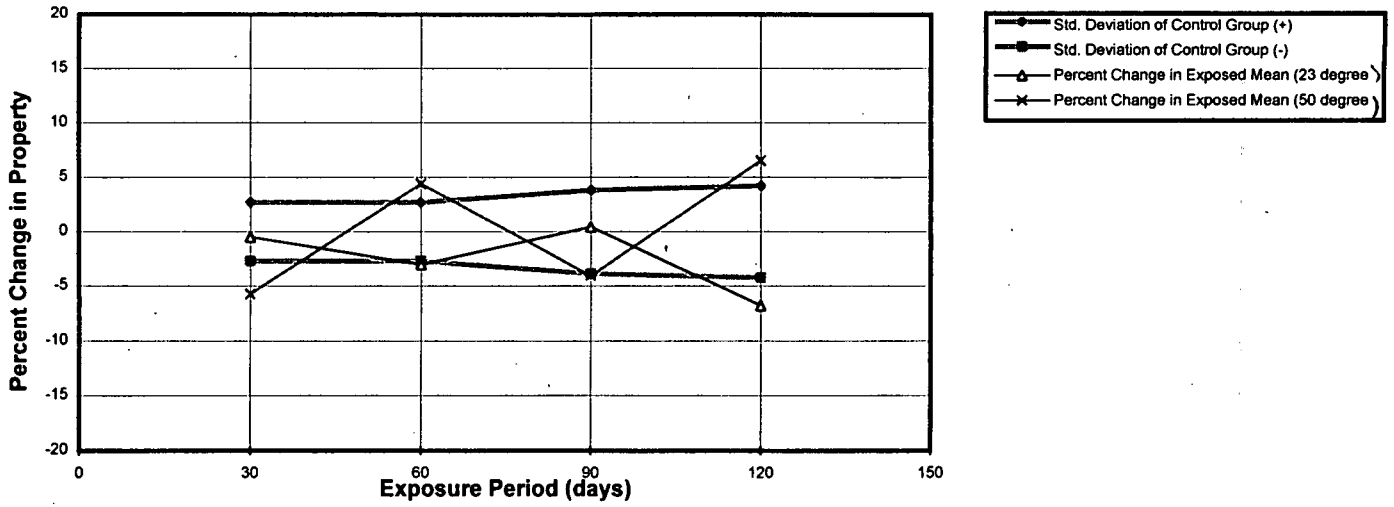
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT YIELD (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 2781.3 | 2705.0 | 2677.5 | 2615.0 | 2900.0 | 2827.5 | 2692.5 | 2725.0 | 2765.0 | 2572.5 | 3000.0 |
| | 2700.0 | 2787.5 | 2492.5 | 2600.0 | 2915.0 | 2855.0 | 2782.5 | 2877.5 | 2762.5 | 2420.0 | 2970.0 |
| | 2675.0 | 2810.0 | 2637.5 | 2505.0 | 2847.5 | 2672.5 | 2895.0 | 2717.5 | 2677.5 | 2477.5 | 2842.5 |
| | 2800.0 | 2647.5 | 2565.0 | 2870.0 | 2930.0 | 2897.5 | 2957.5 | 2645.0 | 2915.0 | 2592.5 | 2982.5 |
| | 2856.3 | 2795.0 | 2650.0 | 2805.0 | 2830.0 | 2967.5 | 2955.0 | 2677.5 | 2605.0 | 2735.0 | 2825.0 |
| Mean of Control Group= | 2762.5 | | | | | 2844.0 | | | 2745.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 74.3 | | | | | 109.5 | | | 115.9 | | |
| Std. Deviation of Mean of Control Group as % = | 2.7 | | | | | 3.8 | | | 4.2 | | |
| Mean of Exposed Group= | | 2749.0 | 2604.5 | 2679.0 | 2884.5 | | 2856.5 | 2728.5 | | 2559.5 | 2924.0 |
| Change in Exposed Mean from Control Mean= | | -13.5 | -158.0 | -83.5 | 122.0 | | 12.5 | -115.5 | | -185.5 | 179.0 |
| Percent change in Exposed Mean from Control Mean= | | -0.49 | -5.72 | -3.02 | 4.42 | | 0.44 | -4.06 | | -6.76 | 6.52 |
| Is change less than one Std. Deviation of Control Group? | | Yes | No | No | No | | Yes | No | | No | No |




000240

706

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

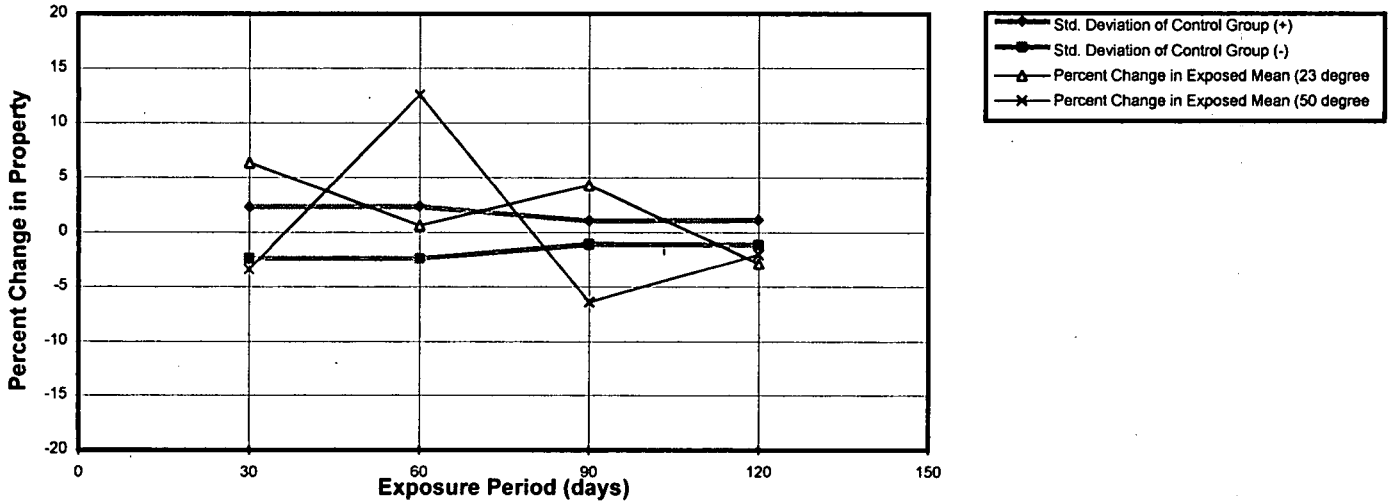
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** POLYFLEX
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** STRESS AT YIELD (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 2700.0 | 2762.5 | 2472.5 | 2667.5 | 3045.0 | 2867.5 | 3075.0 | 2772.5 | 2772.5 | 2747.5 | 2722.5 |
| | 2587.5 | 3050.0 | 2547.5 | 2670.0 | 2962.5 | 2932.5 | 3082.5 | 2720.0 | 2827.5 | 2620.0 | 2900.0 |
| | 2606.3 | 2807.5 | 2625.0 | 2675.0 | 2955.0 | 2883.8 | 2987.5 | 2727.5 | 2762.5 | 2812.5 | 2660.0 |
| | 2650.0 | 2732.5 | 2625.0 | 2652.5 | 2925.0 | 2941.3 | 2965.0 | 2670.0 | 2832.5 | 2645.0 | 2812.5 |
| | 2737.5 | 2772.5 | 2562.5 | 2700.0 | 3062.5 | 2905.0 | 3045.0 | 2715.0 | 2810.0 | 2785.0 | 2630.0 |
| Mean of Control Group= | 2656.3 | | | | | 2906.0 | | | 2801.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 62.8 | | | | | 31.3 | | | 31.9 | | |
| Std. Deviation of Mean of Control Group as % = | 2.4 | | | | | 1.1 | | | 1.1 | | |
| Mean of Exposed Group= | | 2825.0 | 2566.5 | 2673.0 | 2990.0 | | 3031.0 | 2721.0 | | 2722.0 | 2745.0 |
| Change in Exposed Mean from Control Mean= | | 168.8 | -89.8 | 16.8 | 333.8 | | 125.0 | -185.0 | | -79.0 | -56.0 |
| Percent change in Exposed Mean from Control Mean= | | 6.35 | -3.38 | 0.63 | 12.56 | | 4.30 | -6.37 | | -2.82 | -2.00 |
| Is change less than one Std. Deviation of Control Group? | | No | No | Yes | No | | No | No | | No | No |




000241

706

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

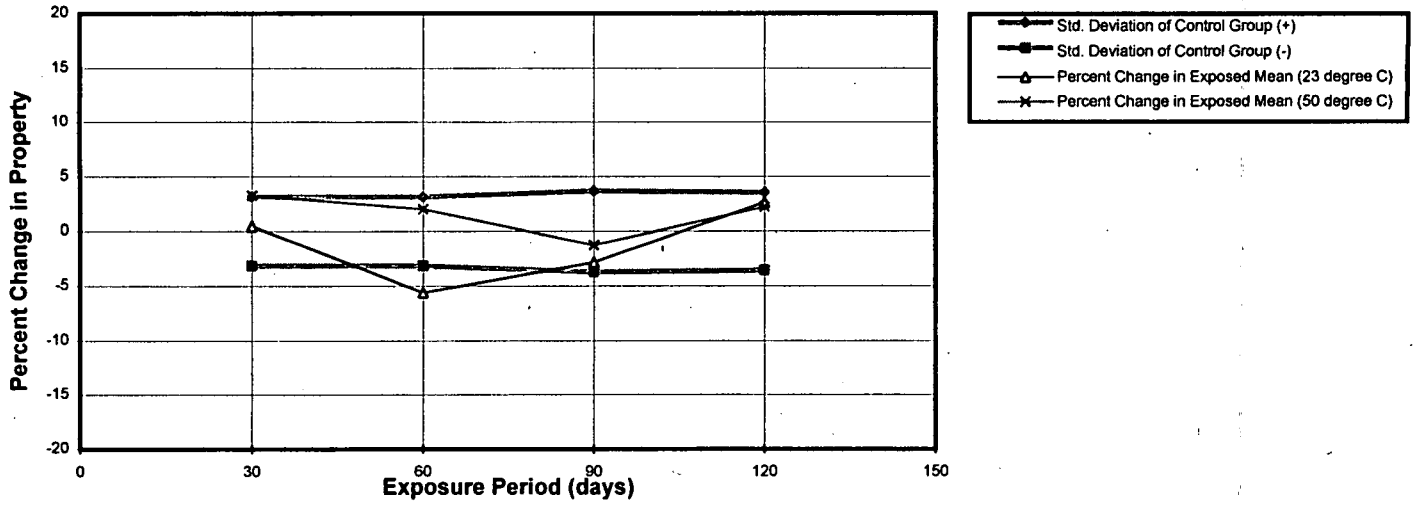
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT YIELD (%)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 19.0 | 19.8 | 21.1 | 18.5 | 19.9 | 20.4 | 20.5 | 20.4 | 21.7 | 22.5 | 21.7 |
| | 19.1 | 20.4 | 20.4 | 18.5 | 19.9 | 21.2 | 20.4 | 20.4 | 21.2 | 21.0 | 21.1 |
| | 19.9 | 19.0 | 19.7 | 19.2 | 21.0 | 21.0 | 20.0 | 20.5 | 21.2 | 21.7 | 21.0 |
| | 20.6 | 19.1 | 19.9 | 18.0 | 19.8 | 21.8 | 19.8 | 21.0 | 20.4 | 21.2 | 21.0 |
| | 19.8 | 20.5 | 20.4 | 18.6 | 19.7 | 19.8 | 20.5 | 20.5 | 19.8 | 20.5 | 21.7 |
| Mean of Control Group= | 19.7 | | | | | 20.8 | | | 20.8 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.6 | | | | | 0.8 | | | 0.7 | | |
| Std. Deviation of Mean of Control Group as % = | 3.2 | | | | | 3.7 | | | 3.6 | | |
| Mean of Exposed Group= | | 19.8 | 20.3 | 18.6 | 20.1 | | 20.2 | 20.6 | | 21.4 | 21.3 |
| Change in Exposed Mean from Control Mean= | | 0.1 | 0.6 | -1.1 | 0.4 | | -0.6 | -0.3 | | 0.5 | 0.5 |
| Percent change in Exposed Mean from Control Mean= | | 0.45 | 3.26 | -5.60 | 1.99 | | -2.87 | -1.29 | | 2.61 | 2.21 |
| Is change less than one Std. Deviation of Control Group? | | Yes | No | No | Yes | | Yes | Yes | | Yes | Yes |




000242

706

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

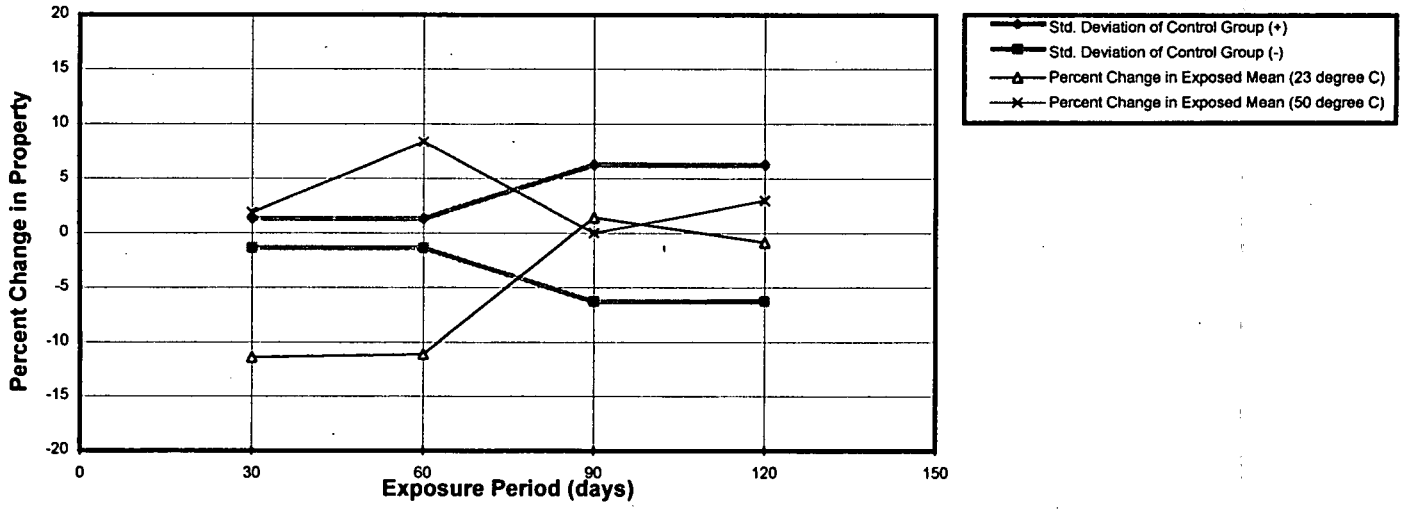
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** POLYFLEX
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** STRAIN AT YIELD (%)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 18.5 | 15.4 | 19.1 | 16.6 | 21.8 | 21.0 | 17.8 | 19.9 | 18.6 | 18.6 | 19.7 |
| | 18.5 | 15.3 | 19.9 | 16.7 | 19.1 | 19.1 | 19.9 | 20.5 | 17.4 | 19.8 | 20.4 |
| | 18.5 | 17.8 | 19.1 | 16.7 | 19.2 | 17.8 | 19.7 | 19.1 | 20.4 | 18.5 | 18.0 |
| | 18.6 | 17.0 | 17.8 | 15.3 | 20.5 | 18.6 | 20.6 | 17.2 | 19.2 | 19.9 | 19.2 |
| | 18.0 | 16.0 | 17.8 | 16.7 | 19.1 | 18.6 | 18.6 | 18.6 | 19.9 | 17.9 | 21.0 |
| Mean of Control Group= | 18.4 | | | | | 19.0 | | | 19.1 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.2 | | | | | 1.2 | | | 1.2 | | |
| Std. Deviation of Mean of Control Group as % = | 1.3 | | | | | 6.3 | | | 6.2 | | |
| Mean of Exposed Group= | | 16.3 | 18.8 | 16.4 | 19.9 | | 19.3 | 19.0 | | 18.9 | 19.7 |
| Change in Exposed Mean from Control Mean= | | -2.1 | 0.3 | -2.0 | 1.5 | | 0.3 | 0.0 | | -0.2 | 0.6 |
| Percent change in Exposed Mean from Control Mean= | | -11.41 | 1.87 | -11.10 | 8.33 | | 1.47 | 0.02 | | -0.84 | 2.99 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | Yes | Yes | | Yes | Yes |




000243

706

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

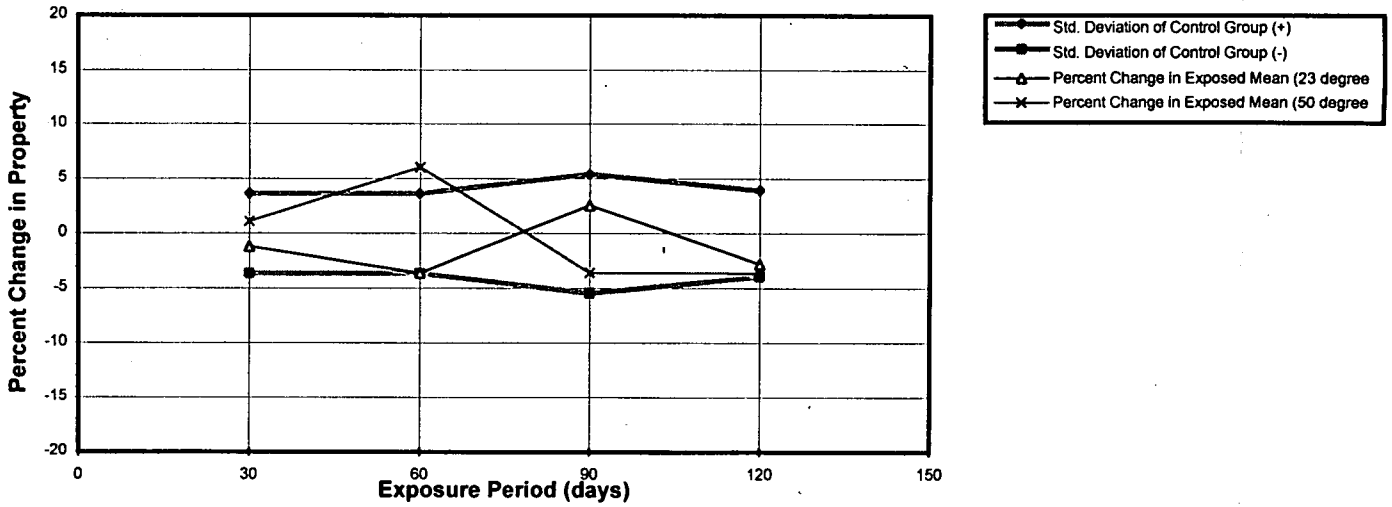
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT YIELD (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 2462.5 | 2382.5 | 2567.5 | 2437.5 | 2850.0 | 2522.5 | 2727.5 | 2543.8 | 2735.0 | 2582.5 | 2547.5 |
| | 2681.3 | 2782.5 | 2612.5 | 2525.0 | 2625.0 | 2517.5 | 2702.5 | 2500.0 | 2825.0 | 2642.5 | 2568.8 |
| | 2512.5 | 2497.5 | 2590.0 | 2462.5 | 2818.8 | 2755.0 | 2787.5 | 2493.8 | 2620.0 | 2582.5 | 2610.0 |
| | 2631.3 | 2447.5 | 2585.0 | 2512.5 | 2618.8 | 2612.5 | 2690.0 | 2543.8 | 2552.5 | 2677.5 | 2600.0 |
| | 2506.3 | 2530.0 | 2577.5 | 2393.8 | 2656.3 | 2842.5 | 2682.5 | 2693.8 | 2712.5 | 2587.5 | 2632.5 |
| Mean of Control Group= | 2558.8 | | | | | 2650.0 | | | 2689.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 92.8 | | | | | 144.3 | | | 105.5 | | |
| Std. Deviation of Mean of Control Group as % = | 3.6 | | | | | 5.4 | | | 3.9 | | |
| Mean of Exposed Group= | | 2528.0 | 2586.5 | 2466.3 | 2713.8 | | 2718.0 | 2555.0 | | 2614.5 | 2591.8 |
| Change in Exposed Mean from Control Mean= | | -30.8 | 27.8 | -92.5 | 155.0 | | 68.0 | -95.0 | | -74.5 | -97.3 |
| Percent change in Exposed Mean from Control Mean= | | -1.20 | 1.08 | -3.62 | 6.06 | | 2.57 | -3.58 | | -2.77 | -3.62 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | No | | Yes | Yes | | Yes | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

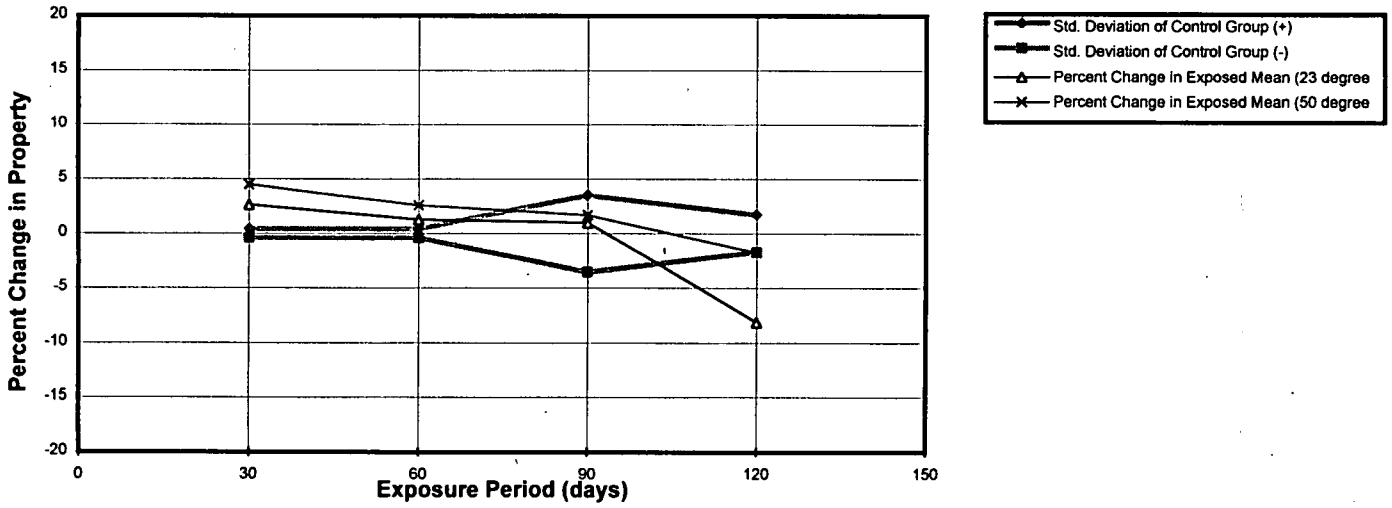
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT YIELD (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 2568.8 | 2795.0 | 2617.5 | 2562.5 | 2593.8 | 2810.0 | 2657.5 | 2770.0 | 2810.0 | 2595.0 | 2693.8 |
| | 2568.8 | 2485.0 | 2847.5 | 2587.5 | 2643.8 | 2678.8 | 2856.3 | 2747.5 | 2862.5 | 2647.5 | 2862.5 |
| | 2581.3 | 2670.0 | 2597.5 | 2606.3 | 2637.5 | 2678.8 | 2793.8 | 2732.5 | 2900.0 | 2665.0 | 2868.8 |
| | 2587.5 | 2615.0 | 2635.0 | 2575.0 | 2631.3 | 2833.8 | 2700.0 | 2807.5 | 2852.5 | 2605.0 | 2825.0 |
| | 2562.5 | 2642.5 | 2752.5 | 2700.0 | 2693.8 | 2607.5 | 2737.5 | 2780.0 | 2940.0 | 2690.0 | 2862.5 |
| Mean of Control Group= | 2573.8 | | | | | 2721.8 | | | 2873.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 10.3 | | | | | 96.3 | | | 49.3 | | |
| Std. Deviation of Mean of Control Group as % = | 0.4 | | | | | 3.5 | | | 1.7 | | |
| Mean of Exposed Group= | | 2641.5 | 2690.0 | 2606.3 | 2640.0 | | 2749.0 | 2767.5 | | 2640.5 | 2822.5 |
| Change in Exposed Mean from Control Mean= | | 67.8 | 116.3 | 32.5 | 66.3 | | 27.3 | 45.8 | | -232.5 | -50.5 |
| Percent change in Exposed Mean from Control Mean= | | 2.63 | 4.52 | 1.26 | 2.57 | | 1.00 | 1.68 | | -8.09 | -1.76 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | Yes | Yes | | No | No |




000245

906

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

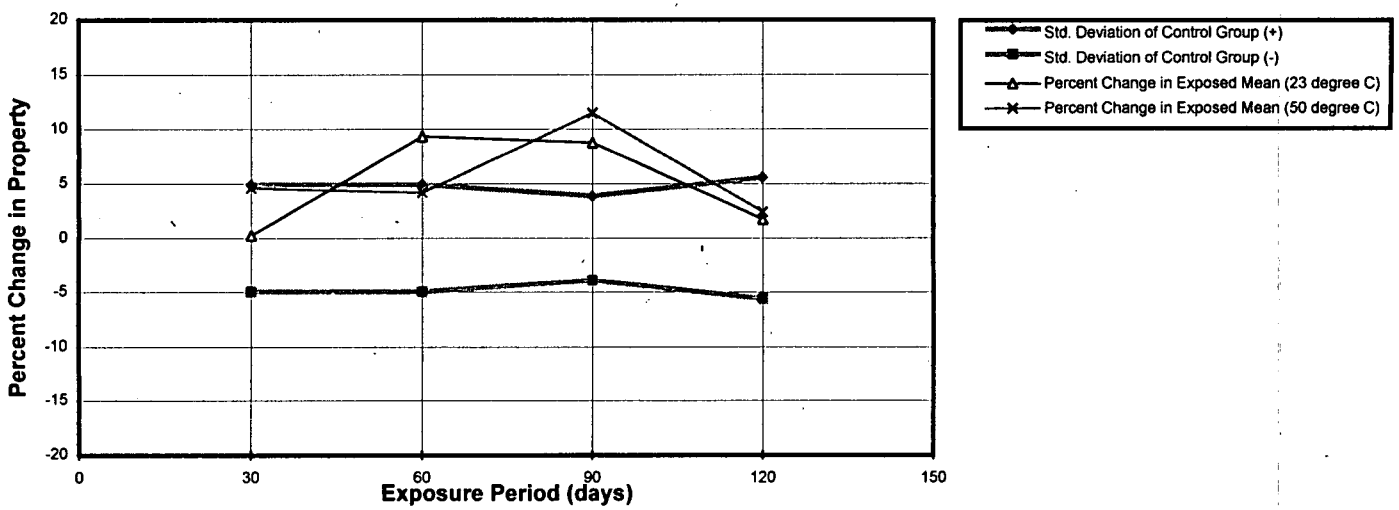
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT YIELD (%)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 19.8 | 18.4 | 20.5 | 21.7 | 19.9 | 20.0 | 20.4 | 23.6 | 19.9 | 21.2 | 21.7 |
| | 18.0 | 20.3 | 20.4 | 20.4 | 20.6 | 18.5 | 21.7 | 21.7 | 21.8 | 21.7 | 21.8 |
| | 19.8 | 19.1 | 19.9 | 22.3 | 19.1 | 20.4 | 21.8 | 20.4 | 21.8 | 20.5 | 19.7 |
| | 18.6 | 19.2 | 20.3 | 20.4 | 20.5 | 19.3 | 21.0 | 21.7 | 20.4 | 20.4 | 20.6 |
| | 20.3 | 19.7 | 19.8 | 20.6 | 20.4 | 19.9 | 21.7 | 21.8 | 19.2 | 21.2 | 21.8 |
| Mean of Control Group= | 19.3 | | | | | 19.6 | | | 20.6 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 1.0 | | | | | 0.8 | | | 1.2 | | |
| Std. Deviation of Mean of Control Group as % = | 4.9 | | | | | 3.9 | | | 5.6 | | |
| Mean of Exposed Group= | | 19.3 | 20.2 | 21.1 | 20.1 | | 21.3 | 21.9 | | 21.0 | 21.1 |
| Change in Exposed Mean from Control Mean= | | 0.0 | 0.9 | 1.8 | 0.8 | | 1.7 | 2.3 | | 0.4 | 0.5 |
| Percent change in Exposed Mean from Control Mean= | | 0.26 | 4.57 | 9.34 | 4.17 | | 8.80 | 11.50 | | 1.73 | 2.42 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | No | Yes | | No | No | | Yes | Yes |




000246

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

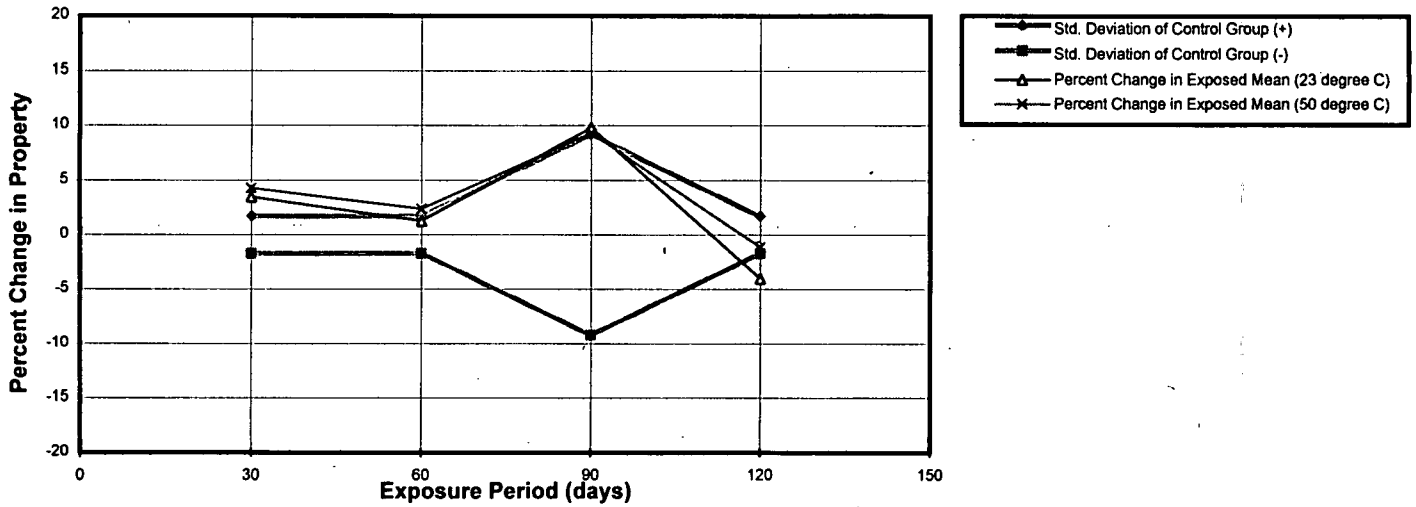
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT YIELD (%)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 18.5 | 18.0 | 20.4 | 18.5 | 19.1 | 17.8 | 21.1 | 18.6 | 19.9 | 20.4 | 19.9 |
| | 18.6 | 20.6 | 18.4 | 19.7 | 18.5 | 21.0 | 19.1 | 21.1 | 19.9 | 18.6 | 19.1 |
| | 18.0 | 19.1 | 18.5 | 18.5 | 17.8 | 16.8 | 18.6 | 19.9 | 20.4 | 18.6 | 19.9 |
| | 18.5 | 18.4 | 19.1 | 18.6 | 20.4 | 17.8 | 20.4 | 20.4 | 20.4 | 20.4 | 20.6 |
| | 18.0 | 18.6 | 19.1 | 17.5 | 18.0 | 17.3 | 20.4 | 19.3 | 20.6 | 19.1 | 20.5 |
| Mean of Control Group= | 18.3 | | | | | 18.2 | | | 20.2 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.3 | | | | | 1.7 | | | 0.3 | | |
| Std. Deviation of Mean of Control Group as % = | 1.7 | | | | | 9.2 | | | 1.7 | | |
| Mean of Exposed Group= | | 18.9 | 19.1 | 18.5 | 18.7 | | 19.9 | 19.8 | | 19.4 | 20.0 |
| Change in Exposed Mean from Control Mean= | | 0.6 | 0.8 | 0.2 | 0.4 | | 1.8 | 1.7 | | -0.8 | -0.2 |
| Percent change in Exposed Mean from Control Mean= | | 3.47 | 4.29 | 1.26 | 2.38 | | 9.81 | 9.32 | | -4.01 | -1.16 |
| Is change less than one Std. Deviation of Control Group? | | No | No | Yes | No | | No | No | | No | Yes |




000247

## 2.8 STRESS AND STRAIN AT BREAK

## 2.8 Stress and Strain at Break

*Rationale for 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 the percent changes in stress and strain at break of the five geomembranes.

GSE-SLT Geomembrane. In the roll direction, the percent changes in stress at break due to exposure were not within one standard deviation of the control means for any of the exposures except the 90-day exposure at 23°C and the 60-day exposure at 50°C. In the cross-roll direction, the percent changes in stress at break due to exposure were not within one standard deviation of the control means for any of the exposures except the 90-day exposure at 23°C, and the 60-day and the 90-day exposures at 50°C. In the roll direction, the percent changes decreased with exposure time; however, these changes maybe considered to be relatively constant because the decreasing trend was not consistent between temperatures. In general, in the cross-roll direction, the percent changes decreased with exposure time; the decrease was consistent between temperatures.

In the roll direction, the percent changes in strain at break due to exposure were within one standard deviation of the control means for all of the exposures except the 90-day and the 120-day exposures at 23°C, and the 90-day exposure at 50°C. In the cross-roll direction, the percent changes in strain at break due to exposure were within one standard deviation of the control means for all of the exposures except the 30-day, the 60-day and the 90-day exposures at 23°C, and the 90-day exposure at 50°C. In both directions, the results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time.

In general, the exposures at 23°C resulted in higher percent change in exposed means than exposures at 50°C, in both directions.

NSC Geomembrane. In the roll direction, the percent changes in stress at break due to exposure were within one standard deviation of the control means for all of the exposures except the 90-day and the 120-day exposures at 23°C, and the 60-day and the 120-day exposures at 50°C. In the cross-roll direction, the percent changes in stress at break due to exposure were within one standard deviation of the control means for all of the exposures except the 120-day exposures at 23°C and 50°C. In general, the percent change in stress at break due to exposure remained relatively constant with exposure time and temperature in both directions.

In the roll direction, the percent changes in strain at break due to exposure were within one standard deviation of the control means for all of the exposures except the 90-day exposure at 23°C, and the 30-day and the 90-day exposures at 50°C. In the cross-roll direction, the percent changes in strain at break due to exposure were within one standard deviation of the control means for all of the exposures except the 90-day exposure at 50°C. In general, the percent change in strain at break due to exposure remained relatively constant with exposure time and temperature in both directions.

GSE-Gundle Geomembrane. In the roll direction, the percent changes in stress at break due to exposure were within one standard deviation of the control means for all the exposures. In the cross-roll direction, the percent changes in stress at break due to exposure were not within one standard deviation of the control means for any of the exposures except the 30-day and the 90-day exposures at 23°C, and the 120-day exposure at 50°C. In general, the percent change in stress at break due to exposure remained relatively constant with exposure time and temperature in both directions.

In the roll direction, the percent changes in strain at break due to exposure were within one standard deviation of the control means for all the exposures. In the cross-roll direction, the percent changes in strain at break due to exposure were within one standard deviation of the control means for all of the exposures except the 90-day exposure at 50°C. In general, the percent change in strain at break due to exposure remained relatively constant with exposure time and temperature in both directions.

PolyFlex Geomembrane. In the roll direction, the percent changes in stress at break due to exposure were within one standard deviation of the control means for all of the exposures except the 30-day exposure at 23°C, and the 60-day and the 120-day exposures at 50°C. In the cross-roll direction, the percent changes in stress at break due to exposure were within one standard deviation of the control means for all of the exposures except the 120-day exposures at 23°C and 50°C. In the roll direction, in general, the percent changes in stress at break due to exposure remained relatively constant with exposure time and temperature. In the cross-roll direction, the percent changes in stress at break due to exposure decreased with exposure time; however, this trend was not consistent between temperatures.

In the roll direction, the percent changes in strain at break due to exposure were within one standard deviation of the control means for all of the exposures except the 60-day exposure at 50°C. In the cross-roll direction, the percent changes in strain at break due to exposure were within one standard deviation of the control means for all of the exposures except the 90-day exposure at 23°C, and the 120-day exposures at 23°C and 50°C. In the roll direction, in general, the percent changes in strain at break due to exposure remained relatively constant with exposure time and temperature. In the cross-roll direction, the percent changes in strain at break due to exposure decreased with exposure time; however, this trend was not consistent between temperatures.

Serrot Geomembrane. In the roll direction, the percent changes in stress at break due to exposure were within one standard deviation of the control means for all of the exposures except the 30-day exposure at 23°C. In the cross-roll direction, the percent changes in stress at break due to exposure were within one standard deviation of the control means for all of the exposures except the 90-day and the 120-day exposures at 23°C and 50°C. In general, the percent change in stress at break due to exposure remained relatively constant with exposure time and temperature in both directions.

In the roll direction, the percent changes in strain at break due to exposure were within one standard deviation of the control means for all of the exposures except the 30-day and the 120-day exposures at 23°C. In the cross-roll direction, the percent changes in strain at break due to exposure were within one standard deviation of the control means for all of the exposures except the 90-day and the 120-day exposures at 23°C and 50°C. In general, the percent change in strain at

break due to exposure remained relatively constant with exposure time and temperature in both directions.

*Conclusion*

The means of percent changes in stress at break were within one standard deviation of the control means for at least 5 out of 8 exposures for all geomembranes except GSE-SLT geomembrane in both directions and the GSE-Gundle geomembrane in the cross-roll direction. The means of percent changes in strain at break were within one standard deviation of the control means for at least 5 out of 8 exposures for all geomembranes except the GSE-SLT geomembrane in the cross-roll direction. No consistent trends between exposure time and temperature were observed for the five geomembranes for stress or strain at break in either direction except GSE-SLT geomembrane in the cross-roll direction. However, the trends with exposure time and temperature for stress at break for the GSE-SLT geomembrane in the cross-roll direction are not reflected as a trend in the roll direction or in the strain at break in either directions. Therefore, no detrimental effects are expected to the tested property due to exposure to the leachate.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

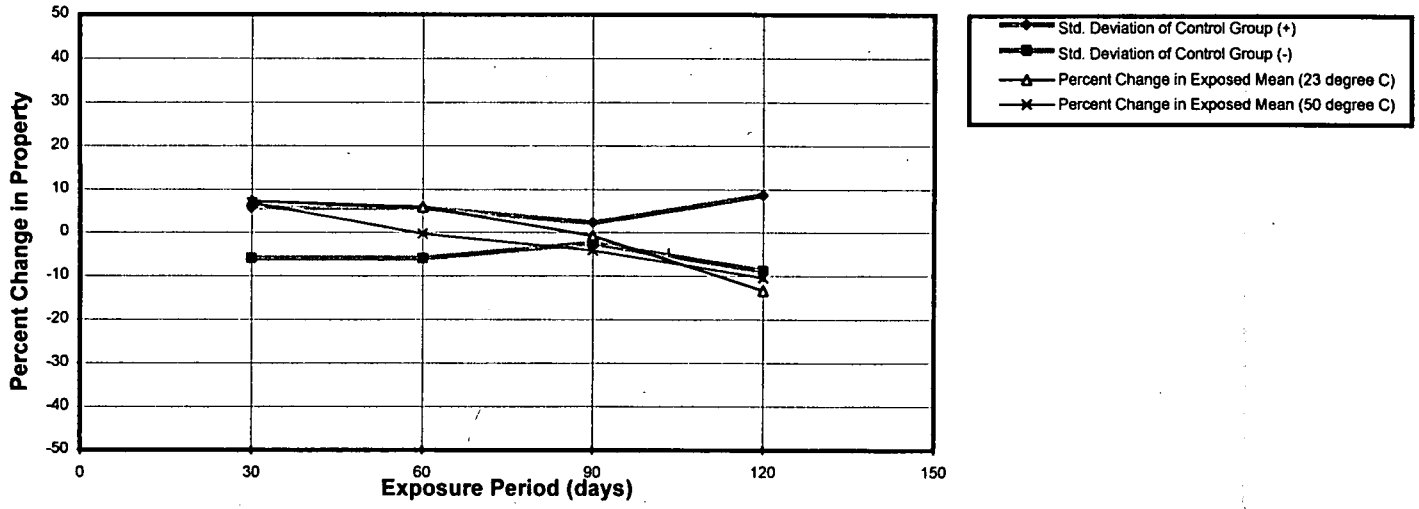
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT BREAK (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 5010.0 | 5835.0 | 5620.0 | 5855.0 | 5280.0 | 5695.0 | 6015.0 | 6085.0 | 5625.0 | 4887.5 | 4150.0 |
| | 5520.0 | 5780.0 | 5100.0 | 5350.0 | 5255.0 | 5950.0 | 5925.0 | 5840.0 | 4937.5 | 3912.5 | 5362.5 |
| | 5380.0 | 5490.0 | 5940.0 | 5390.0 | 5150.0 | 6030.0 | 5395.0 | 5520.0 | 5912.5 | 4837.5 | 4662.5 |
| | 5470.0 | 5845.0 | 5665.0 | 5570.0 | 5280.0 | 6010.0 | 6065.0 | 5980.0 | 5780.0 | 4837.5 | 4750.0 |
| | 4830.0 | 5170.0 | 5695.0 | 5600.0 | 5175.0 | 5995.0 | 6075.0 | 5055.0 | 4918.8 | 5100.0 | 5437.5 |
| Mean of Control Group= | 5242.0 | | | | | 5936.0 | | | 5434.8 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 304.9 | | | | | 137.9 | | | 473.6 | | |
| Std. Deviation of Mean of Control Group as % = | 5.8 | | | | | 2.3 | | | 8.7 | | |
| Mean of Exposed Group= | | 5624.0 | 5604.0 | 5553.0 | 5228.0 | | 5895.0 | 5696.0 | | 4715.0 | 4872.5 |
| Change in Exposed Mean from Control Mean= | | 382.0 | 362.0 | 311.0 | -14.0 | | -41.0 | -240.0 | | -719.8 | -562.3 |
| Percent change in Exposed Mean from Control Mean= | | 7.29 | 6.91 | 5.93 | -0.27 | | -0.69 | -4.04 | | -13.24 | -10.35 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | Yes | | Yes | No | | No | No |




000253

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

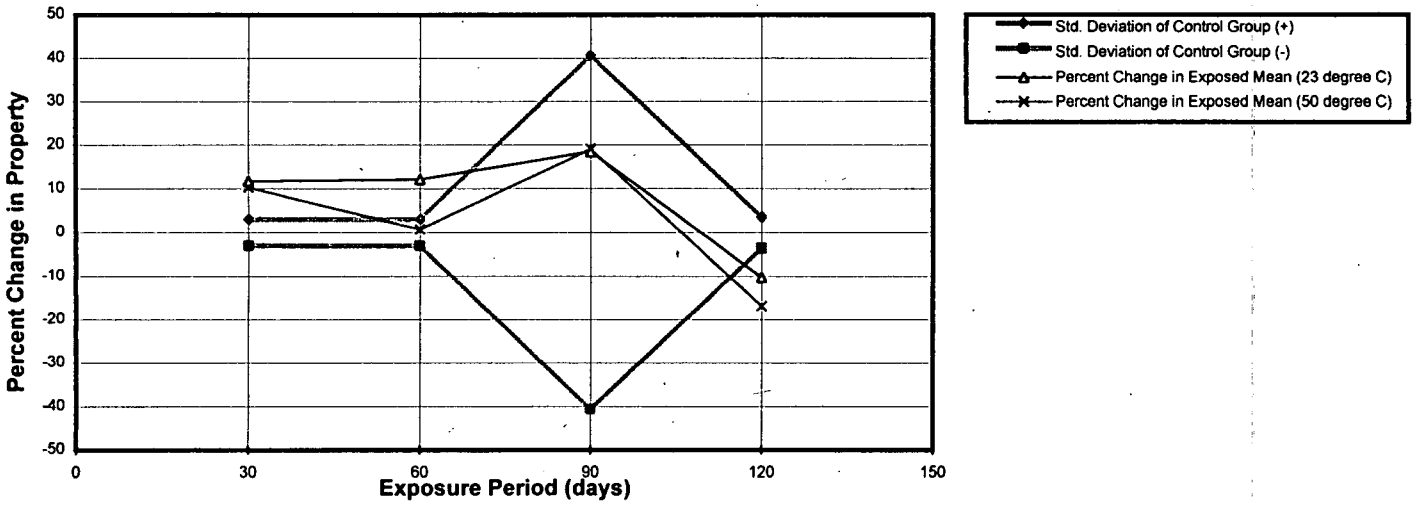
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT BREAK (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 5320.0 | 5745.0 | 5900.0 | 5700.0 | 5110.0 | 5180.0 | 6090.0 | 6280.0 | 5668.8 | 5262.5 | 5150.0 |
| | 5025.0 | 5470.0 | 5660.0 | 5565.0 | 5045.0 | 6410.0 | 5937.5 | 5860.0 | 5943.8 | 4875.0 | 4925.0 |
| | 5020.0 | 5765.0 | 5645.0 | 5700.0 | 5000.0 | 6045.0 | 5790.0 | 5895.0 | 5843.8 | 5000.0 | 5375.0 |
| | 5125.0 | 5712.5 | 5675.0 | 5760.0 | 5375.0 | 1452.5 | 5670.0 | 5725.0 | 5718.8 | 5112.5 | 5200.0 |
| | 4915.0 | 5705.0 | 5145.0 | 5790.0 | 5060.0 | 5685.0 | 5895.0 | 5745.0 | 5406.3 | 5400.0 | 3112.5 |
| Mean of Control Group= | 5081.0 | | | | | 4954.5 | | | 5716.3 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 152.9 | | | | | 2009.7 | | | 203.9 | | |
| Std. Deviation of Mean of Control Group as % = | 3.0 | | | | | 40.6 | | | 3.6 | | |
| Mean of Exposed Group= | | 5679.5 | 5605.0 | 5703.0 | 5118.0 | | 5876.5 | 5901.0 | | 5130.0 | 4752.5 |
| Change in Exposed Mean from Control Mean= | | 598.5 | 524.0 | 622.0 | 37.0 | | 922.0 | 946.5 | | -586.3 | -963.8 |
| Percent change in Exposed Mean from Control Mean= | | 11.78 | 10.31 | 12.24 | 0.73 | | 18.61 | 19.10 | | -10.26 | -16.86 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | Yes | | Yes | Yes | | No | No |




000253

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

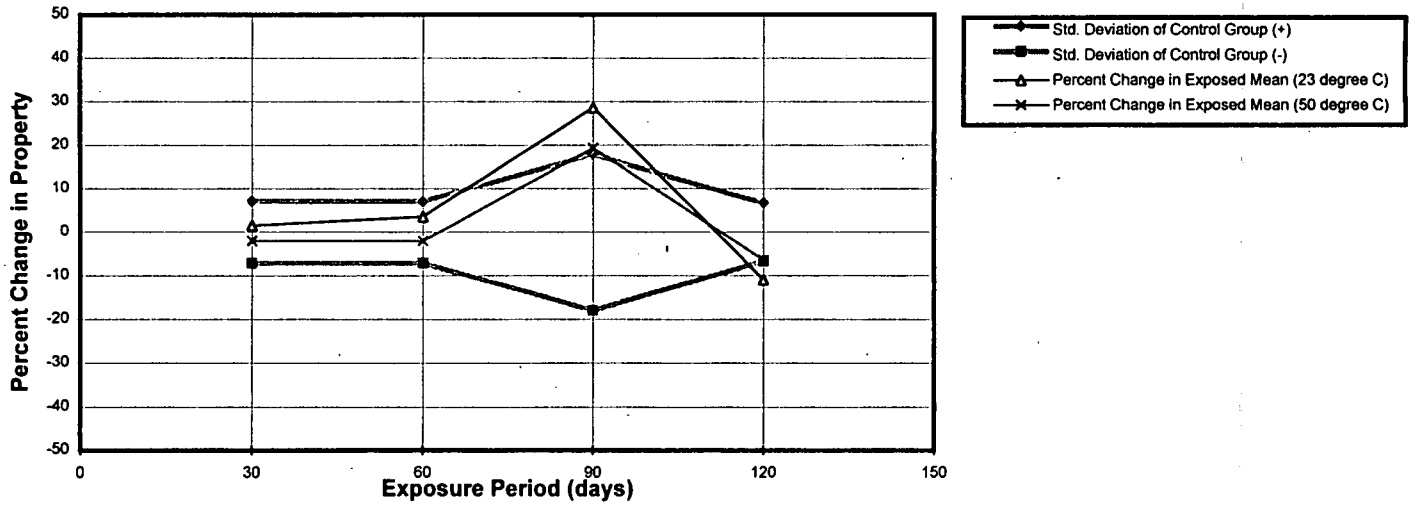
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT BREAK (%)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 1360.0 | 1557.0 | 1415.0 | 1568.0 | 1438.0 | 1257.0 | 1530.0 | 1536.0 | 1287.0 | 1154.0 | 1267.0 |
| | 1545.0 | 1507.0 | 1282.0 | 1458.0 | 1435.0 | 1274.0 | 1482.0 | 1367.0 | 1328.0 | 1335.0 | 1269.0 |
| | 1488.0 | 1436.0 | 1515.0 | 1480.0 | 1385.0 | 1225.0 | 1330.0 | 1293.0 | 1344.0 | 1271.0 | 1100.0 |
| | 1533.0 | 1528.0 | 1433.0 | 1486.0 | 1435.0 | 1163.0 | 1492.0 | 1418.0 | 1304.0 | 845.4 | 1231.0 |
| | 1322.0 | 1338.0 | 1457.0 | 1515.0 | 1408.0 | 785.4 | 1499.0 | 1191.0 | 1132.0 | 1092.0 | 1119.0 |
| Mean of Control Group= | 1449.6 | | | | | 1140.9 | | | 1279.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 102.3 | | | | | 203.2 | | | 85.0 | | |
| Std. Deviation of Mean of Control Group as % = | 7.1 | | | | | 17.8 | | | 6.6 | | |
| Mean of Exposed Group= | | 1473.2 | 1420.4 | 1501.4 | 1420.2 | | 1466.6 | 1361.0 | | 1139.5 | 1197.2 |
| Change in Exposed Mean from Control Mean= | | 23.6 | -29.2 | 51.8 | -29.4 | | 325.7 | 220.1 | | -139.5 | -81.8 |
| Percent change in Exposed Mean from Control Mean= | | 1.63 | -2.01 | 3.57 | -2.03 | | 28.55 | 19.29 | | -10.91 | -6.40 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | No | No | | No | Yes |




000254

706

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

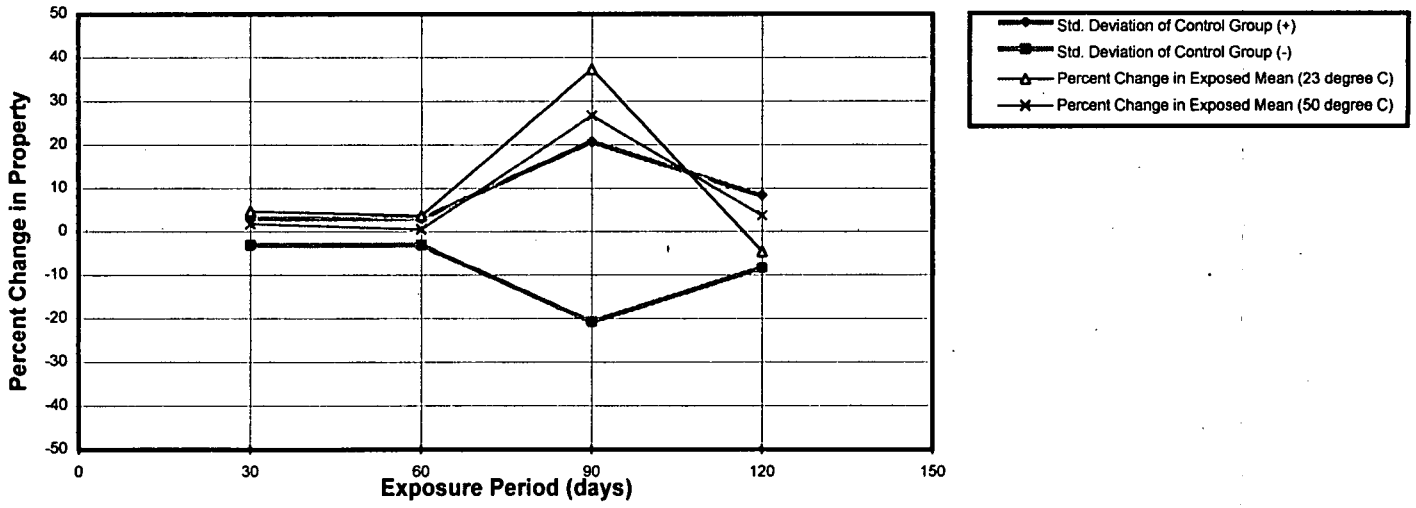
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT BREAK (%)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 1512.0 | 1534.0 | 1523.0 | 1480.0 | 1449.0 | 1310.0 | 1494.0 | 1494.0 | 1359.0 | 1389.0 | 1412.0 |
| | 1426.0 | 1449.0 | 1492.0 | 1442.0 | 1428.0 | 1135.0 | 1805.0 | 1391.0 | 1185.0 | 1297.0 | 1423.0 |
| | 1428.0 | 1528.0 | 1482.0 | 1505.0 | 1415.0 | 1071.0 | 1465.0 | 1401.0 | 1366.0 | 1212.0 | 1223.0 |
| | 1458.0 | 1522.0 | 1498.0 | 1525.0 | 1537.0 | 742.3 | 1411.0 | 1362.0 | 1204.0 | 811.5 | 1256.0 |
| | 1397.0 | 1528.0 | 1358.0 | 1532.0 | 1432.0 | 1295.0 | 1453.0 | 1387.0 | 1143.0 | 1269.0 | 1175.0 |
| Mean of Control Group= | 1444.2 | | | | | 1110.7 | | | 1251.4 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 43.6 | | | | | 230.0 | | | 103.8 | | |
| Std. Deviation of Mean of Control Group as % = | 3.0 | | | | | 20.7 | | | 8.3 | | |
| Mean of Exposed Group= | | 1512.2 | 1470.6 | 1496.8 | 1452.2 | | 1525.6 | 1407.0 | | 1195.7 | 1297.8 |
| Change in Exposed Mean from Control Mean= | | 68.0 | 26.4 | 52.6 | 8.0 | | 414.9 | 296.3 | | -55.7 | 46.4 |
| Percent change in Exposed Mean from Control Mean= | | 4.71 | 1.83 | 3.64 | 0.55 | | 37.36 | 26.68 | | -4.45 | 3.71 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | No | Yes | | No | No | | Yes | Yes |




000255

906

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

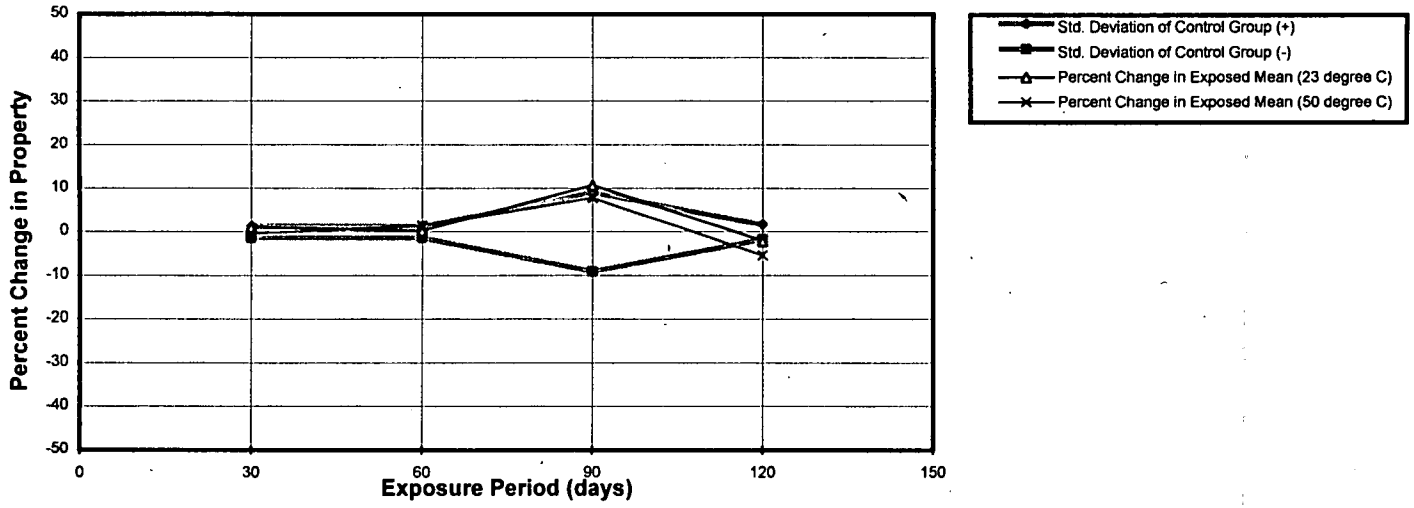
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT BREAK (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 4492.5 | 4535.0 | 4482.5 | 4552.5 | 4340.0 | 3767.5 | 4942.5 | 4740.0 | 4606.3 | 4650.0 | 3925.0 |
| | 4600.0 | 4582.5 | 4517.5 | 4365.0 | 4567.5 | 4422.5 | 4727.5 | 4630.0 | 4493.8 | 4322.5 | 4325.0 |
| | 4455.0 | 4450.0 | 4532.5 | 4625.0 | 4687.5 | 4627.5 | 4642.5 | 4352.5 | 4431.3 | 4395.0 | 4375.0 |
| | 4565.0 | 4775.0 | 4510.0 | 4585.0 | 4727.5 | 3955.0 | 4555.0 | 4647.5 | 4412.5 | 4510.0 | 4302.5 |
| | 4487.5 | 4480.0 | 4460.0 | 4537.5 | 4587.5 | 4572.5 | 4757.5 | 4635.0 | 4468.8 | 4085.0 | 4302.5 |
| Mean of Control Group= | 4520.0 | | | | | 4269.0 | | | 4482.5 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 60.1 | | | | | 385.5 | | | 76.1 | | |
| Std. Deviation of Mean of Control Group as % = | 1.3 | | | | | 9.0 | | | 1.7 | | |
| Mean of Exposed Group= | | 4564.5 | 4500.5 | 4533.0 | 4582.0 | | 4725.0 | 4601.0 | | 4392.5 | 4246.0 |
| Change in Exposed Mean from Control Mean= | | 44.5 | -19.5 | 13.0 | 62.0 | | 456.0 | 332.0 | | -90.0 | -236.5 |
| Percent change in Exposed Mean from Control Mean= | | 0.98 | -0.43 | 0.29 | 1.37 | | 10.68 | 7.78 | | -2.01 | -5.28 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | No | | No | Yes | | No | No |




0002256

906

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

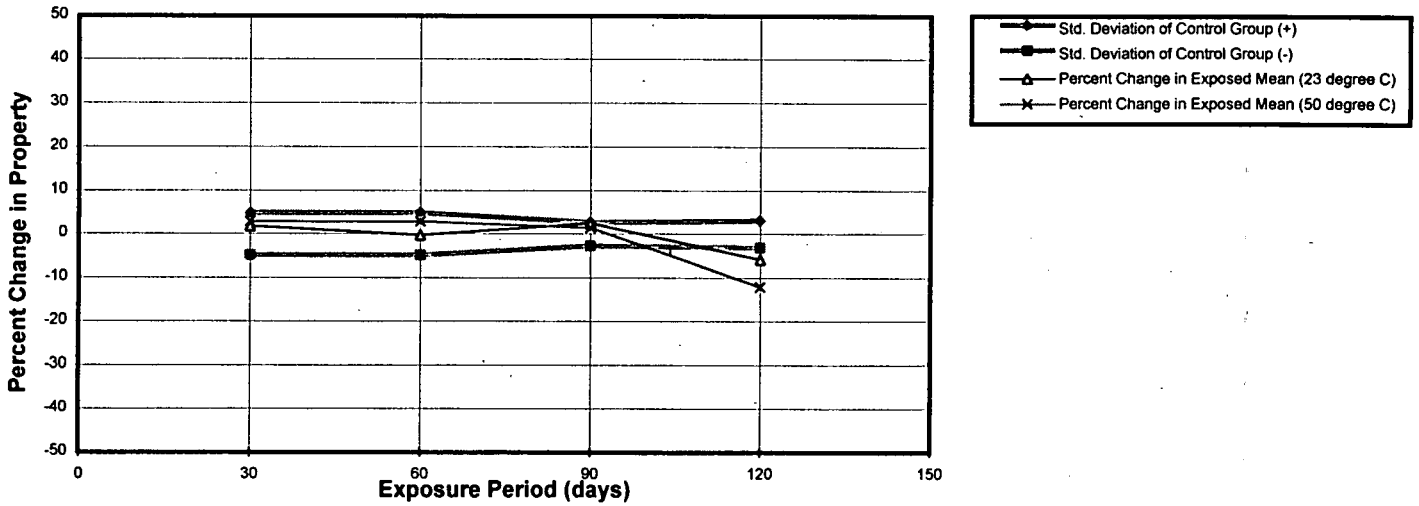
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT BREAK (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 4157.5 | 4425.0 | 4510.0 | 4920.0 | 4747.5 | 4435.0 | 4657.5 | 4770.0 | 4937.5 | 4567.5 | 4282.5 |
| | 4722.5 | 4622.5 | 4620.0 | 4607.5 | 4635.0 | 4247.5 | 4630.0 | 4675.0 | 4565.0 | 4430.0 | 3927.5 |
| | 4610.0 | 4767.5 | 4777.5 | 4310.0 | 4942.5 | 4522.5 | 4407.5 | 4892.5 | 4667.5 | 4527.5 | 4302.5 |
| | 4645.0 | 4762.5 | 4725.0 | 4465.0 | 4360.0 | 4480.0 | 4670.0 | 3762.5 | 4832.5 | 4542.5 | 3877.5 |
| | 4547.5 | 4520.0 | 4692.5 | 4320.0 | 4645.0 | 4555.0 | 4432.5 | 4455.0 | 4790.0 | 4342.5 | 4535.0 |
| Mean of Control Group= | 4536.5 | | | | | 4448.0 | | | 4758.5 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 221.1 | | | | | 120.8 | | | 145.1 | | |
| Std. Deviation of Mean of Control Group as % = | 4.9 | | | | | 2.7 | | | 3.0 | | |
| Mean of Exposed Group= | | 4619.5 | 4665.0 | 4524.5 | 4666.0 | | 4559.5 | 4511.0 | | 4482.0 | 4185.0 |
| Change in Exposed Mean from Control Mean= | | 83.0 | 128.5 | -12.0 | 129.5 | | 111.5 | 63.0 | | -276.5 | -573.5 |
| Percent change in Exposed Mean from Control Mean= | | 1.83 | 2.83 | -0.26 | 2.85 | | 2.51 | 1.42 | | -5.81 | -12.05 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | Yes | Yes | | No | No |




000257

906

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

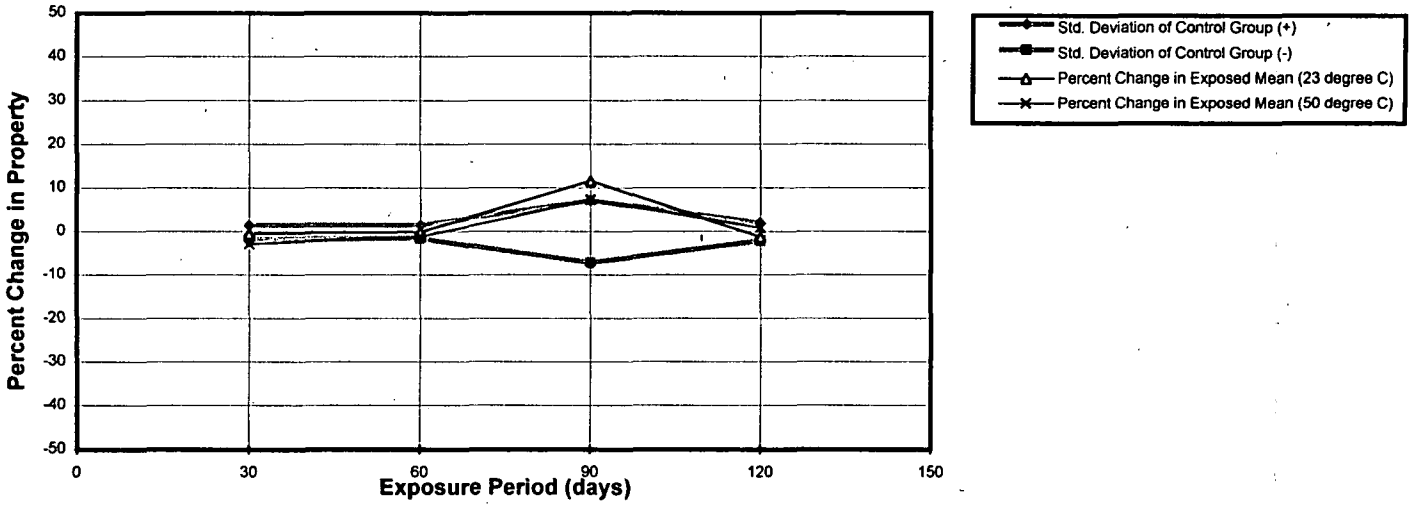
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** ASTM D638
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT BREAK (%)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 1287.0 | 1295.0 | 1271.0 | 1318.0 | 1242.0 | 1088.0 | 1400.0 | 1322.0 | 1358.0 | 1361.0 | 1342.0 |
| | 1338.0 | 1303.0 | 1277.0 | 1265.0 | 1295.0 | 1233.0 | 1352.0 | 1296.0 | 1318.0 | 1296.0 | 1320.0 |
| | 1294.0 | 1278.0 | 1278.0 | 1334.0 | 1318.0 | 1278.0 | 1325.0 | 1228.0 | 1300.0 | 1291.0 | 1309.0 |
| | 1322.0 | 1352.0 | 1277.0 | 1319.0 | 1326.0 | 1142.0 | 1292.0 | 1309.0 | 1293.0 | 1315.0 | 1330.0 |
| | 1308.0 | 1285.0 | 1264.0 | 1307.0 | 1293.0 | 1278.0 | 1349.0 | 1303.0 | 1296.0 | 1220.0 | 1324.0 |
| Mean of Control Group= | 1309.8 | | | | | 1203.8 | | | 1313.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 20.7 | | | | | 85.3 | | | 27.0 | | |
| Std. Deviation of Mean of Control Group as % = | 1.6 | | | | | 7.1 | | | 2.1 | | |
| Mean of Exposed Group= | | 1302.6 | 1273.4 | 1308.6 | 1294.8 | | 1343.6 | 1291.6 | | 1296.6 | 1325.0 |
| Change in Exposed Mean from Control Mean= | | -7.2 | -36.4 | -1.2 | -15.0 | | 139.8 | 87.8 | | -16.4 | 12.0 |
| Percent change in Exposed Mean from Control Mean= | | -0.55 | -2.78 | -0.09 | -1.15 | | 11.61 | 7.29 | | -1.25 | 0.91 |
| Is change less than one Std. Deviation of Control Group? | | Yes | No | Yes | Yes | | No | No | | Yes | Yes |




000258

706

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

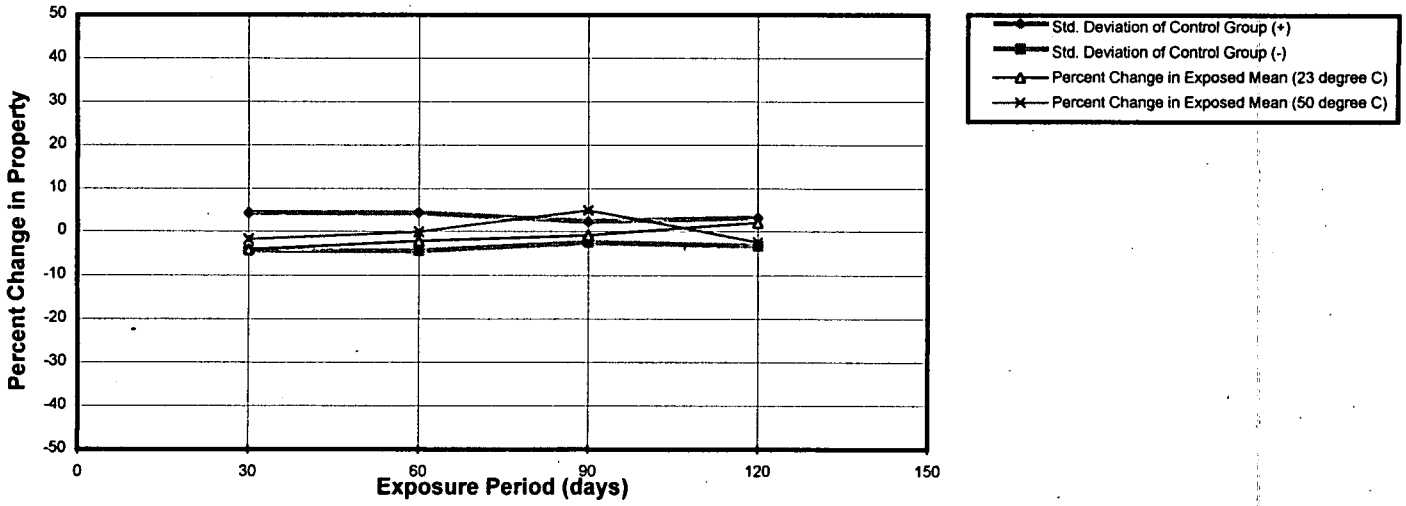
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT BREAK (%)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 1304.0 | 1307.0 | 1348.0 | 1487.0 | 1430.0 | 1297.0 | 1307.0 | 1422.0 | 1458.0 | 1436.0 | 1443.0 |
| | 1455.0 | 1357.0 | 1368.0 | 1398.0 | 1402.0 | 1249.0 | 1302.0 | 1407.0 | 1344.0 | 1467.0 | 1280.0 |
| | 1428.0 | 1384.0 | 1407.0 | 1315.0 | 1473.0 | 1321.0 | 1259.0 | 1467.0 | 1375.0 | 1424.0 | 1391.0 |
| | 1438.0 | 1385.0 | 1401.0 | 1364.0 | 1329.0 | 1310.0 | 1312.0 | 1172.0 | 1425.0 | 1436.0 | 1264.0 |
| | 1409.0 | 1321.0 | 1392.0 | 1325.0 | 1398.0 | 1325.0 | 1272.0 | 1349.0 | 1400.0 | 1380.0 | 1460.0 |
| Mean of Control Group= | 1406.8 | | | | | 1300.4 | | | 1400.4 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 59.8 | | | | | 30.7 | | | 44.0 | | |
| Std. Deviation of Mean of Control Group as % = | 4.3 | | | | | 2.4 | | | 3.1 | | |
| Mean of Exposed Group= | | 1350.8 | 1383.2 | 1377.8 | 1406.4 | | 1290.4 | 1363.4 | | 1428.6 | 1367.6 |
| Change in Exposed Mean from Control Mean= | | -56.0 | -23.6 | -29.0 | -0.4 | | -10.0 | 63.0 | | 28.2 | -32.8 |
| Percent change in Exposed Mean from Control Mean= | | -3.98 | -1.68 | -2.06 | -0.03 | | -0.77 | 4.84 | | 2.01 | -2.34 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | Yes | No | | Yes | Yes |




000259

906

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

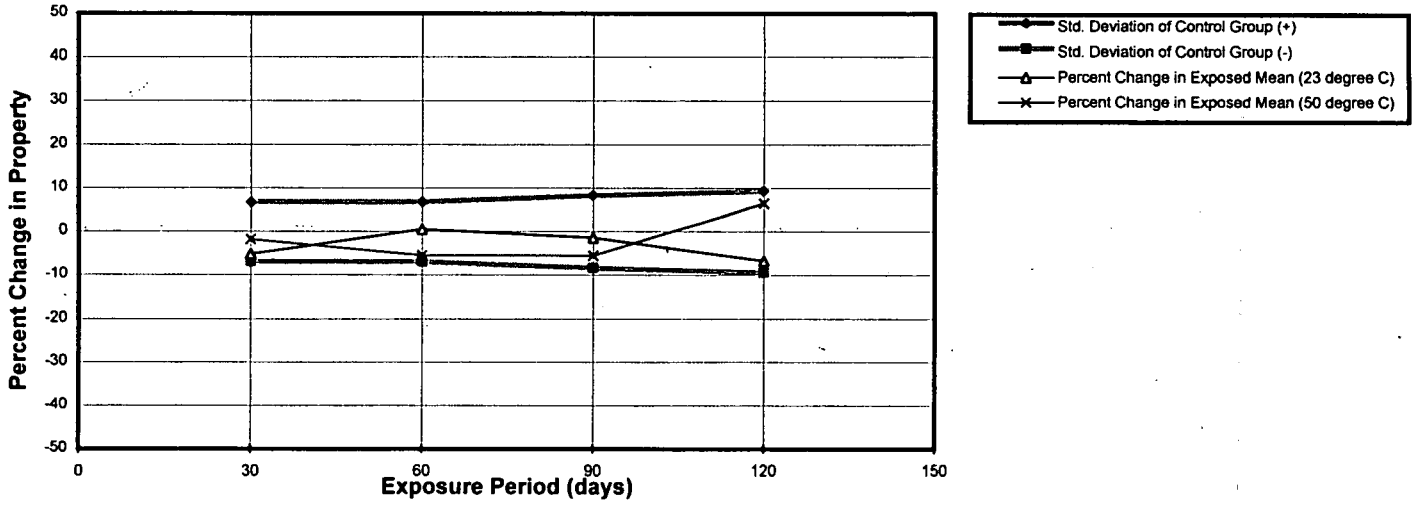
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT BREAK (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 4630.0 | 4837.5 | 4647.5 | 3906.3 | 4687.5 | 5280.0 | 4670.0 | 4177.5 | 4192.5 | 4272.5 | 4757.5 |
| | 4775.0 | 4565.0 | 4300.0 | 4475.0 | 4393.8 | 4805.0 | 4740.0 | 4942.5 | 4190.0 | 4185.0 | 5030.0 |
| | 4002.5 | 3235.0 | 4740.0 | 4731.3 | 4700.0 | 4895.0 | 4557.5 | 5070.0 | 4997.5 | 3862.5 | 4550.0 |
| | 4672.5 | 4880.0 | 4025.0 | 4775.0 | 3162.5 | 4177.5 | 4882.5 | 3977.5 | 4895.0 | 4135.0 | 4597.5 |
| | 4657.5 | 4072.5 | 4627.5 | 4975.0 | 4568.8 | 4880.0 | 4862.5 | 4555.0 | 4172.5 | 4510.0 | 4947.5 |
| Mean of Control Group= | 4547.5 | | | | | 4807.5 | | | 4489.5 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 309.6 | | | | | 397.8 | | | 418.6 | | |
| Std. Deviation of Mean of Control Group as % = | 6.8 | | | | | 8.3 | | | 9.3 | | |
| Mean of Exposed Group= | | 4318.0 | 4468.0 | 4572.5 | 4302.5 | | 4742.5 | 4544.5 | | 4193.0 | 4776.5 |
| Change in Exposed Mean from Control Mean= | | -229.5 | -79.5 | 25.0 | -245.0 | | -65.0 | -263.0 | | -296.5 | 287.0 |
| Percent change in Exposed Mean from Control Mean= | | -5.05 | -1.75 | 0.55 | -5.39 | | -1.35 | -5.47 | | -6.60 | 6.39 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |




000250

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

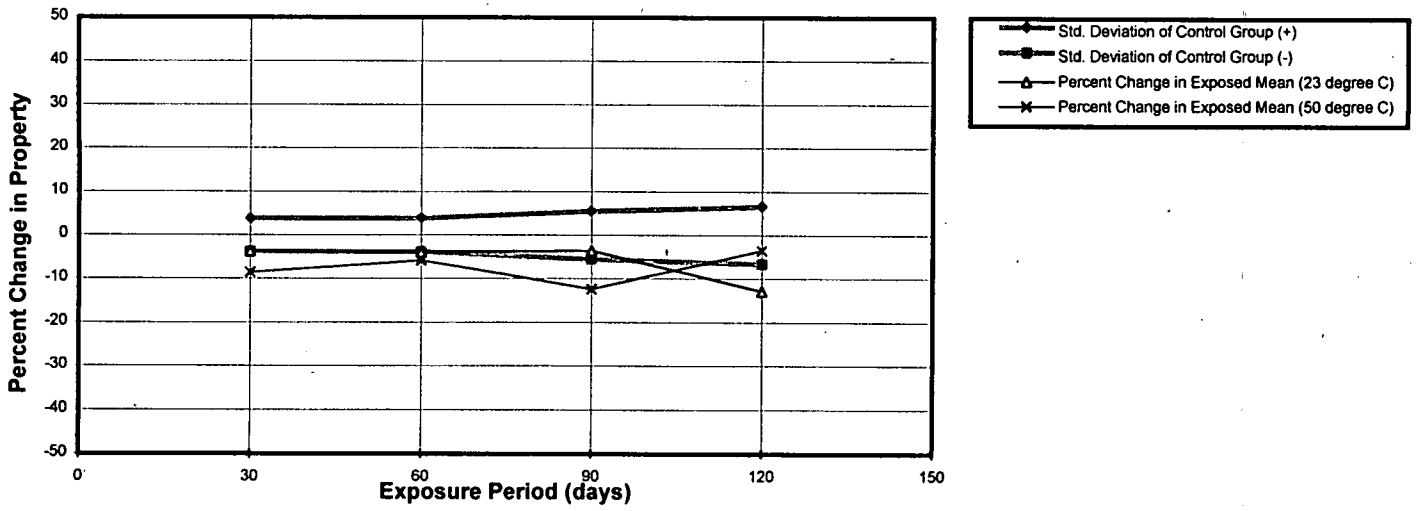
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** GSE-Gundle
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** STRESS AT BREAK (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 5004.9 | 4762.5 | 4967.5 | 4581.3 | 4275.0 | 4737.5 | 5015.0 | 4177.5 | 5117.5 | 4880.0 | 4880.0 |
| | 5211.3 | 4512.5 | 4420.0 | 5000.0 | 4950.0 | 5250.0 | 4952.5 | 4942.5 | 5500.0 | 3647.5 | 4947.5 |
| | 4807.5 | 5175.0 | 4692.5 | 4862.5 | 5185.0 | 5410.0 | 5315.0 | 5070.0 | 4587.5 | 5007.5 | 4670.0 |
| | 5306.8 | 5065.0 | 4395.0 | 4975.0 | 4687.5 | 5085.0 | 4757.5 | 3977.5 | 4962.5 | 4220.0 | 4795.0 |
| | 5097.1 | 4972.5 | 4775.0 | 5015.0 | 4843.8 | 5430.0 | 4937.5 | 4555.0 | 4940.0 | 4147.5 | 4927.5 |
| Mean of Control Group= | 5085.5 | | | | | 5182.5 | | | 5021.5 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 192.8 | | | | | 285.1 | | | 330.4 | | |
| Std. Deviation of Mean of Control Group as % = | 3.8 | | | | | 5.5 | | | 6.6 | | |
| Mean of Exposed Group= | | 4897.5 | 4650.0 | 4886.8 | 4788.3 | | 4995.5 | 4544.5 | | 4380.5 | 4844.0 |
| Change in Exposed Mean from Control Mean= | | -188.0 | -435.5 | -198.8 | -297.3 | | -187.0 | -638.0 | | -641.0 | -177.5 |
| Percent change in Exposed Mean from Control Mean= | | -3.70 | -8.56 | -3.91 | -5.85 | | -3.61 | -12.31 | | -12.77 | -3.53 |
| Is change less than one Std. Deviation of Control Group? | | Yes | No | No | No | | Yes | No | | No | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

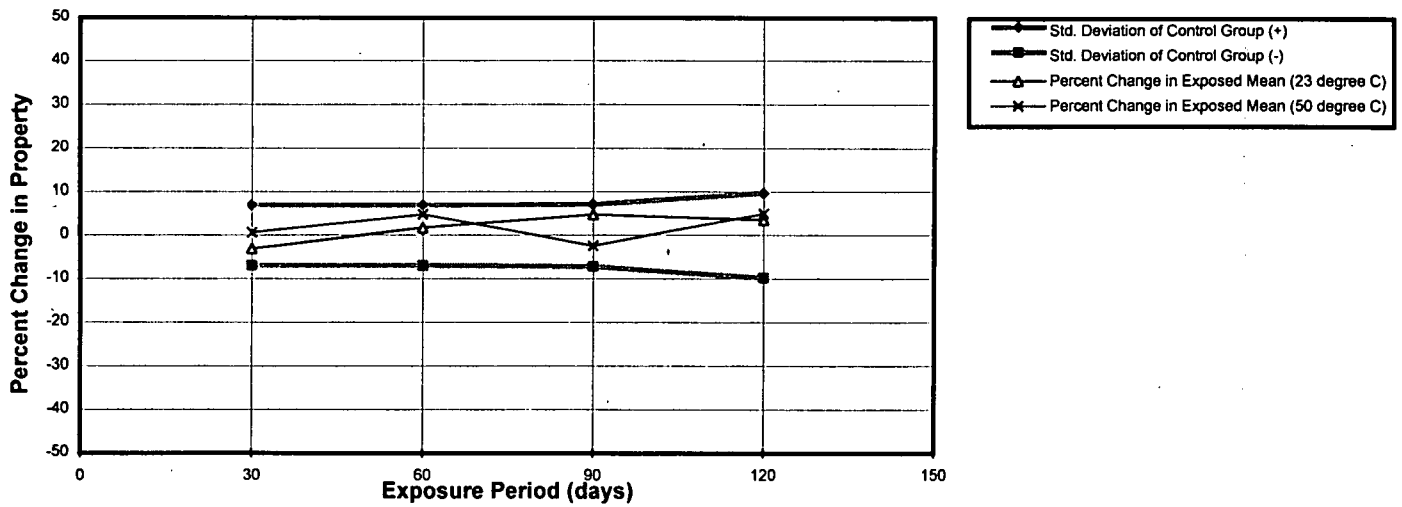
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT BREAK (%)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 1187.0 | 1228.0 | 1227.0 | 1036.0 | 1266.0 | 1275.0 | 1270.0 | 1072.0 | 1047.0 | 1218.0 | 1204.0 |
| | 1222.0 | 1167.0 | 1157.0 | 1193.0 | 1174.0 | 1177.0 | 1287.0 | 1231.0 | 1047.0 | 1251.0 | 1289.0 |
| | 1043.0 | 1063.0 | 1285.0 | 1256.0 | 1247.0 | 1194.0 | 1154.0 | 1271.0 | 1241.0 | 1085.0 | 1159.0 |
| | 1246.0 | 1241.0 | 1069.0 | 1236.0 | 1303.0 | 1043.0 | 1241.0 | 1024.0 | 1223.0 | 1247.0 | 1195.0 |
| | 1223.0 | 1044.0 | 1220.0 | 1302.0 | 1215.0 | 1196.0 | 1213.0 | 1151.0 | 1287.0 | 1252.0 | 1292.0 |
| Mean of Control Group= | 1184.2 | | | | | 1177.0 | | | 1169.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 81.7 | | | | | 84.0 | | | 113.8 | | |
| Std. Deviation of Mean of Control Group as % = | 6.9 | | | | | 7.1 | | | 9.7 | | |
| Mean of Exposed Group= | | 1148.6 | 1191.6 | 1204.6 | 1241.0 | | 1233.0 | 1149.8 | | 1210.6 | 1227.8 |
| Change in Exposed Mean from Control Mean= | | -35.6 | 7.4 | 20.4 | 56.8 | | 56.0 | -27.2 | | 41.6 | 58.8 |
| Percent change in Exposed Mean from Control Mean= | | -3.01 | 0.62 | 1.72 | 4.80 | | 4.76 | -2.31 | | 3.56 | 5.03 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

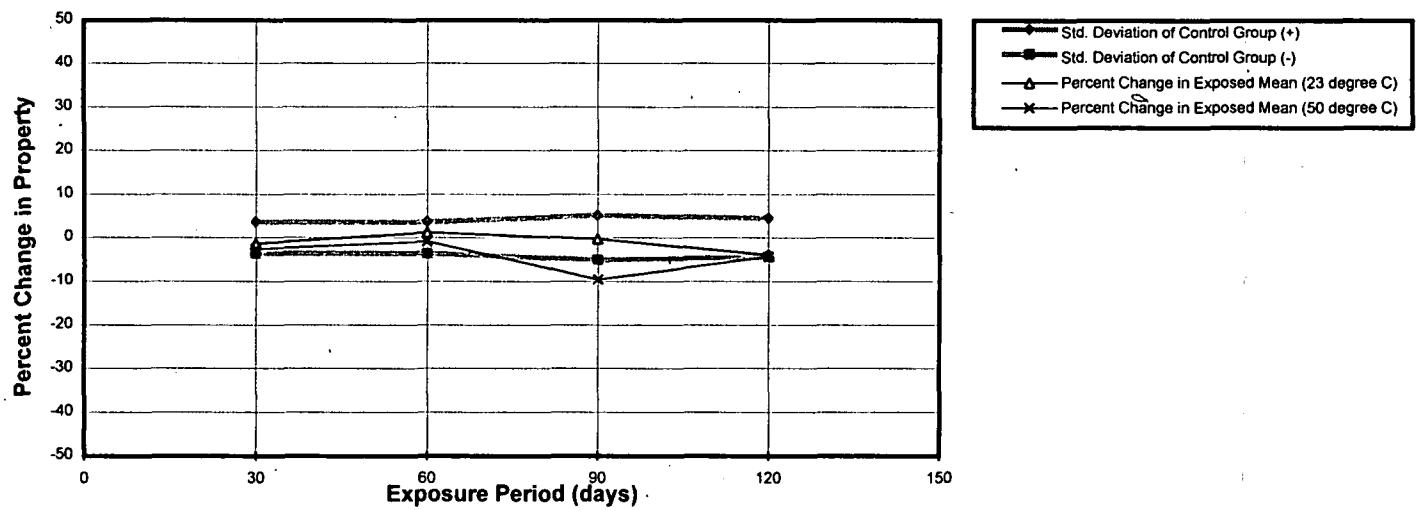
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT BREAK (%)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 1254.0 | 1215.0 | 1298.0 | 1218.0 | 1139.0 | 1173.0 | 1273.0 | 1072.0 | 1292.0 | 1368.0 | 1262.0 |
| | 1315.0 | 1175.0 | 1197.0 | 1318.0 | 1295.0 | 1285.0 | 1257.0 | 1231.0 | 1380.0 | 1370.0 | 1276.0 |
| | 1208.0 | 1322.0 | 1252.0 | 1282.0 | 1368.0 | 1328.0 | 1345.0 | 1271.0 | 1352.0 | 1303.0 | 1205.0 |
| | 1320.0 | 1291.0 | 1175.0 | 1308.0 | 1232.0 | 1242.0 | 1212.0 | 1024.0 | 1251.0 | 1119.0 | 1235.0 |
| | 1272.0 | 1278.0 | 1280.0 | 1325.0 | 1279.0 | 1325.0 | 1248.0 | 1151.0 | 1256.0 | 1112.0 | 1267.0 |
| Mean of Control Group= | 1273.8 | | | | | 1270.6 | | | 1306.2 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 46.3 | | | | | 64.8 | | | 57.7 | | |
| Std. Deviation of Mean of Control Group as % = | 3.6 | | | | | 5.1 | | | 4.4 | | |
| Mean of Exposed Group= | | 1256.2 | 1240.4 | 1290.2 | 1262.6 | | 1267.0 | 1149.8 | | 1254.4 | 1249.0 |
| Change in Exposed Mean from Control Mean= | | -17.6 | -33.4 | 16.4 | -11.2 | | -3.6 | -120.8 | | -51.8 | -57.2 |
| Percent change in Exposed Mean from Control Mean= | | -1.38 | -2.62 | 1.29 | -0.88 | | -0.28 | -9.51 | | -3.97 | -4.38 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | Yes | No | | Yes | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

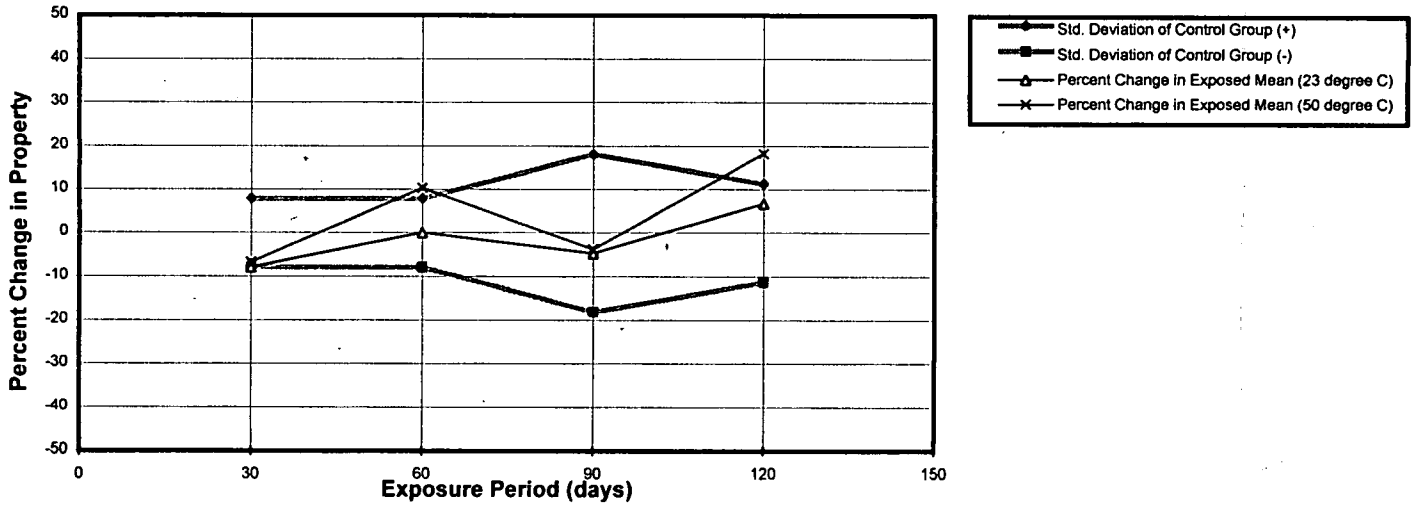
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT BREAK (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 3737.5 | 4495.0 | 3875.0 | 4287.5 | 4672.5 | 4302.5 | 3760.0 | 4217.5 | 3210.0 | 4277.5 | 4862.5 |
| | 4025.0 | 3765.0 | 3892.5 | 4417.5 | 4265.0 | 3717.5 | 4230.0 | 3960.0 | 4342.5 | 4067.5 | 4685.0 |
| | 4000.0 | 4422.5 | 3547.5 | 3725.0 | 4335.0 | 3070.0 | 3892.5 | 3537.5 | 4255.0 | 4115.0 | 4527.5 |
| | 4162.5 | 2118.8 | 3862.5 | 3915.0 | 4987.5 | 4885.0 | 4085.0 | 3907.5 | 3970.0 | 4170.0 | 4832.5 |
| | 4612.5 | 4127.5 | 3977.5 | 4205.0 | 4385.0 | 4705.0 | 3745.0 | 4275.0 | 3990.0 | 4457.5 | 4452.5 |
| Mean of Control Group= | 4107.5 | | | | | 4136.0 | | | 3953.5 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 321.4 | | | | | 745.7 | | | 446.3 | | |
| Std. Deviation of Mean of Control Group as % = | 7.8 | | | | | 18.0 | | | 11.3 | | |
| Mean of Exposed Group= | | 3785.8 | 3831.0 | 4110.0 | 4529.0 | | 3942.5 | 3979.5 | | 4217.5 | 4672.0 |
| Change in Exposed Mean from Control Mean= | | -321.8 | -276.5 | 2.5 | 421.5 | | -193.5 | -156.5 | | 264.0 | 718.5 |
| Percent change in Exposed Mean from Control Mean= | | -7.83 | -6.73 | 0.06 | 10.26 | | -4.68 | -3.78 | | 6.68 | 18.17 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | Yes | No | | Yes | Yes | | Yes | No |




000264

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

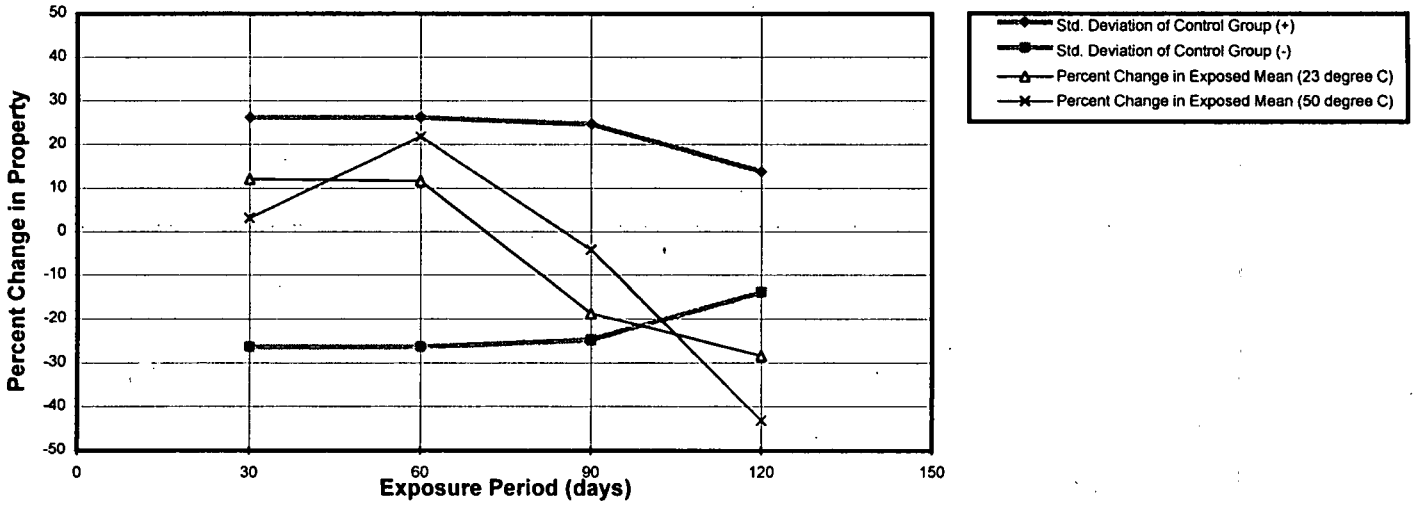
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT BREAK (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 3781.3 | 3732.5 | 3397.5 | 3877.5 | 3662.5 | 4655.0 | 3187.5 | 3917.5 | 4165.0 | 2610.0 | 1970.0 |
| | 3343.8 | 1860.0 | 3217.5 | 3237.5 | 3737.5 | 2300.0 | 4230.0 | 3795.0 | 4060.0 | 3090.0 | 2467.5 |
| | 3293.8 | 4532.5 | 3552.5 | 4372.5 | 4355.0 | 4430.0 | 3002.5 | 3442.5 | 3415.0 | 3542.5 | 1785.0 |
| | 1843.8 | 4412.5 | 2962.5 | 3357.5 | 4412.5 | 4112.5 | 3565.0 | 2720.0 | 3032.5 | 2095.0 | 3142.5 |
| | 4081.3 | 3787.5 | 3745.0 | 3402.5 | 3743.8 | 3533.8 | 1482.5 | 4392.5 | 4202.5 | 2180.0 | 1357.5 |
| Mean of Control Group= | 3268.8 | | | | | 3806.3 | | | 3775.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 860.2 | | | | | 941.6 | | | 523.7 | | |
| Std. Deviation of Mean of Control Group as % = | 26.3 | | | | | 24.7 | | | 13.9 | | |
| Mean of Exposed Group= | | 3665.0 | 3375.0 | 3649.5 | 3982.3 | | 3093.5 | 3653.5 | | 2703.5 | 2144.5 |
| Change in Exposed Mean from Control Mean= | | 396.3 | 106.3 | 380.8 | 713.5 | | -712.8 | -152.8 | | -1071.5 | -1630.5 |
| Percent change in Exposed Mean from Control Mean= | | 12.12 | 3.25 | 11.65 | 21.83 | | -18.73 | -4.01 | | -28.38 | -43.19 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | Yes | Yes | | No | No |




000265

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

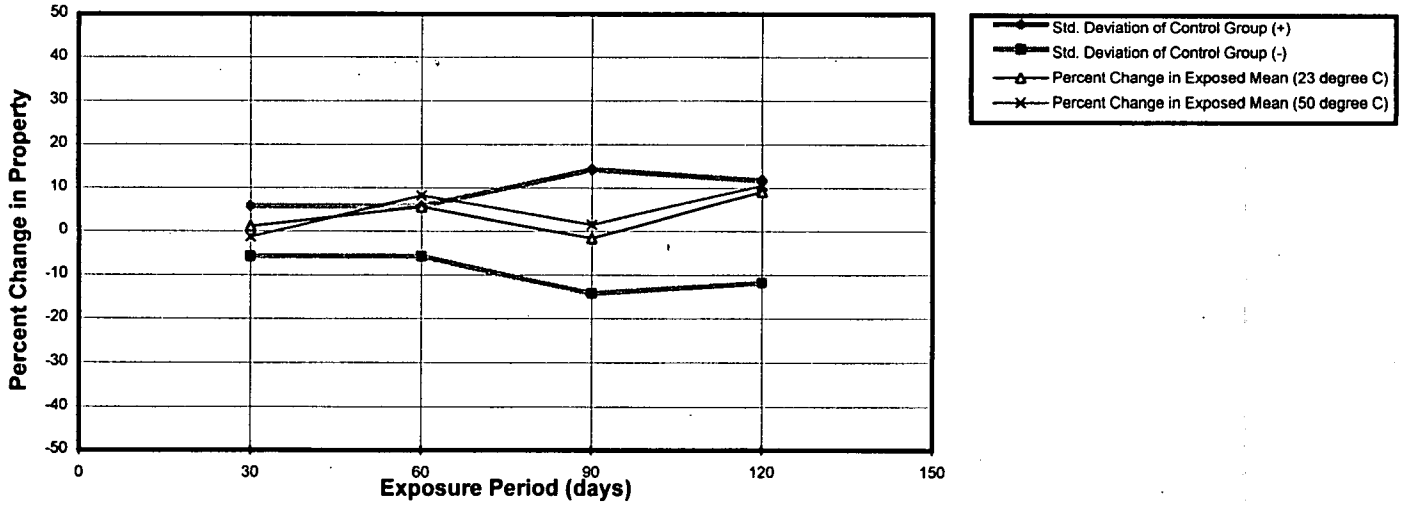
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** POLYFLEX
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** STRAIN AT BREAK (%)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 1152.0 | 1330.0 | 1188.0 | 1352.0 | 1355.0 | 1232.0 | 1166.0 | 1232.0 | 995.7 | 1316.0 | 1365.0 |
| | 1218.0 | 1157.0 | 1256.0 | 1385.0 | 1253.0 | 1078.0 | 1252.0 | 1171.0 | 1322.0 | 1340.0 | 1299.0 |
| | 1222.0 | 1285.0 | 1135.0 | 1242.0 | 1302.0 | 948.5 | 1128.0 | 1108.0 | 1300.0 | 1328.0 | 1346.0 |
| | 1224.0 | | 1252.0 | 1212.0 | 1448.0 | 1357.0 | 1207.0 | 1216.0 | 1151.0 | 1300.0 | 1376.0 |
| | 1348.0 | 1218.0 | 1252.0 | 1319.0 | 1312.0 | 1302.0 | 1068.0 | 1285.0 | 1319.0 | 1362.0 | 1343.0 |
| Mean of Control Group= | 1232.8 | | | | | 1183.5 | | | 1217.5 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 71.1 | | | | | 168.0 | | | 142.9 | | |
| Std. Deviation of Mean of Control Group as % = | 5.8 | | | | | 14.2 | | | 11.7 | | |
| Mean of Exposed Group= | | 1247.5 | 1216.6 | 1302.0 | 1334.0 | | 1164.2 | 1202.4 | | 1329.2 | 1345.8 |
| Change in Exposed Mean from Control Mean= | | 14.7 | -16.2 | 69.2 | 101.2 | | -19.3 | 18.9 | | 111.7 | 128.3 |
| Percent change in Exposed Mean from Control Mean= | | 1.19 | -1.31 | 5.61 | 8.21 | | -1.63 | 1.60 | | 9.17 | 10.53 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | No | | Yes | Yes | | Yes | Yes |




000266

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

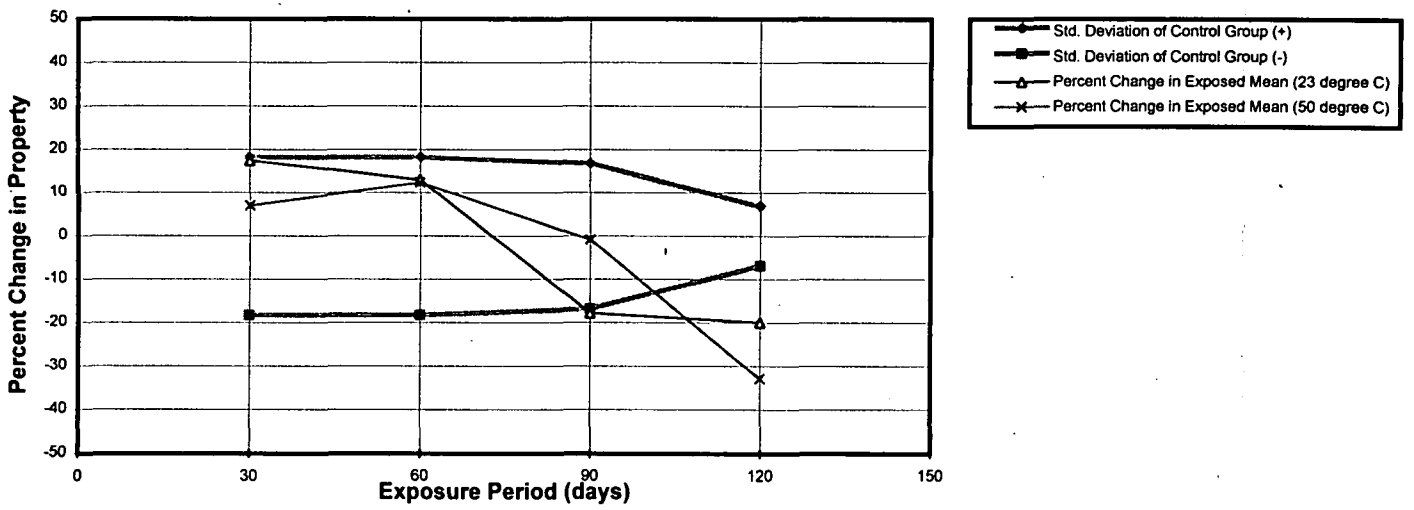
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT BREAK (%)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 1216.0 | 1190.0 | 1187.0 | 1316.0 | 1149.0 | 1369.0 | 1016.0 | 1277.0 | 1276.0 | 993.8 | 811.5 |
| | 1135.0 | | 1131.0 | 1132.0 | 1209.0 | 885.4 | 1267.0 | 1233.0 | 1246.0 | 1087.0 | 738.4 |
| | 1103.0 | 1418.0 | 1199.0 | 1443.0 | 1338.0 | 1313.0 | 1027.0 | 1134.0 | 1105.0 | 1150.0 | 788.5 |
| | 775.4 | 1404.0 | 1152.0 | 1177.0 | 1348.0 | 1251.0 | 1102.0 | 878.5 | 1240.0 | 887.7 | 1079.0 |
| | 1308.0 | 1188.0 | 1256.0 | 1185.0 | 1177.0 | 1073.0 | 433.8 | 1320.0 | 1337.0 | 848.8 | 746.9 |
| Mean of Control Group= | 1107.5 | | | | | 1178.3 | | | 1240.8 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 201.9 | | | | | 197.9 | | | 85.1 | | |
| Std. Deviation of Mean of Control Group as % = | 18.2 | | | | | 16.8 | | | 6.9 | | |
| Mean of Exposed Group= | | 1300.0 | 1185.0 | 1250.6 | 1244.2 | | 969.2 | 1168.5 | | 993.5 | 832.9 |
| Change in Exposed Mean from Control Mean= | | 192.5 | 77.5 | 143.1 | 136.7 | | -209.1 | -9.8 | | -247.3 | -407.9 |
| Percent change in Exposed Mean from Control Mean= | | 17.38 | 7.00 | 12.92 | 12.35 | | -17.75 | -0.83 | | -19.93 | -32.88 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | No | Yes | | No | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

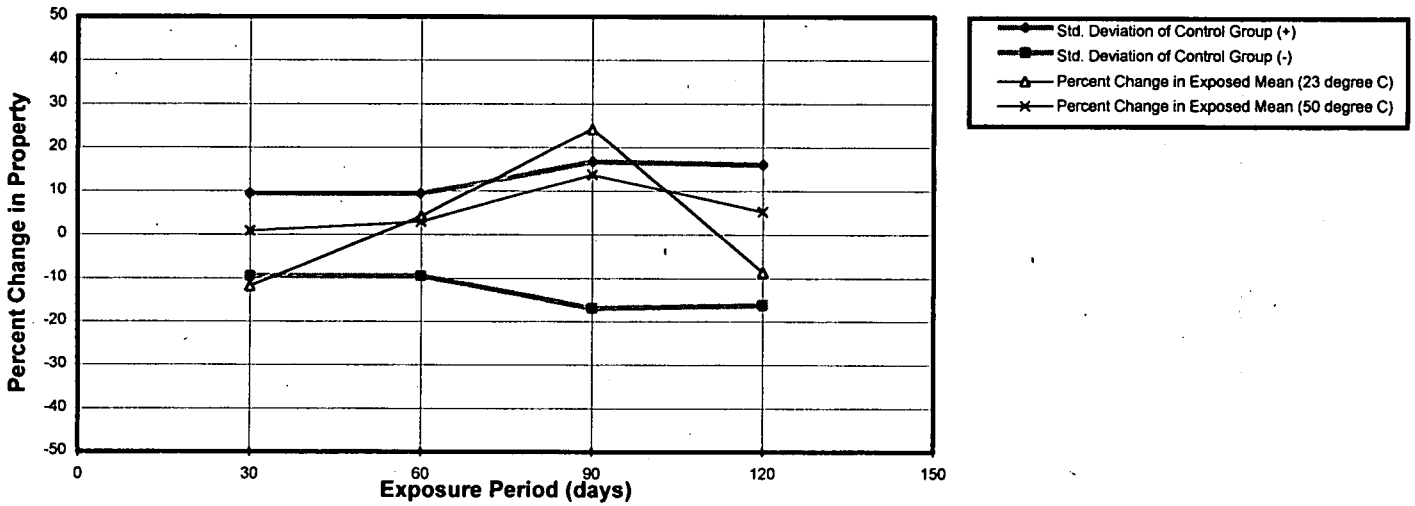
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** SERROT
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** STRESS AT BREAK (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 3556.3 | 4082.5 | 4472.5 | 4112.5 | 3818.8 | 4075.0 | 4600.0 | 4050.0 | 4310.0 | 3750.0 | 4345.0 |
| | 4575.0 | 4395.0 | 4222.5 | 4481.3 | 4587.5 | 4040.0 | 4607.5 | 4275.0 | 4222.5 | 3885.0 | 4355.0 |
| | 4100.0 | 1590.0 | 3755.0 | 4375.0 | 4068.8 | 4165.0 | 4790.0 | 4125.0 | 4420.0 | 4282.5 | 3711.3 |
| | 4431.3 | 4277.5 | 4277.5 | 4506.3 | 4700.0 | 3703.8 | 4515.0 | 4356.3 | 2977.5 | 2710.0 | 4233.8 |
| | 4162.5 | 4027.5 | 4290.0 | 4218.8 | 4275.0 | 2650.0 | 4655.0 | 4400.0 | 3475.0 | 3125.0 | 3776.3 |
| Mean of Control Group= | 4165.0 | | | | | 3726.8 | | | 3881.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 391.7 | | | | | 626.8 | | | 627.0 | | |
| Std. Deviation of Mean of Control Group as % = | 9.4 | | | | | 16.8 | | | 16.2 | | |
| Mean of Exposed Group= | | 3674.5 | 4203.5 | 4338.8 | 4290.0 | | 4633.5 | 4241.3 | | 3550.5 | 4084.3 |
| Change in Exposed Mean from Control Mean= | | -490.5 | 38.5 | 173.8 | 125.0 | | 906.8 | 514.5 | | -330.5 | 203.3 |
| Percent change in Exposed Mean from Control Mean= | | -11.78 | 0.92 | 4.17 | 3.00 | | 24.33 | 13.81 | | -8.52 | 5.24 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | Yes | Yes | | No | Yes | | Yes | Yes |




000268

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

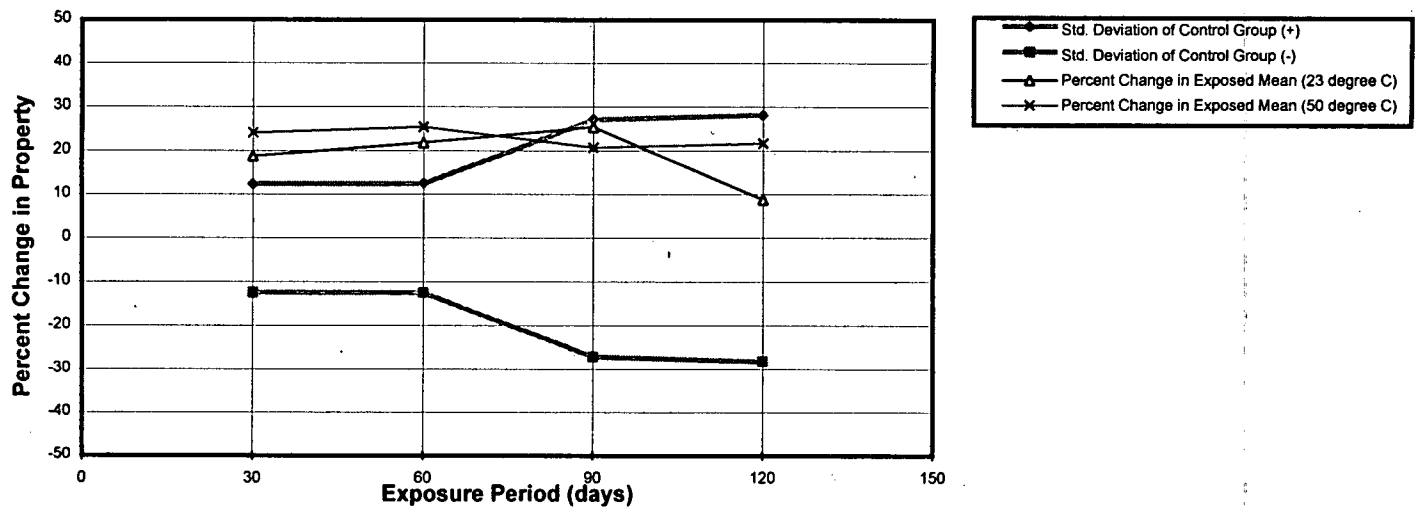
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRESS AT BREAK (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 4025.0 | 4075.0 | 4807.5 | 4162.5 | 4000.0 | 4165.0 | 4247.5 | 4280.0 | 4222.5 | 4402.5 | 4437.5 |
| | 3375.0 | 4442.5 | 4427.5 | 4718.8 | 4581.3 | 3562.5 | 4712.5 | 4027.5 | 3032.5 | 4067.5 | 4500.0 |
| | 3893.8 | 4637.5 | 4197.5 | 3918.8 | 4568.8 | 3152.5 | 3350.0 | 4577.5 | 4412.5 | 3780.0 | 3731.3 |
| | 2918.8 | 4242.5 | 4252.5 | 4281.3 | 4531.3 | 1911.3 | 4131.3 | 3587.5 | 2490.0 | 1875.0 | 3906.3 |
| | 3518.8 | 3667.5 | 4307.5 | 4525.0 | 4556.3 | 4057.5 | 4687.5 | 3870.0 | 2470.0 | 3957.5 | 3662.5 |
| Mean of Control Group= | 3546.3 | | | | | 3369.8 | | | 3325.5 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 439.8 | | | | | 910.6 | | | 935.7 | | |
| Std. Deviation of Mean of Control Group as % = | 12.4 | | | | | 27.0 | | | 28.1 | | |
| Mean of Exposed Group= | | 4213.0 | 4398.5 | 4321.3 | 4447.5 | | 4225.8 | 4068.5 | | 3616.5 | 4047.5 |
| Change in Exposed Mean from Control Mean= | | 666.8 | 852.3 | 775.0 | 901.3 | | 856.0 | 698.8 | | 291.0 | 722.0 |
| Percent change in Exposed Mean from Control Mean= | | 18.80 | 24.03 | 21.85 | 25.41 | | 25.40 | 20.74 | | 8.75 | 21.71 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | Yes | Yes | | Yes | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

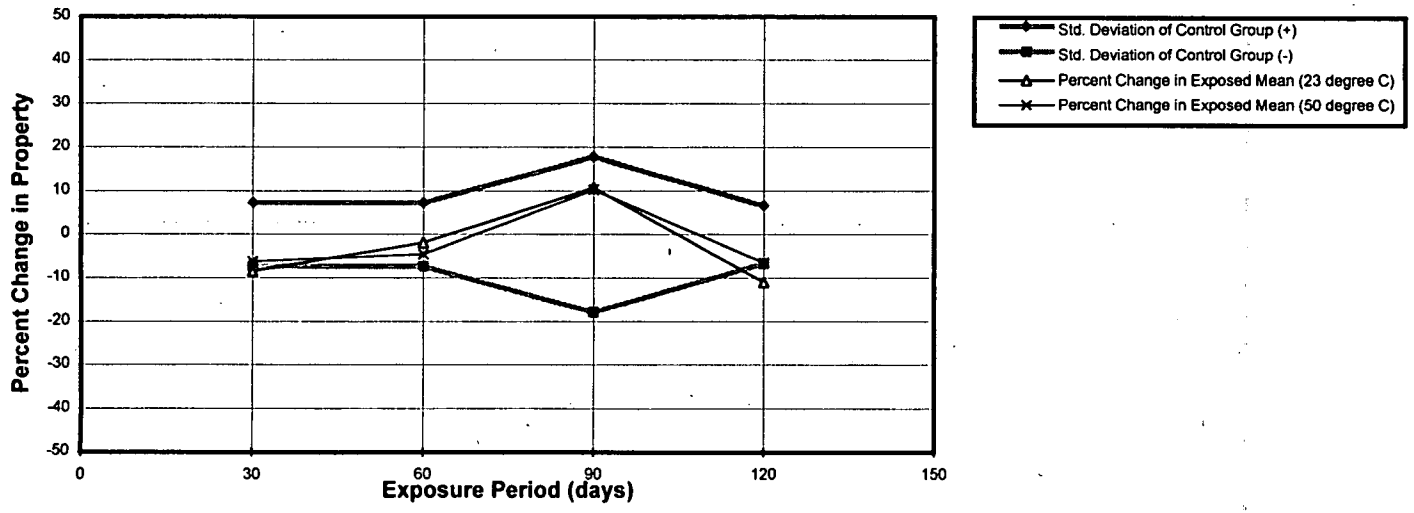
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT BREAK (%)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 1143.0 | 1208.0 | 1295.0 | 1218.0 | 1111.0 | 1257.0 | 1242.0 | 1212.0 | 1287.0 | 1154.0 | 1267.0 |
| | 1366.0 | 1289.0 | 1229.0 | 1328.0 | 1305.0 | 1274.0 | 1228.0 | 1264.0 | 1328.0 | 1335.0 | 1269.0 |
| | 1307.0 | 1036.0 | 1125.0 | 1285.0 | 1198.0 | 1225.0 | 1311.0 | 1232.0 | 1344.0 | 1271.0 | 1100.0 |
| | 1378.0 | 1253.0 | 1236.0 | 1328.0 | 1365.0 | 1163.0 | 1246.0 | 1283.0 | 1304.0 | 845.4 | 1231.0 |
| | 1336.0 | 1194.0 | 1242.0 | 1250.0 | 1258.0 | 785.4 | 1288.0 | 1301.0 | 1132.0 | 1092.0 | 1119.0 |
| Mean of Control Group= | 1306.0 | | | | | 1140.9 | | | 1279.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 95.2 | | | | | 203.2 | | | 85.0 | | |
| Std. Deviation of Mean of Control Group as % = | 7.3 | | | | | 17.8 | | | 6.6 | | |
| Mean of Exposed Group= | | 1196.0 | 1225.4 | 1281.8 | 1247.4 | | 1263.0 | 1258.4 | | 1139.5 | 1197.2 |
| Change in Exposed Mean from Control Mean= | | -110.0 | -80.6 | -24.2 | -58.6 | | 122.1 | 117.5 | | -139.5 | -81.8 |
| Percent change in Exposed Mean from Control Mean= | | -8.42 | -6.17 | -1.85 | -4.49 | | 10.70 | 10.30 | | -10.91 | -6.40 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | Yes | Yes | | Yes | Yes | | No | Yes |




000270

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

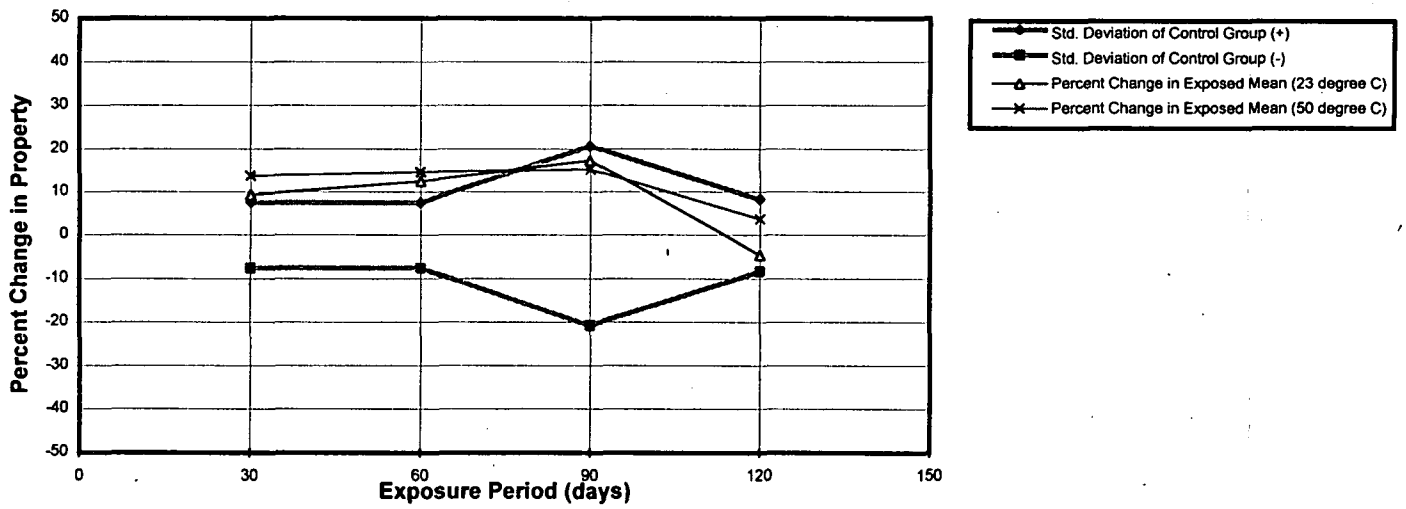
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** STRAIN AT BREAK (%)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 1343.0 | 1295.0 | 1507.0 | 1345.0 | 1273.0 | 1310.0 | 1286.0 | 1329.0 | 1359.0 | 1389.0 | 1412.0 |
| | 1172.0 | 1413.0 | 1412.0 | 1499.0 | 1450.0 | 1135.0 | 1421.0 | 1261.0 | 1185.0 | 1297.0 | 1423.0 |
| | 1302.0 | 1454.0 | 1350.0 | 1267.0 | 1441.0 | 1071.0 | 1098.0 | 1408.0 | 1366.0 | 1212.0 | 1223.0 |
| | 1119.0 | 1352.0 | 1354.0 | 1363.0 | 1432.0 | 742.3 | 1275.0 | 1141.0 | 1204.0 | 811.5 | 1256.0 |
| | 1204.0 | 1198.0 | 1363.0 | 1431.0 | 1441.0 | 1295.0 | 1434.0 | 1261.0 | 1143.0 | 1269.0 | 1175.0 |
| Mean of Control Group= | 1228.0 | | | | | 1110.7 | | | 1251.4 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 92.6 | | | | | 230.0 | | | 103.8 | | |
| Std. Deviation of Mean of Control Group as % = | 7.5 | | | | | 20.7 | | | 8.3 | | |
| Mean of Exposed Group= | | 1342.4 | 1397.2 | 1381.0 | 1407.4 | | 1302.8 | 1280.0 | | 1195.7 | 1297.8 |
| Change in Exposed Mean from Control Mean= | | 114.4 | 169.2 | 153.0 | 179.4 | | 192.1 | 169.3 | | -55.7 | 46.4 |
| Percent change in Exposed Mean from Control Mean= | | 9.32 | 13.78 | 12.46 | 14.61 | | 17.30 | 15.25 | | -4.45 | 3.71 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | Yes | Yes | | Yes | Yes |




000271

2.9 MODULUS OF ELASTIC

## 2.9 Modulus of Elasticity

*Rationale for 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 percent changes in modulus of elasticity of the five geomembranes.

GSE-SLT Geomembrane. In the roll direction, the percent changes in modulus of elasticity due to exposure were within one standard deviation of the control means for all of the exposures except the 120-day exposures at 23°C and 50°C. In the cross-roll direction, the percent changes in modulus of elasticity due to exposure were within one standard deviation of the control means for all of the exposures except the 60-day exposure at 23°C, and the 30-day exposure at 50°C. In the roll direction, percent change in property for exposures at 23°C remained relatively constant with exposure time; for exposures at 50°C percent change in property decreased with exposure time. In the cross-roll direction, percent change in property for exposures at 50°C remained relatively constant with exposure time; for exposures at 23°C, results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time.

NSC Geomembrane. In the roll direction, the percent changes in modulus of elasticity due to exposure were not within one standard deviation of the control means for any of the exposures except the 30-day and the 90-day exposures at 23°C. In the cross-roll direction, the percent changes in modulus of elasticity due to exposure were within one standard deviation of the control means for all of the exposures except the 30-day, the 60-day and the 90-day exposures at 23°C, and the 30-day exposure at 50°C. In the roll direction, results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature. In the cross-roll direction, in general, percent change in property

decreased with exposure time; however, this trend was not consistent between temperatures.

GSE-Gundle Geomembrane. In the roll direction, the percent changes in modulus of elasticity due to exposure were not within one standard deviation of the control means for any of the exposures except the 90-day exposures at 23°C and 50°C. In the cross-roll direction, the percent changes in modulus of elasticity due to exposure were not within one standard deviation of the control means for any of the exposures except the 120-day exposure at 23°C, and the 30-day exposure at 50°C. In the roll direction, in general, percent change in property decreased with exposure time; however, this trend was contradicted between temperatures. In the cross-roll direction, percent change in property remained relatively constant with exposure time and temperature.

PolyFlex Geomembrane. In the roll direction, the percent changes in modulus of elasticity due to exposure were within one standard deviation of the control means for all of the exposures except the 90-day and the 120-day exposures at 23°C, and the 120-day exposure at 50°C. In the cross-roll direction, the percent changes in modulus of elasticity due to exposure were within one standard deviation of the control means for all of the exposures except the 60-day and 120-day exposures at 23°C, and the 90-day exposure at 50°C. In the roll direction, percent change in property for exposures at 50°C remained relatively constant with exposure time; for exposures at 23°C, results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time. In the cross-roll direction, percent change in property remained relatively constant with exposure time and temperature.

Serrot Geomembrane. In the roll direction, the percent changes in modulus of elasticity due to exposure were not within one standard deviation of the control means for any of the exposures except the 60-day exposure at 50°C. In the cross-roll direction, the percent changes in modulus of elasticity due to exposure were not within one standard deviation of the control means for any of the exposures except the 120-day exposure at 50°C. In both directions, the percent change in property remained relatively constant with exposure time; however, exposures at 50°C showed less percent changes than exposures at 23°C.

*Conclusion*

The means of percent changes in modulus of elasticity were within one standard deviation of the control means for at least 5 out of 8 exposures for GSE-SLT and Polyflex geomembranes in both directions. Randomness in data or inconsistent trends were observed in means of percent changes in both directions for NSC and Serrot geomembranes. The means of percent changes for GSE-Gundle geomembrane exhibited consistent trends between exposure time and temperature in the cross-roll direction; however, a similar trend was not observed in the roll direction. Therefore, no detrimental effects are expected to the tested property due to exposure to the leachate.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

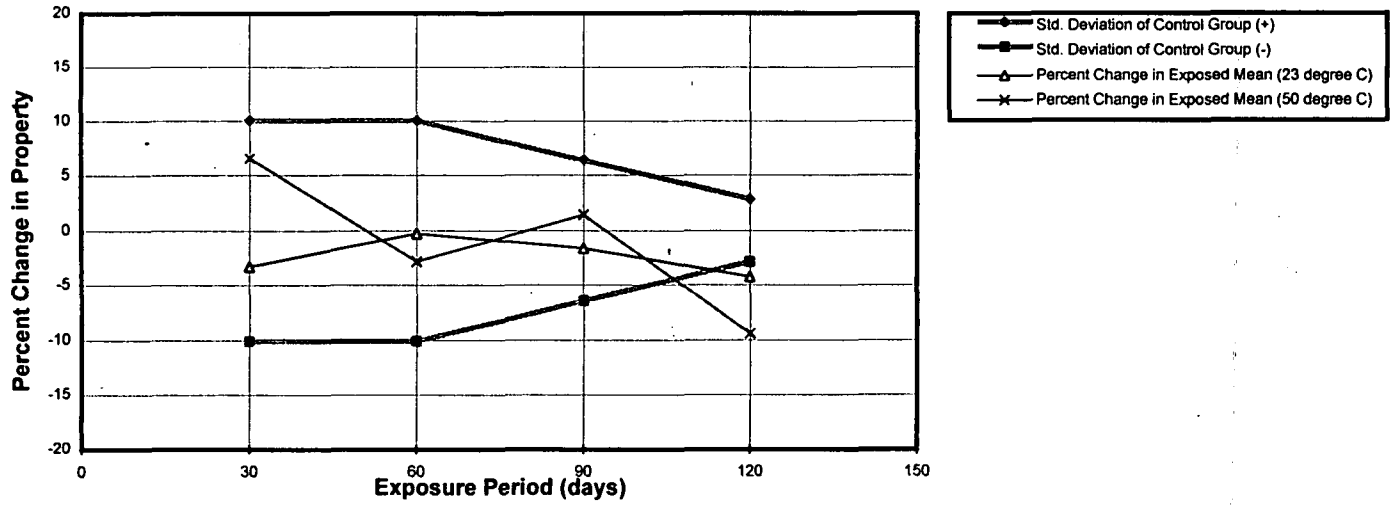
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** ELASTIC MODULUS (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 36920.0 | 35240.0 | 34450.0 | 32900.0 | 30840.0 | 31580.0 | 32330.0 | 36800.0 | 34570.0 | 32080.0 | 30180.0 |
| | 31280.0 | 30280.0 | 36820.0 | 33020.0 | 35560.0 | 35630.0 | 34390.0 | 36070.0 | 36050.0 | 31540.0 | 31200.0 |
| | 33960.0 | 33580.0 | 38020.0 | 32540.0 | 34260.0 | 36620.0 | 35500.0 | 34660.0 | 35550.0 | 34460.0 | 31560.0 |
| | 30860.0 | 32960.0 | 37490.0 | 36430.0 | 30560.0 | 37390.0 | 36260.0 | 34400.0 | 33830.0 | 34280.0 | 31500.0 |
| | 38750.0 | 34090.0 | 36270.0 | 36470.0 | 35680.0 | 34770.0 | 34680.0 | 36580.0 | 33900.0 | 34200.0 | 33130.0 |
| Mean of Control Group= | 34354.0 | | | | | 35198.0 | | | 34780.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 3454.1 | | | | | 2252.0 | | | 990.8 | | |
| Std. Deviation of Mean of Control Group as % = | 10.1 | | | | | 6.4 | | | 2.8 | | |
| Mean of Exposed Group= | | 33230.0 | 36610.0 | 34272.0 | 33380.0 | | 34632.0 | 35702.0 | | 33312.0 | 31514.0 |
| Change in Exposed Mean from Control Mean= | | -1124.0 | 2256.0 | -82.0 | -974.0 | | -566.0 | 504.0 | | -1468.0 | -3266.0 |
| Percent change in Exposed Mean from Control Mean= | | -3.27 | 6.57 | -0.24 | -2.84 | | -1.61 | 1.43 | | -4.22 | -9.39 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | Yes | Yes | | No | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

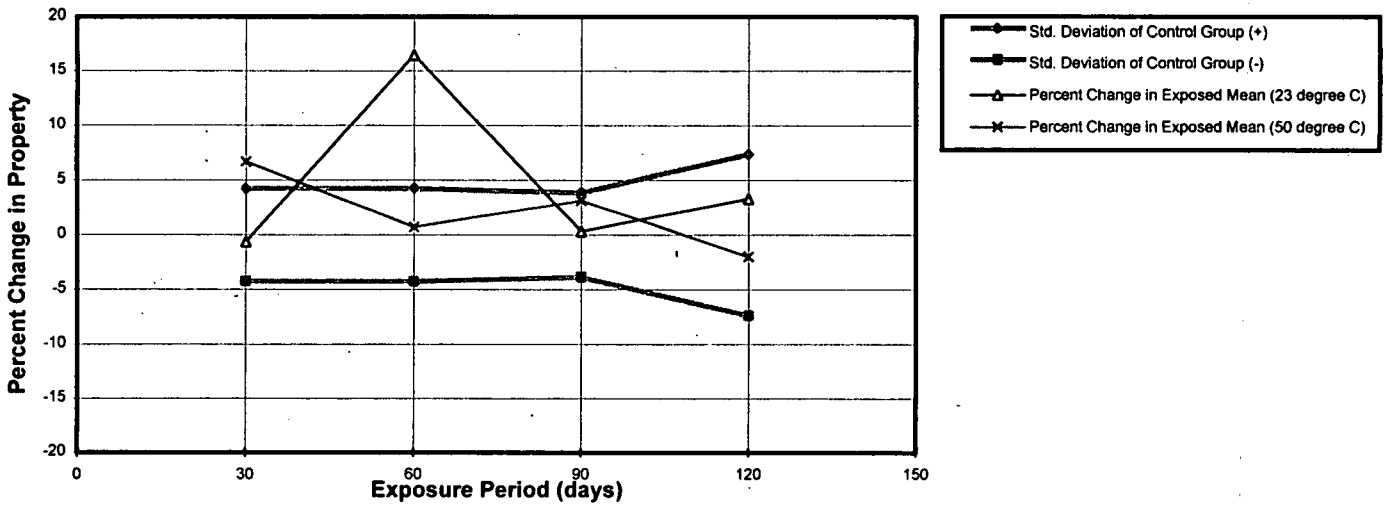
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** ELASTIC MODULUS (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 34090.0 | 34940.0 | 36840.0 | 33120.0 | 34890.0 | 34080.0 | 33340.0 | 37240.0 | 36820.0 | 33280.0 | 33350.0 |
| | 31880.0 | 32200.0 | 36920.0 | 38830.0 | 32290.0 | 37390.0 | 37510.0 | 38560.0 | 33000.0 | 33540.0 | 32550.0 |
| | 33010.0 | 30390.0 | 35410.0 | 42200.0 | 32140.0 | 34170.0 | 35120.0 | 34850.0 | 30750.0 | 33960.0 | 32650.0 |
| | 35000.0 | 30611.0 | 35280.0 | 40610.0 | 32670.0 | 35580.0 | 35090.0 | 37900.0 | 31570.0 | 34420.0 | 31550.0 |
| | 31760.0 | 36580.0 | 32370.0 | 38210.0 | 34910.0 | 35840.0 | 36600.0 | 34100.0 | 31580.0 | 33950.0 | 30360.0 |
| Mean of Control Group= | 33148.0 | | | | | 35412.0 | | | 32744.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 1402.7 | | | | | 1363.9 | | | 2418.1 | | |
| Std. Deviation of Mean of Control Group as % = | 4.2 | | | | | 3.9 | | | 7.4 | | |
| Mean of Exposed Group= | | 32944.2 | 35364.0 | 38594.0 | 33380.0 | | 35532.0 | 36530.0 | | 33830.0 | 32092.0 |
| Change in Exposed Mean from Control Mean= | | -203.8 | 2216.0 | 5446.0 | 232.0 | | 120.0 | 1118.0 | | 1086.0 | -652.0 |
| Percent change in Exposed Mean from Control Mean= | | -0.61 | 6.69 | 16.43 | 0.70 | | 0.34 | 3.16 | | 3.32 | -1.99 |
| Is change less than one Std. Deviation of Control Group? | | Yes | No | No | Yes | | Yes | Yes | | Yes | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

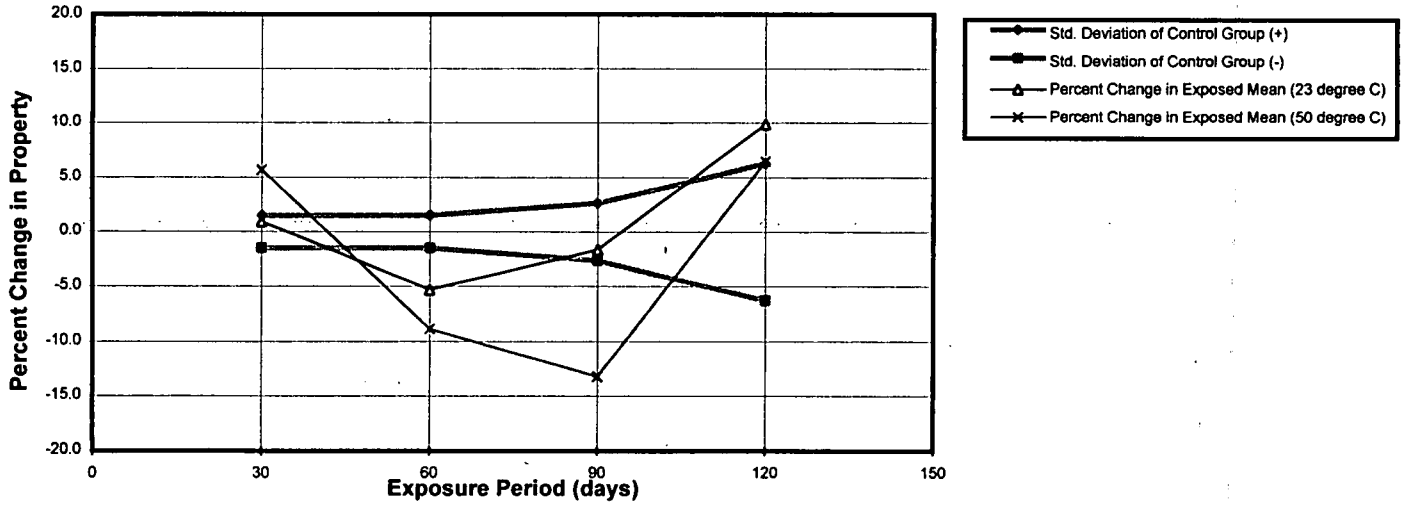
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** ELASTIC MODULUS (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 36580.0 | 35470.0 | 37700.0 | 35310.0 | 33950.0 | 38950.0 | 40930.0 | 33300.0 | 33790.0 | 37620.0 | 35130.0 |
| | 37570.0 | 38300.0 | 40240.0 | 38790.0 | 29540.0 | 39120.0 | 36510.0 | 36550.0 | 34110.0 | 37190.0 | 36730.0 |
| | 37150.0 | 37190.0 | 40210.0 | 34420.0 | 34150.0 | 41500.0 | 39480.0 | 35690.0 | 35490.0 | 37690.0 | 34940.0 |
| | 37050.0 | 37730.0 | 38560.0 | 28430.0 | 33570.0 | 40510.0 | 41800.0 | 29680.0 | 29900.0 | 35930.0 | 35860.0 |
| | 36140.0 | 37530.0 | 38240.0 | 37770.0 | 36940.0 | 40050.0 | 38120.0 | 38500.0 | 33980.0 | 35370.0 | 35390.0 |
| Mean of Control Group= | 36898.0 | | | | | 40026.0 | | | 33454.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 550.9 | | | | | 1047.2 | | | 2097.4 | | |
| Std. Deviation of Mean of Control Group as % = | 1.5 | | | | | 2.6 | | | 6.3 | | |
| Mean of Exposed Group= | | 37244.0 | 38990.0 | 34944.0 | 33630.0 | | 39368.0 | 34744.0 | | 36760.0 | 35610.0 |
| Change in Exposed Mean from Control Mean= | | 346.0 | 2092.0 | -1954.0 | -3268.0 | | -658.0 | -5282.0 | | 3306.0 | 2156.0 |
| Percent change in Exposed Mean from Control Mean= | | 0.94 | 5.67 | -5.30 | -8.86 | | -1.64 | -13.20 | | 9.88 | 6.44 |
| Is change less than one Std. Deviation of Control Group? | | Yes | No | No | No | | Yes | No | | No | No |




0002277

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

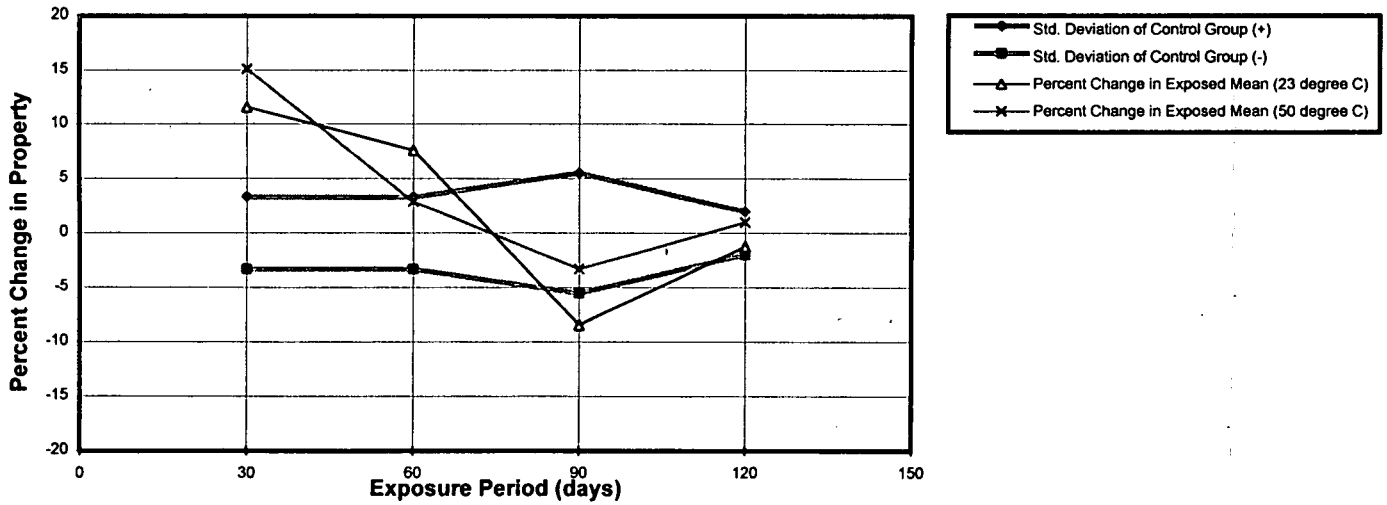
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** ELASTIC MODULUS (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 38410.0 | 38820.0 | 40100.0 | 44340.0 | 36910.0 | 35790.0 | 34600.0 | 36410.0 | 36400.0 | 36990.0 | 36190.0 |
| | 35470.0 | 40560.0 | 42890.0 | 42030.0 | 37340.0 | 40610.0 | 33480.0 | 36870.0 | 36790.0 | 34980.0 | 37000.0 |
| | 36310.0 | 42660.0 | 44400.0 | 38280.0 | 42300.0 | 37260.0 | 33040.0 | 36470.0 | 36390.0 | 37360.0 | 36840.0 |
| | 36560.0 | 41190.0 | 41010.0 | 36030.0 | 37020.0 | 40460.0 | 39810.0 | 39540.0 | 35540.0 | 36220.0 | 37630.0 |
| | 37980.0 | 42890.0 | 44260.0 | 38170.0 | 36440.0 | 39800.0 | 36600.0 | 38200.0 | 37520.0 | 34830.0 | 36750.0 |
| Mean of Control Group= | 36946.0 | | | | | 38784.0 | | | 36528.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 1219.1 | | | | | 2148.4 | | | 718.4 | | |
| Std. Deviation of Mean of Control Group as % = | 3.3 | | | | | 5.5 | | | 2.0 | | |
| Mean of Exposed Group= | | 41224.0 | 42532.0 | 39770.0 | 38002.0 | | 35506.0 | 37498.0 | | 36076.0 | 36882.0 |
| Change in Exposed Mean from Control Mean= | | 4278.0 | 5586.0 | 2824.0 | 1056.0 | | -3278.0 | -1286.0 | | -452.0 | 354.0 |
| Percent change in Exposed Mean from Control Mean= | | 11.58 | 15.12 | 7.64 | 2.86 | | -8.45 | -3.32 | | -1.24 | 0.97 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | Yes | | No | Yes | | Yes | Yes |




000278

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

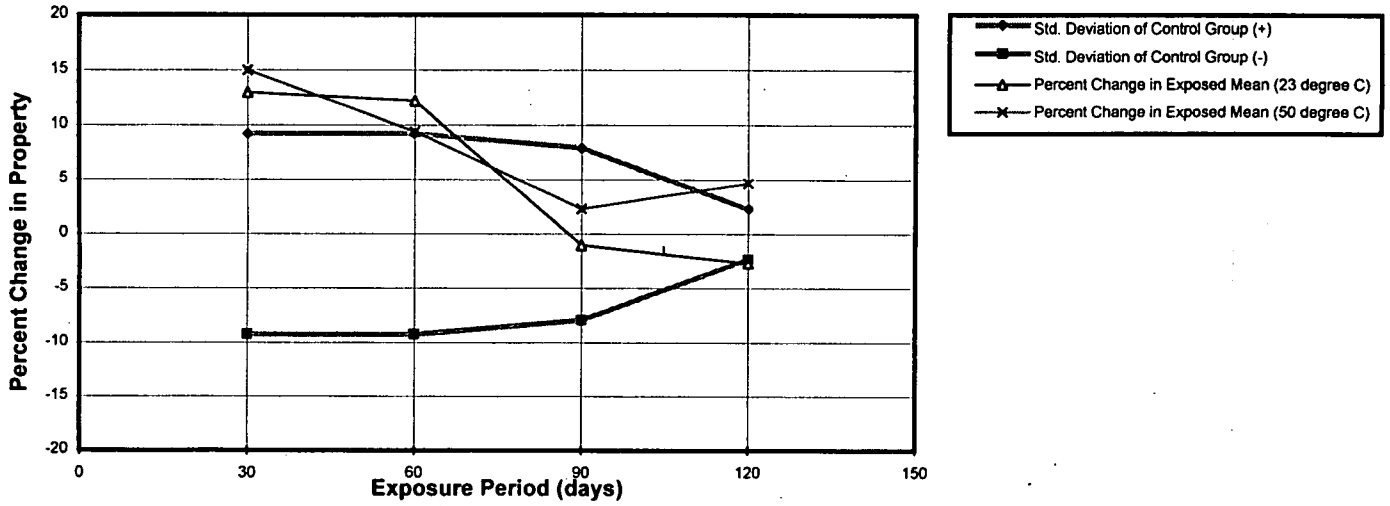
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** GSE-Gundle
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** ELASTIC MODULUS (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 41930.0 | 38450.0 | 42050.0 | 39470.0 | 40220.0 | 38780.0 | 39330.0 | 41110.0 | 39650.0 | 38590.0 | 40530.0 |
| | 36790.0 | 41560.0 | 41730.0 | 38600.0 | 44380.0 | 45890.0 | 37350.0 | 39810.0 | 38910.0 | 37420.0 | 39700.0 |
| | 35110.0 | 41200.0 | 42550.0 | 41280.0 | 39540.0 | 41280.0 | 42540.0 | 40360.0 | 38830.0 | 38160.0 | 42030.0 |
| | 33060.0 | 40390.0 | 39480.0 | 42890.0 | 33090.0 | 37780.0 | 39680.0 | 43920.0 | 37540.0 | 38730.0 | 40420.0 |
| | 35080.0 | 43980.0 | 43410.0 | 41950.0 | 41880.0 | 39290.0 | 42050.0 | 42480.0 | 39810.0 | 36660.0 | 41150.0 |
| Mean of Control Group= | 36394.0 | | | | | 40604.0 | | | 38948.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 3365.1 | | | | | 3218.2 | | | 899.1 | | |
| Std. Deviation of Mean of Control Group as % = | 9.2 | | | | | 7.9 | | | 2.3 | | |
| Mean of Exposed Group= | | 41116.0 | 41844.0 | 40838.0 | 39822.0 | | 40190.0 | 41536.0 | | 37912.0 | 40766.0 |
| Change in Exposed Mean from Control Mean= | | 4722.0 | 5450.0 | 4444.0 | 3428.0 | | -414.0 | 932.0 | | -1036.0 | 1818.0 |
| Percent change in Exposed Mean from Control Mean= | | 12.97 | 14.97 | 12.21 | 9.42 | | -1.02 | 2.30 | | -2.66 | 4.67 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | Yes | Yes | | No | No |




000279

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

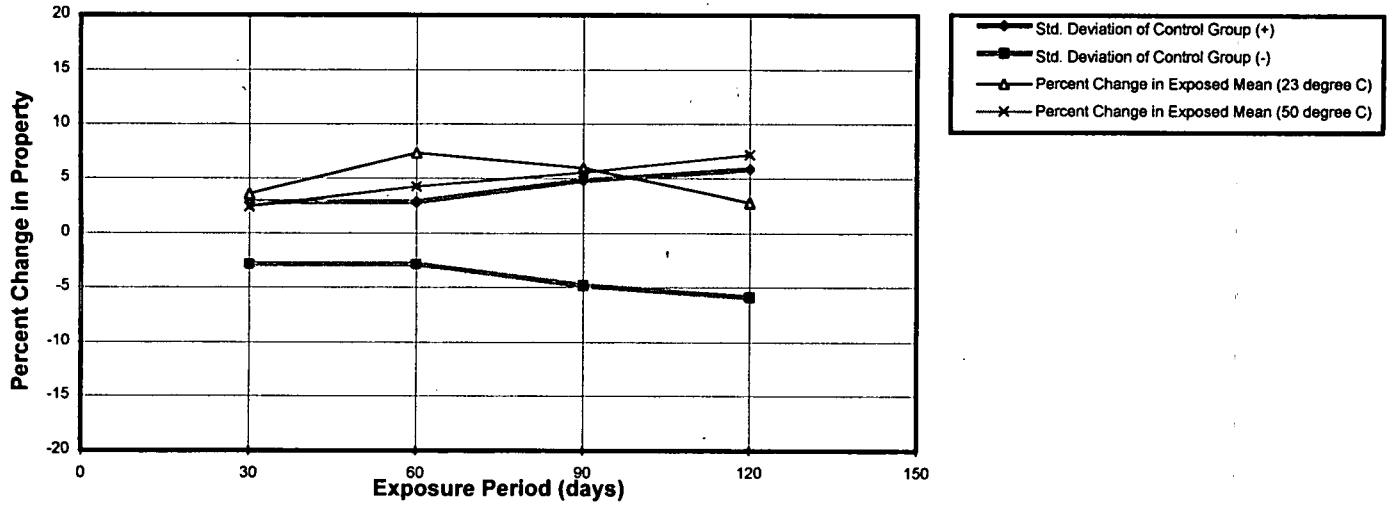
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** ELASTIC MODULUS (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 42900.0 | 41140.0 | 39840.0 | 42000.0 | 41450.0 | 39570.0 | 44940.0 | 42840.0 | 41130.0 | 38900.0 | 42560.0 |
| | 39920.0 | 40640.0 | 43960.0 | 44570.0 | 44210.0 | 42740.0 | 40140.0 | 43740.0 | 37290.0 | 39100.0 | 41670.0 |
| | 42000.0 | 40490.0 | 42440.0 | 45990.0 | 43770.0 | 38900.0 | 42590.0 | 40100.0 | 41110.0 | 41900.0 | 44080.0 |
| | 40620.0 | 47700.0 | 42440.0 | 46140.0 | 42850.0 | 42380.0 | 42900.0 | 42120.0 | 43160.0 | 42970.0 | 44730.0 |
| | 41840.0 | 44700.0 | 43680.0 | 43840.0 | 43760.0 | 38690.0 | 43820.0 | 44720.0 | 38400.0 | 43860.0 | 42570.0 |
| Mean of Control Group= | 41456.0 | | | | | 40456.0 | | | 40218.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 1181.8 | | | | | 1952.1 | | | 2353.8 | | |
| Std. Deviation of Mean of Control Group as % = | 2.9 | | | | | 4.8 | | | 5.9 | | |
| Mean of Exposed Group= | | 42934.0 | 42472.0 | 44508.0 | 43208.0 | | 42878.0 | 42704.0 | | 41346.0 | 43122.0 |
| Change in Exposed Mean from Control Mean= | | 1478.0 | 1016.0 | 3052.0 | 1752.0 | | 2422.0 | 2248.0 | | 1128.0 | 2904.0 |
| Percent change in Exposed Mean from Control Mean= | | 3.57 | 2.45 | 7.36 | 4.23 | | 5.99 | 5.56 | | 2.80 | 7.22 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | No | No | | No | No | | Yes | No |




000280

706

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

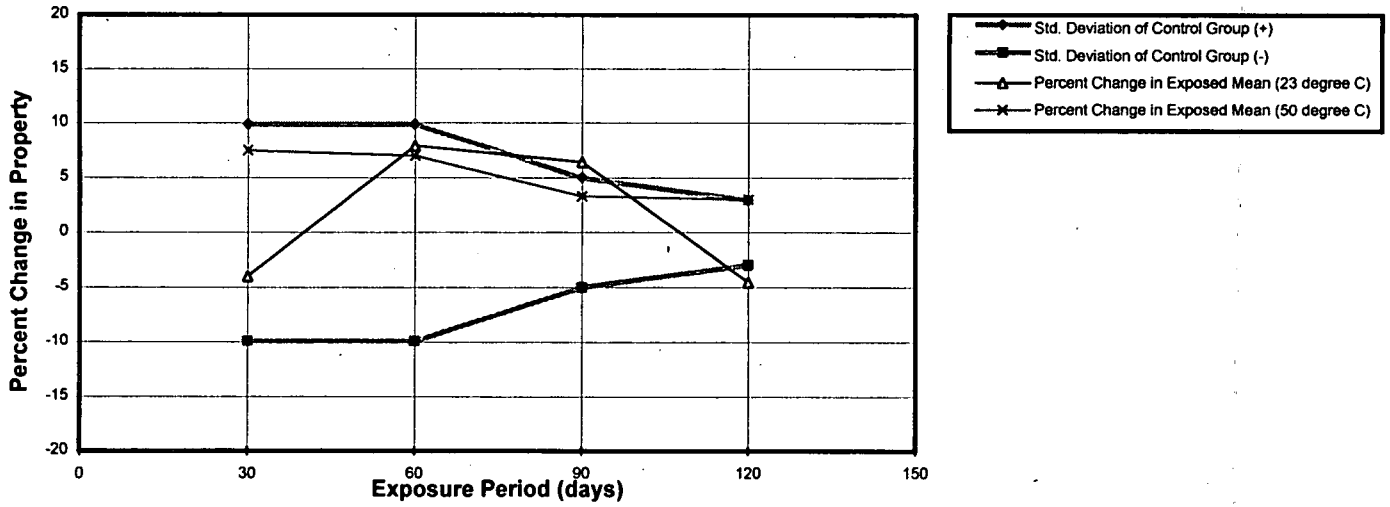
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** ELASTIC MODULUS (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 37600.0 | 38290.0 | 44930.0 | 44590.0 | 44840.0 | 42610.0 | 44040.0 | 42260.0 | 42890.0 | 37260.0 | 42990.0 |
| | 41480.0 | 39010.0 | 42470.0 | 43610.0 | 43640.0 | 41890.0 | 45180.0 | 48260.0 | 39620.0 | 40070.0 | 40600.0 |
| | 45210.0 | 45160.0 | 47160.0 | 43130.0 | 42370.0 | 42960.0 | 45740.0 | 41770.0 | 41950.0 | 38800.0 | 41610.0 |
| | 36810.0 | 39440.0 | 42510.0 | 44030.0 | 44590.0 | 38870.0 | 48000.0 | 41920.0 | 40900.0 | 39920.0 | 44610.0 |
| | 45520.0 | 36490.0 | 45020.0 | 47560.0 | 45660.0 | 44630.0 | 41630.0 | 43710.0 | 41070.0 | 41040.0 | 42860.0 |
| Mean of Control Group= | 41324.0 | | | | | 42192.0 | | | 41286.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 4091.9 | | | | | 2111.6 | | | 1223.2 | | |
| Std. Deviation of Mean of Control Group as % = | 9.9 | | | | | 5.0 | | | 3.0 | | |
| Mean of Exposed Group= | | 39678.0 | 44418.0 | 44584.0 | 44220.0 | | 44918.0 | 43584.0 | | 39418.0 | 42534.0 |
| Change in Exposed Mean from Control Mean= | | -1646.0 | 3094.0 | 3260.0 | 2896.0 | | 2726.0 | 1392.0 | | -1868.0 | 1248.0 |
| Percent change in Exposed Mean from Control Mean= | | -3.98 | 7.49 | 7.89 | 7.01 | | 6.46 | 3.30 | | -4.52 | 3.02 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | No | Yes | | No | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

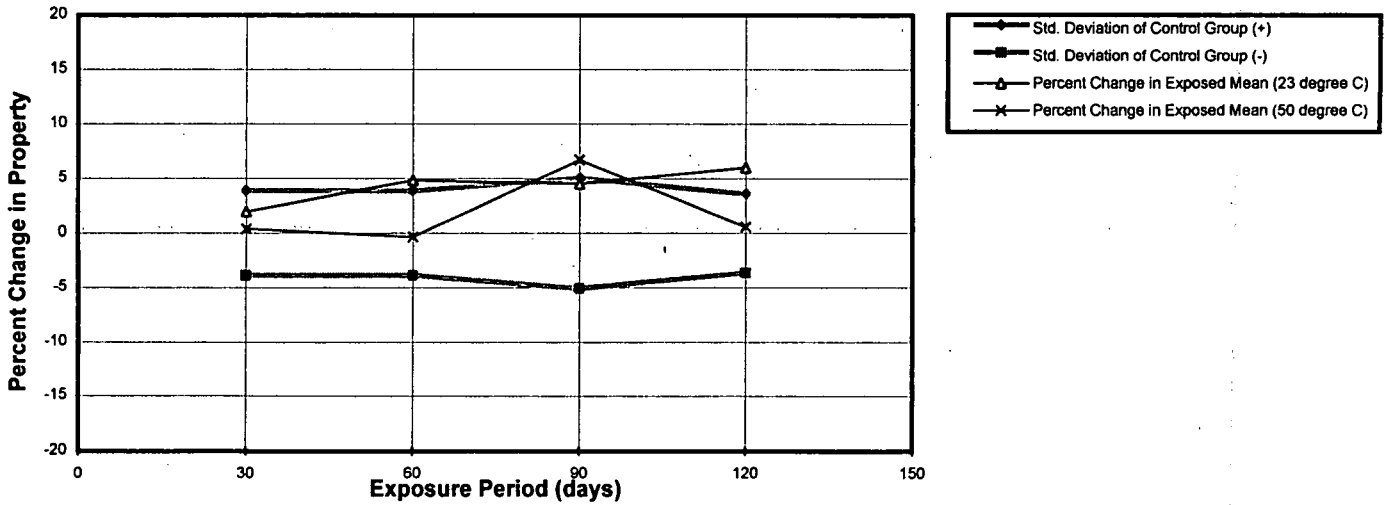
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** ELASTIC MODULUS (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 45940.0 | 49190.0 | 41180.0 | 46380.0 | 43280.0 | 40090.0 | 50470.0 | 49330.0 | 43840.0 | 45890.0 | 42340.0 |
| | 45570.0 | 51400.0 | 43120.0 | 49780.0 | 46580.0 | 44110.0 | 45940.0 | 45090.0 | 44360.0 | 44590.0 | 45540.0 |
| | 45220.0 | 43580.0 | 45700.0 | 49550.0 | 46790.0 | 43840.0 | 44910.0 | 48370.0 | 41780.0 | 46340.0 | 41400.0 |
| | 43260.0 | 42700.0 | 50640.0 | 48220.0 | 44320.0 | 44850.0 | 41140.0 | 41030.0 | 45120.0 | 47460.0 | 45860.0 |
| | 48210.0 | 45820.0 | 48380.0 | 45330.0 | 46470.0 | 45940.0 | 46290.0 | 49680.0 | 41670.0 | 45590.0 | 42860.0 |
| Mean of Control Group= | 45640.0 | | | | | 43766.0 | | | 43354.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 1770.6 | | | | | 2210.1 | | | 1555.7 | | |
| Std. Deviation of Mean of Control Group as % = | 3.9 | | | | | 5.0 | | | 3.6 | | |
| Mean of Exposed Group= | | 46538.0 | 45804.0 | 47852.0 | 45488.0 | | 45750.0 | 46700.0 | | 45974.0 | 43600.0 |
| Change in Exposed Mean from Control Mean= | | 898.0 | 164.0 | 2212.0 | -152.0 | | 1984.0 | 2934.0 | | 2620.0 | 246.0 |
| Percent change in Exposed Mean from Control Mean= | | 1.97 | 0.36 | 4.85 | -0.33 | | 4.53 | 6.70 | | 6.04 | 0.57 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | No | Yes | | Yes | No | | No | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

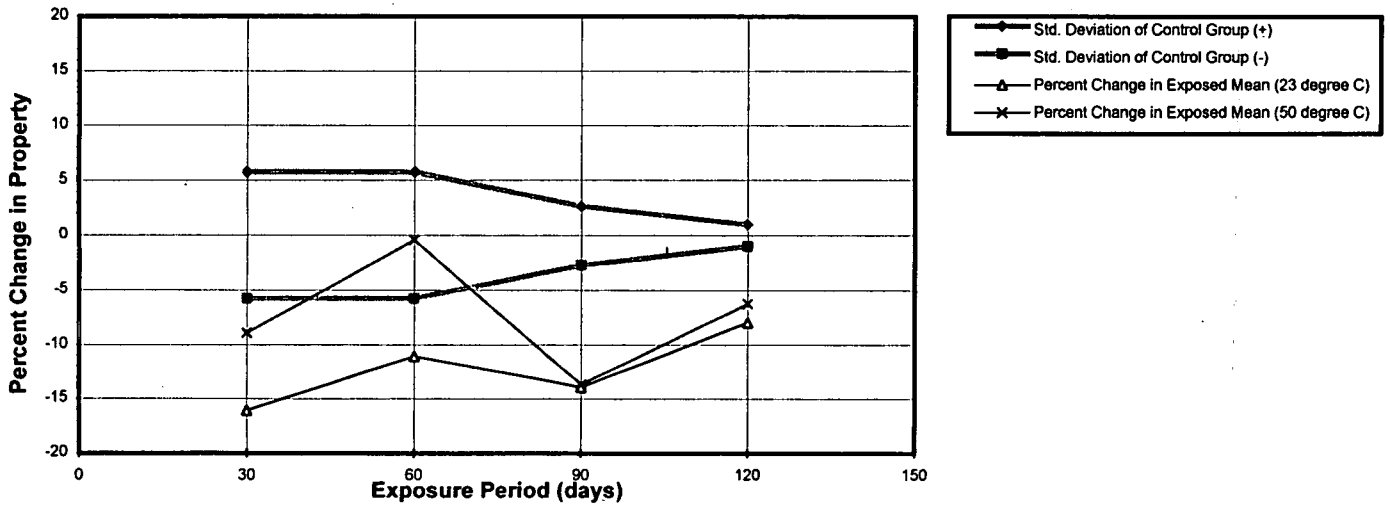
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** ASTM D638
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** SERROT
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** ELASTIC MODULUS (psi)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 40360.0 | 31910.0 | 38420.0 | 38110.0 | 42790.0 | 44390.0 | 38210.0 | 38110.0 | 41400.0 | 36010.0 | 38900.0 |
| | 43800.0 | 39430.0 | 40380.0 | 40050.0 | 41650.0 | 44840.0 | 38310.0 | 36100.0 | 41640.0 | 39110.0 | 36420.0 |
| | 46510.0 | 42580.0 | 39010.0 | 35930.0 | 44100.0 | 44630.0 | 35970.0 | 37800.0 | 41380.0 | 38370.0 | 39360.0 |
| | 40940.0 | 28880.0 | 37750.0 | 39780.0 | 41980.0 | 42000.0 | 37240.0 | 35840.0 | 40670.0 | 38420.0 | 39230.0 |
| | 42580.0 | 36980.0 | 39550.0 | 36670.0 | 42770.0 | 43270.0 | 38980.0 | 41380.0 | 41680.0 | 38370.0 | 39970.0 |
| Mean of Control Group= | 42838.0 | | | | | 43826.0 | | | 41354.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 2460.6 | | | | | 1187.0 | | | 405.8 | | |
| Std. Deviation of Mean of Control Group as % = | 5.7 | | | | | 2.7 | | | 1.0 | | |
| Mean of Exposed Group= | | 35956.0 | 39022.0 | 38108.0 | 42658.0 | | 37742.0 | 37846.0 | | 38056.0 | 38776.0 |
| Change in Exposed Mean from Control Mean= | | -6882.0 | -3816.0 | -4730.0 | -180.0 | | -6084.0 | -5980.0 | | -3298.0 | -2578.0 |
| Percent change in Exposed Mean from Control Mean= | | -16.07 | -8.91 | -11.04 | -0.42 | | -13.88 | -13.64 | | -7.98 | -6.23 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | Yes | | No | No | | No | No |




000283

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

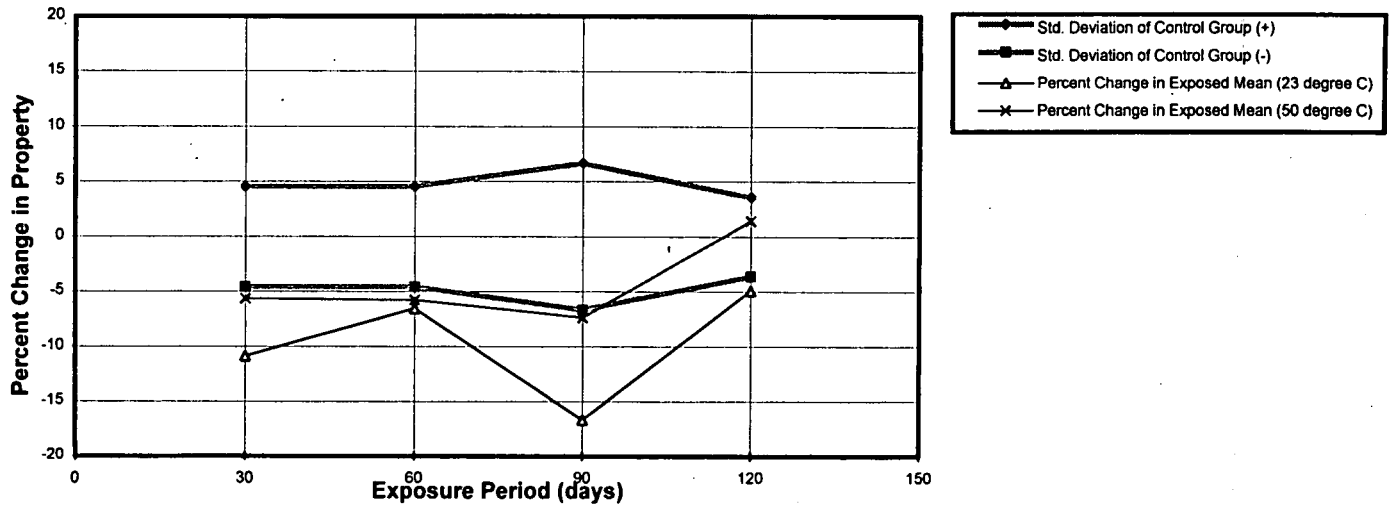
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D638*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** ELASTIC MODULUS (psi)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 44270.0 | 43960.0 | 34060.0 | 41450.0 | 40630.0 | 48190.0 | 38400.0 | 45180.0 | 42330.0 | 41390.0 | 41510.0 |
| | 48830.0 | 39870.0 | 47760.0 | 43110.0 | 42620.0 | 45410.0 | 37090.0 | 43110.0 | 42770.0 | 41200.0 | 45820.0 |
| | 43680.0 | 43250.0 | 44040.0 | 41280.0 | 45330.0 | 48540.0 | 41320.0 | 40530.0 | 45160.0 | 42070.0 | 46340.0 |
| | 46520.0 | 37170.0 | 41680.0 | 41520.0 | 42840.0 | 49350.0 | 38370.0 | 44220.0 | 43220.0 | 42320.0 | 43290.0 |
| | 44830.0 | 39060.0 | 47720.0 | 45850.0 | 43530.0 | 41780.0 | 39180.0 | 43040.0 | 45950.0 | 41630.0 | 45570.0 |
| Mean of Control Group= | 45626.0 | | | | | 46654.0 | | | 43886.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 2081.1 | | | | | 3101.9 | | | 1580.6 | | |
| Std. Deviation of Mean of Control Group as % = | 4.6 | | | | | 6.6 | | | 3.6 | | |
| Mean of Exposed Group= | | 40662.0 | 43052.0 | 42642.0 | 42990.0 | | 38872.0 | 43216.0 | | 41722.0 | 44506.0 |
| Change in Exposed Mean from Control Mean= | | -4964.0 | -2574.0 | -2984.0 | -2636.0 | | -7782.0 | -3438.0 | | -2164.0 | 620.0 |
| Percent change in Exposed Mean from Control Mean= | | -10.88 | -5.64 | -6.54 | -5.78 | | -16.68 | -7.37 | | -4.93 | 1.41 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | No | No | | No | Yes |




000581

2.10 INITIAL TEARING RESISTANCE

## 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 percent changes in initial tearing resistance of the five geomembranes.

GSE-SLT Geomembrane. In the roll direction, the percent changes in initial tearing resistance due to exposure were within one standard deviation of the control means for all of the exposures except the 30-day, the 60-day and the 90-day exposures at 23°C. In the cross-roll direction, the percent changes in initial tearing resistance due to exposure were within one standard deviation of the control means for all of the exposures except 90-day and the 120-day exposures at 50°C. In both directions, the percent change in property remained relatively constant with exposure time and temperature.

NSC Geomembrane. In the roll direction, the percent changes in initial tearing resistance due to exposure were within one standard deviation of the control means for all of the exposures except the 90-day and the 120-day exposures at 23°C and 50°C. In the cross-roll direction, the percent changes in initial tearing resistance due to exposure were not within one standard deviation of the control means for any of the exposures except the 30-day exposure at 23°C, and the 30-day and the 60-day exposures at 50°C. In the roll direction, the percent change in property increased with exposure time; however, this trend was not consistent between temperatures. In the cross-roll direction, results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time or temperature.

GSE-Gundle Geomembrane. In the roll direction, the percent changes in initial tearing resistance due to exposure were within one standard deviation of the

control means for all of the exposures except the 120-day exposure at 23°C, and the 90-day and the 120-day exposures at 50°C. In the cross-roll direction, the percent changes in initial tearing resistance due to exposure were not within one standard deviation of the control means for any of the exposures except the 60-day exposure at 23°C, and the 30-day and the 60-day exposures at 50°C. In both directions, the percent change in property decreased with exposure time; this trend was consistent between temperatures.

PolyFlex Geomembrane. In the roll direction, the percent changes in initial tearing resistance due to exposure were not within one standard deviation of the control means for any of the exposures except the 30-day exposure at 23°C, and the 30-day, 60-day and the 120-day exposures at 50°C. In the cross-roll direction, the percent changes in initial tearing resistance due to exposure were not within one standard deviation of the control means for any of the exposures except the 120-day exposures at 23°C and 50°C. In both directions, results exhibited randomness, and no consistent trends were observed for the changes in property with exposure time.

Serrot Geomembrane. In the roll direction, the percent changes in initial tearing resistance due to exposure were within one standard deviation of the control means for all of the exposures except the 60-day and the 120-day exposures at 23°C, and 30-day and the 120-day exposures at 50°C. In the cross-roll direction, the percent changes in initial tearing resistance due to exposure were within one standard deviation of the control means for all of the exposures except the 60-day and the 120-day exposures at 23°C, and 30-day and the 120-day exposures at 50°C. In both directions, the percent change in property decreased with exposure time; this trend was consistent between temperatures.

*Conclusion*

The means of the percent changes in initial tearing resistance were less than one standard deviation of the control means for at least 5 out of 8 exposures for GSE-SLT geomembrane in both directions and the GSE-Gundle geomembrane in the roll direction. Randomness in data or inconsistent trends were observed in means of the percent changes in initial tearing resistance for NSC and Polyflex geomembranes in both directions. The means of percent changes for Serrot geomembrane exhibited consistent trends between exposure time and temperature in both directions; however,

these trends were not supported by trends exhibited by other properties. Therefore, no detrimental effects are expected to the tested property due to exposure to the leachate.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

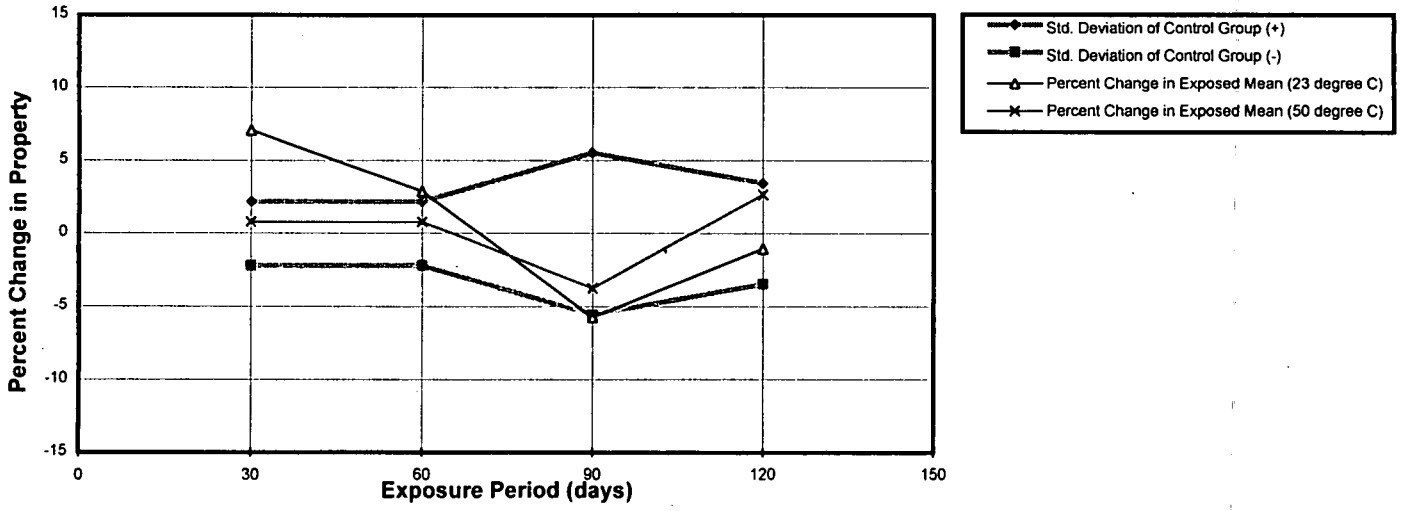
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D1004*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** INTITIAL TEARING RESISTANCE (lb)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 75.0 | 81.0 | 78.0 | 80.0 | 82.0 | 75.0 | 81.0 | 76.0 | 78.0 | 76.0 | 74.0 |
| | 79.0 | 82.0 | 79.0 | 79.0 | 74.0 | 87.0 | 71.0 | 82.0 | 72.0 | 72.0 | 78.0 |
| | 77.0 | 88.0 | 76.0 | 76.0 | 76.0 | 80.0 | 75.0 | 77.0 | 78.0 | 80.0 | 77.0 |
| | 76.0 | 79.0 | 78.0 | 80.0 | 80.0 | 78.0 | 81.0 | 72.0 | 74.0 | 73.0 | 80.0 |
| | 75.0 | 79.0 | 74.0 | 78.0 | 73.0 | 81.0 | 70.0 | 79.0 | 75.0 | 72.0 | 78.0 |
| Mean of Control Group= | 76.4 | | | | | 80.2 | | | 75.4 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 1.7 | | | | | 4.4 | | | 2.6 | | |
| Std. Deviation of Mean of Control Group as % = | 2.2 | | | | | 5.5 | | | 3.5 | | |
| Mean of Exposed Group= | | 81.8 | 77.0 | 78.6 | 77.0 | | 75.6 | 77.2 | | 74.6 | 77.4 |
| Change in Exposed Mean from Control Mean= | | 5.4 | 0.6 | 2.2 | 0.6 | | -4.6 | -3.0 | | -0.8 | 2.0 |
| Percent change in Exposed Mean from Control Mean= | | 7.07 | 0.79 | 2.88 | 0.79 | | -5.74 | -3.74 | | -1.06 | 2.65 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | No | Yes | | No | Yes | | Yes | Yes |




000288

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

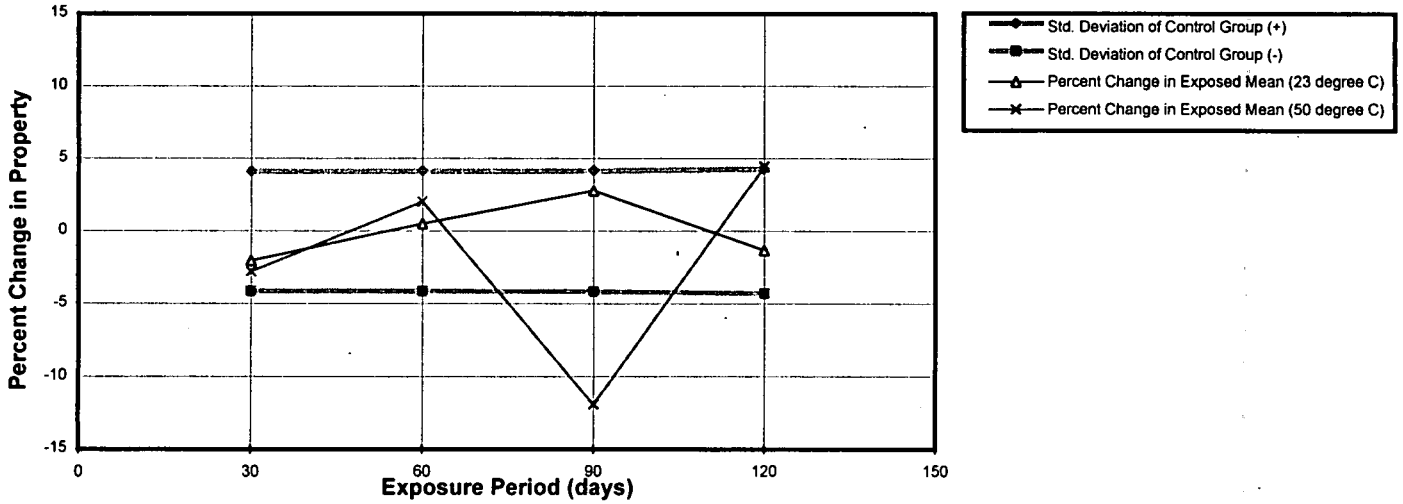
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D1004*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** INTITIAL TEARING RESISTANCE (lb)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | *30-day* | | *60-day* | | *90-day* | | | *120-day* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 78.0 | 77.0 | 77.0 | 75.0 | 75.0 | 78.0 | 84.0 | 69.0 | 72.0 | 74.0 | 79.0 |
| | 78.0 | 79.0 | 74.0 | 80.0 | 86.0 | 79.0 | 80.0 | 69.0 | 80.0 | 75.0 | 85.0 |
| | 85.0 | 74.0 | 76.0 | 79.0 | 79.0 | 78.0 | 79.0 | 71.0 | 78.0 | 74.0 | 77.0 |
| | 78.0 | 74.0 | 79.0 | 81.0 | 80.0 | 84.0 | 84.0 | 69.0 | 74.0 | 78.0 | 79.0 |
| | 77.0 | 84.0 | 79.0 | 83.0 | 84.0 | 75.0 | 78.0 | 69.0 | 78.0 | 76.0 | 79.0 |
| Mean of Control Group= | 79.2 | | | | | 78.8 | | | 76.4 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 3.3 | | | | | 3.3 | | | 3.3 | | |
| Std. Deviation of Mean of Control Group as % = | 4.1 | | | | | 4.2 | | | 4.3 | | |
| Mean of Exposed Group= | | 77.6 | 77.0 | 79.6 | 80.8 | | 81.0 | 69.4 | | 75.4 | 79.8 |
| Change in Exposed Mean from Control Mean= | | -1.6 | -2.2 | 0.4 | 1.6 | | 2.2 | -9.4 | | -1.0 | 3.4 |
| Percent change in Exposed Mean from Control Mean= | | -2.02 | -2.78 | 0.51 | 2.02 | | 2.79 | -11.93 | | -1.31 | 4.45 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | Yes | No | | Yes | No |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

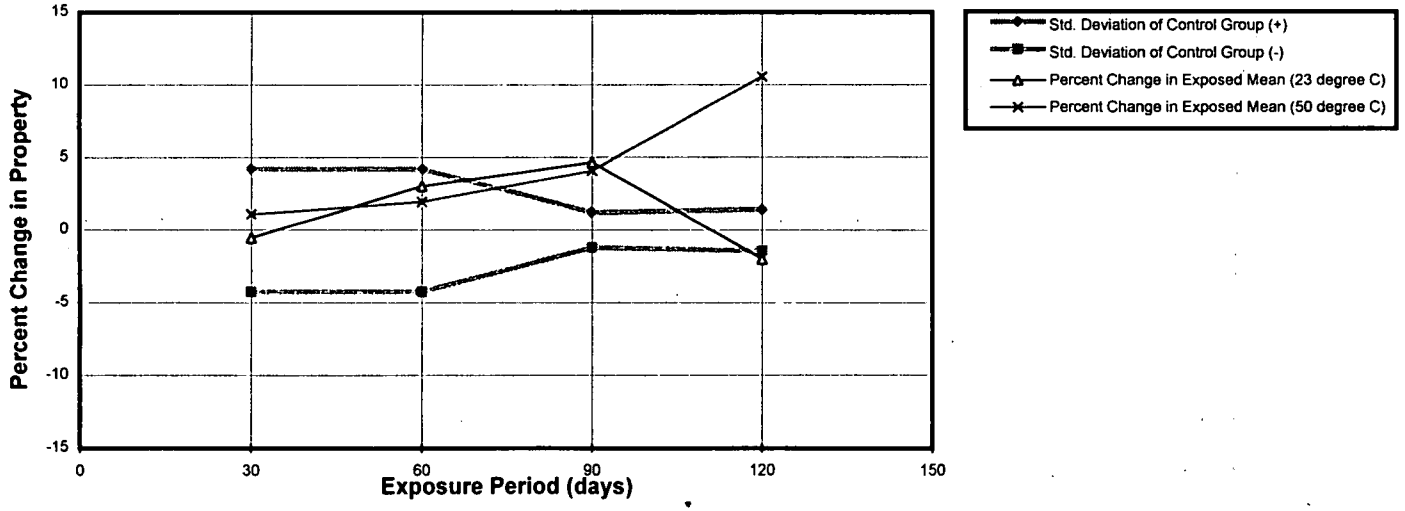
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D1004*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** INTITIAL TEARING RESISTANCE (lb)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 71.0 | 70.0 | 76.0 | 76.0 | 76.0 | 68.0 | 72.0 | 71.0 | 71.0 | 69.0 | 74.0 |
| | 71.0 | 73.0 | 72.0 | 76.0 | 75.0 | 69.0 | 72.0 | 73.0 | 70.0 | 68.0 | 78.0 |
| | 78.0 | 75.0 | 74.0 | 74.0 | 75.0 | 70.0 | 72.0 | 74.0 | 69.0 | 68.0 | 77.0 |
| | 74.0 | 73.0 | 75.0 | 74.0 | 73.0 | 68.0 | 72.0 | 70.0 | 69.0 | 68.0 | 80.0 |
| | 71.0 | 72.0 | 72.0 | 76.0 | 73.0 | 69.0 | 72.0 | 70.0 | 71.0 | 70.0 | 78.0 |
| Mean of Control Group= | 73.0 | | | | | 68.8 | | | 70.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 3.1 | | | | | 0.8 | | | 1.0 | | |
| Std. Deviation of Mean of Control Group as % = | 4.2 | | | | | 1.2 | | | 1.4 | | |
| Mean of Exposed Group= | | 72.6 | 73.8 | 75.2 | 74.4 | | 72.0 | 71.6 | | 68.6 | 77.4 |
| Change in Exposed Mean from Control Mean= | | -0.4 | 0.8 | 2.2 | 1.4 | | 3.2 | 2.8 | | -1.4 | 7.4 |
| Percent change in Exposed Mean from Control Mean= | | -0.55 | 1.10 | 3.01 | 1.92 | | 4.65 | 4.07 | | -2.00 | 10.57 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | No | No | | No | No |




000290

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

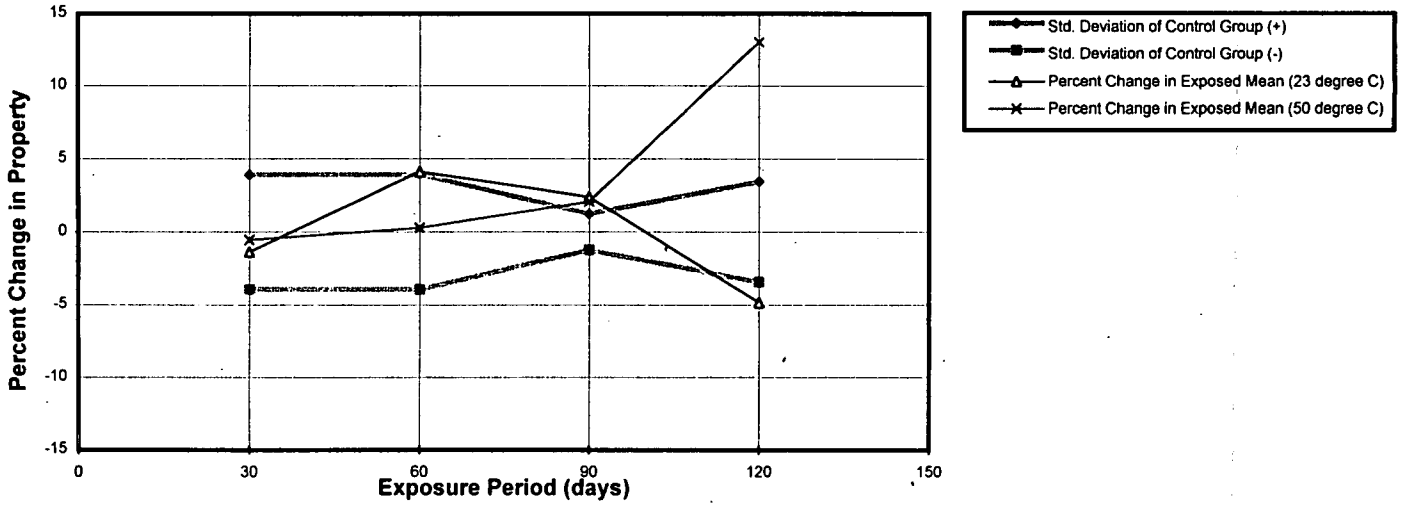
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D1004*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** INTITIAL TEARING RESISTANCE (lb)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 77.0 | 73.0 | 71.0 | 74.0 | 74.0 | 68.0 | 69.0 | 68.0 | 68.0 | 68.0 | 79.0 |
| | 73.0 | 71.0 | 74.0 | 76.0 | 73.0 | 69.0 | 69.0 | 67.0 | 70.0 | 67.0 | 85.0 |
| | 72.0 | 69.0 | 75.0 | 76.0 | 70.0 | 67.0 | 71.0 | 71.0 | 72.0 | 67.0 | 77.0 |
| | 73.0 | 72.0 | 70.0 | 74.0 | 74.0 | 68.0 | 69.0 | 72.0 | 74.0 | 67.0 | 79.0 |
| | 69.0 | 74.0 | 72.0 | 79.0 | 74.0 | 67.0 | 69.0 | 68.0 | 69.0 | 67.0 | 79.0 |
| Mean of Control Group= | 72.8 | | | | | 67.8 | | | 70.6 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 2.9 | | | | | 0.8 | | | 2.4 | | |
| Std. Deviation of Mean of Control Group as % = | 3.9 | | | | | 1.2 | | | 3.4 | | |
| Mean of Exposed Group= | | 71.8 | 72.4 | 75.8 | 73.0 | | 69.4 | 69.2 | | 67.2 | 79.8 |
| Change in Exposed Mean from Control Mean= | | -1.0 | -0.4 | 3.0 | 0.2 | | 1.6 | 1.4 | | -3.4 | 9.2 |
| Percent change in Exposed Mean from Control Mean= | | -1.37 | -0.55 | 4.12 | 0.27 | | 2.36 | 2.06 | | -4.82 | 13.03 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | No | Yes | | No | No | | No | No |




000291

706

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

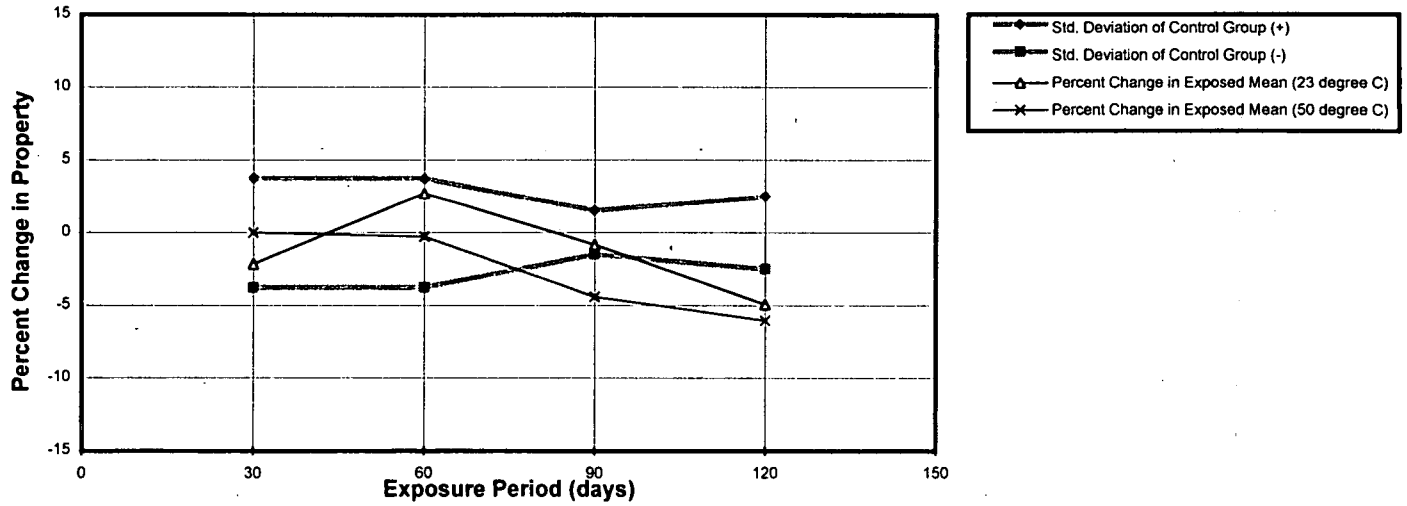
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D1004*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** INTITIAL TEARING RESISTANCE (lb)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 76.0 | 71.0 | 73.0 | 72.0 | 74.0 | 74.0 | 74.0 | 68.0 | 75.0 | 70.0 | 67.0 |
| | 75.0 | 72.0 | 74.0 | 78.0 | 74.0 | 72.0 | 71.0 | 71.0 | 75.0 | 69.0 | 71.0 |
| | 70.0 | 74.0 | 73.0 | 77.0 | 73.0 | 74.0 | 69.0 | 71.0 | 72.0 | 70.0 | 70.0 |
| | 77.0 | 75.0 | 77.0 | 78.0 | 73.0 | 72.0 | 72.0 | 69.0 | 74.0 | 70.0 | 69.0 |
| | 73.0 | 71.0 | 74.0 | 76.0 | 76.0 | 72.0 | 75.0 | 69.0 | 71.0 | 70.0 | 68.0 |
| Mean of Control Group= | 74.2 | | | | | 72.8 | | | 73.4 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 2.8 | | | | | 1.1 | | | 1.8 | | |
| Std. Deviation of Mean of Control Group as % = | 3.7 | | | | | 1.5 | | | 2.5 | | |
| Mean of Exposed Group= | | 72.6 | 74.2 | 76.2 | 74.0 | | 72.2 | 69.6 | | 69.8 | 69.0 |
| Change in Exposed Mean from Control Mean= | | -1.6 | 0.0 | 2.0 | -0.2 | | -0.6 | -3.2 | | -3.6 | -4.4 |
| Percent change in Exposed Mean from Control Mean= | | -2.16 | 0.00 | 2.70 | -0.27 | | -0.82 | -4.40 | | -4.90 | -5.99 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | Yes | | Yes | No | | No | No |




000292

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

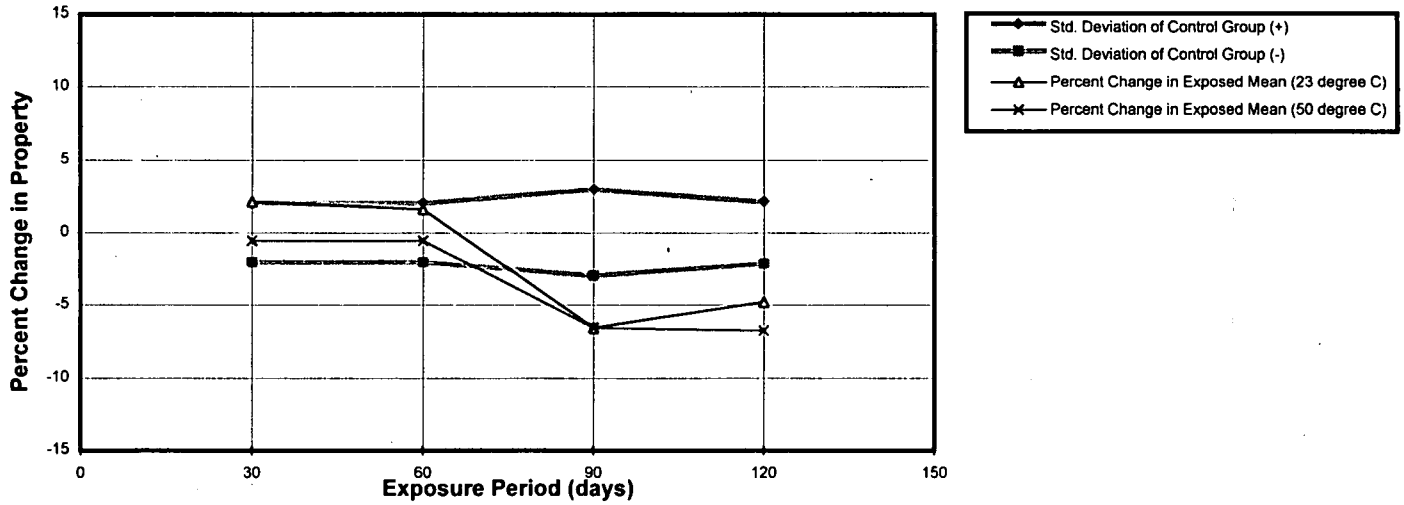
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D1004*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** INTITIAL TEARING RESISTANCE (lb)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 75.0 | 76.0 | 70.0 | 75.0 | 74.0 | 74.0 | 69.0 | 67.0 | 72.0 | 68.0 | 67.0 |
| | 73.0 | 73.0 | 73.0 | 74.0 | 74.0 | 75.0 | 66.0 | 68.0 | 71.0 | 69.0 | 67.0 |
| | 76.0 | 76.0 | 74.0 | 74.0 | 72.0 | 75.0 | 70.0 | 71.0 | 69.0 | 67.0 | 66.0 |
| | 76.0 | 77.0 | 75.0 | 77.0 | 78.0 | 72.0 | 69.0 | 67.0 | 72.0 | 69.0 | 65.0 |
| | 73.0 | 79.0 | 79.0 | 79.0 | 73.0 | 70.0 | 68.0 | 69.0 | 73.0 | 67.0 | 68.0 |
| Mean of Control Group= | 74.6 | | | | | 73.2 | | | 71.4 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 1.5 | | | | | 2.2 | | | 1.5 | | |
| Std. Deviation of Mean of Control Group as % = | 2.0 | | | | | 3.0 | | | 2.1 | | |
| Mean of Exposed Group= | | 76.2 | 74.2 | 75.8 | 74.2 | | 68.4 | 68.4 | | 68.0 | 66.6 |
| Change in Exposed Mean from Control Mean= | | 1.6 | -0.4 | 1.2 | -0.4 | | -4.8 | -4.8 | | -3.4 | -4.8 |
| Percent change in Exposed Mean from Control Mean= | | 2.14 | -0.54 | 1.61 | -0.54 | | -6.56 | -6.56 | | -4.76 | -6.72 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | Yes | Yes | | No | No | | No | No |




000293

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

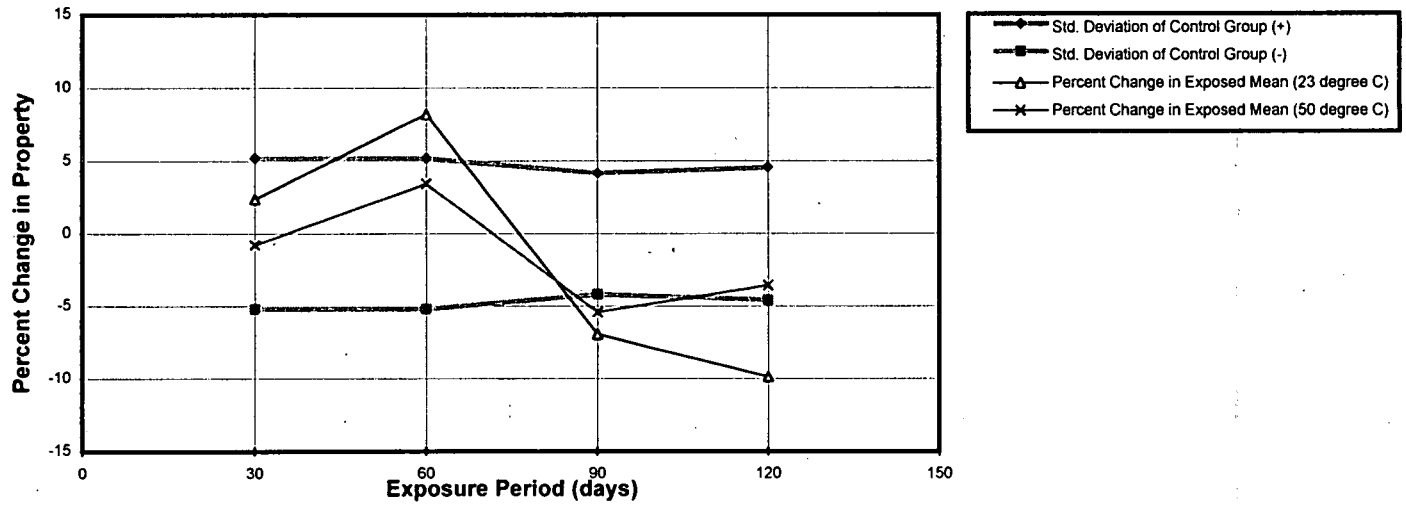
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D1004*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** INTITIAL TEARING RESISTANCE (lb)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 70.0 | 74.0 | 74.0 | 84.0 | 74.0 | 69.0 | 71.4 | 68.1 | 78.0 | 65.0 | 72.0 |
| | 73.0 | 75.0 | 76.0 | 82.0 | 79.0 | 73.0 | 65.8 | 72.6 | 74.0 | 64.0 | 69.0 |
| | 79.0 | 83.0 | 71.0 | 81.0 | 84.0 | 74.0 | 66.1 | 67.3 | 70.0 | 67.0 | 70.0 |
| | 78.0 | 79.0 | 77.0 | 84.0 | 76.0 | 71.0 | 68.1 | 67.3 | 70.0 | 71.0 | 70.0 |
| | 78.0 | 76.0 | 77.0 | 78.0 | 78.0 | 77.0 | 67.5 | 69.1 | 73.0 | 62.0 | 71.0 |
| Mean of Control Group= | 75.6 | | | | | 72.8 | | | 73.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 3.9 | | | | | 3.0 | | | 3.3 | | |
| Std. Deviation of Mean of Control Group as % = | 5.2 | | | | | 4.2 | | | 4.5 | | |
| Mean of Exposed Group= | | 77.4 | 75.0 | 81.8 | 78.2 | | 67.8 | 68.9 | | 65.8 | 70.4 |
| Change in Exposed Mean from Control Mean= | | 1.8 | -0.6 | 6.2 | 2.6 | | -5.0 | -3.9 | | -7.2 | -2.6 |
| Percent change in Exposed Mean from Control Mean= | | 2.38 | -0.79 | 8.20 | 3.44 | | -6.91 | -5.40 | | -9.86 | -3.56 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | No | Yes | | No | No | | No | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

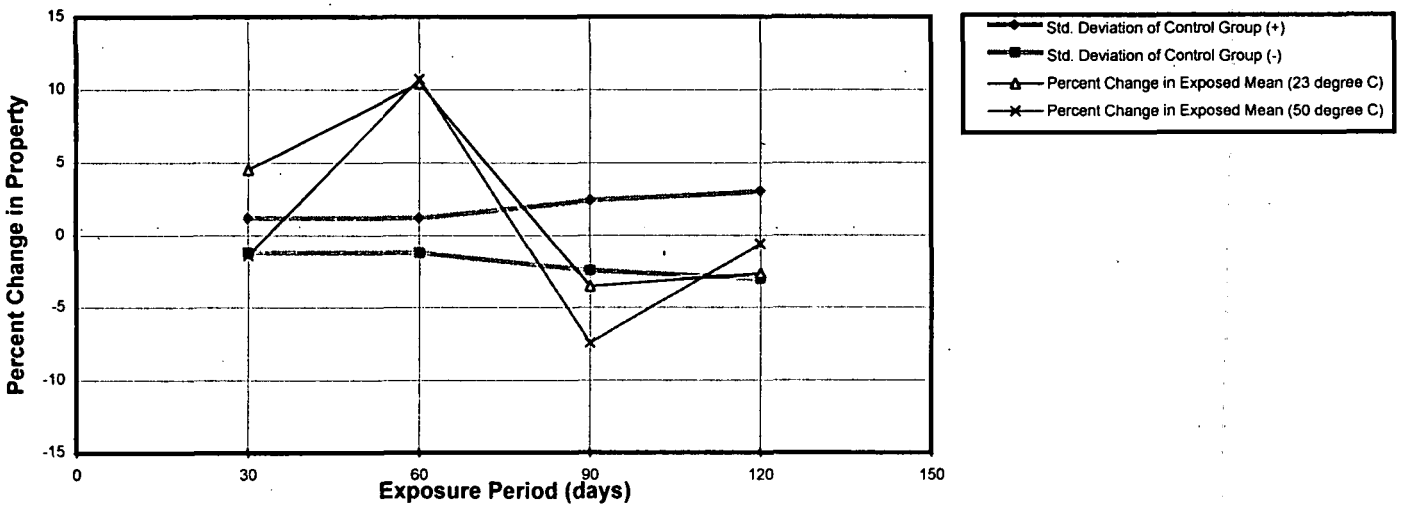
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D1004*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** INTITIAL TEARING RESISTANCE (lb)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 70.0 | 73.0 | 69.0 | 78.0 | 80.0 | 70.0 | 67.5 | 65.3 | 66.0 | 63.0 | 70.0 |
| | 71.0 | 72.0 | 69.0 | 79.0 | 79.0 | 68.0 | 66.0 | 67.5 | 69.0 | 68.0 | 70.0 |
| | 70.0 | 73.0 | 70.0 | 80.0 | 79.0 | 69.0 | 68.8 | 61.1 | 70.0 | 67.0 | 68.0 |
| | 71.0 | 75.0 | 70.0 | 76.0 | 76.0 | 72.0 | 65.8 | 65.3 | 66.0 | 65.0 | 65.0 |
| | 72.0 | 77.0 | 71.0 | 78.0 | 78.0 | 68.0 | 66.9 | 62.3 | 70.0 | 69.0 | 66.0 |
| Mean of Control Group= | 70.8 | | | | | 69.4 | | | 68.2 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 0.8 | | | | | 1.7 | | | 2.0 | | |
| Std. Deviation of Mean of Control Group as % = | 1.2 | | | | | 2.4 | | | 3.0 | | |
| Mean of Exposed Group= | | 74.0 | 69.8 | 78.2 | 78.4 | | 67.0 | 64.3 | | 66.4 | 67.8 |
| Change in Exposed Mean from Control Mean= | | 3.2 | -1.0 | 7.4 | 7.6 | | -2.4 | -5.1 | | -1.8 | -0.4 |
| Percent change in Exposed Mean from Control Mean= | | 4.52 | -1.41 | 10.45 | 10.73 | | -3.50 | -7.39 | | -2.64 | -0.59 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | No | No | | Yes | Yes |




000291

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

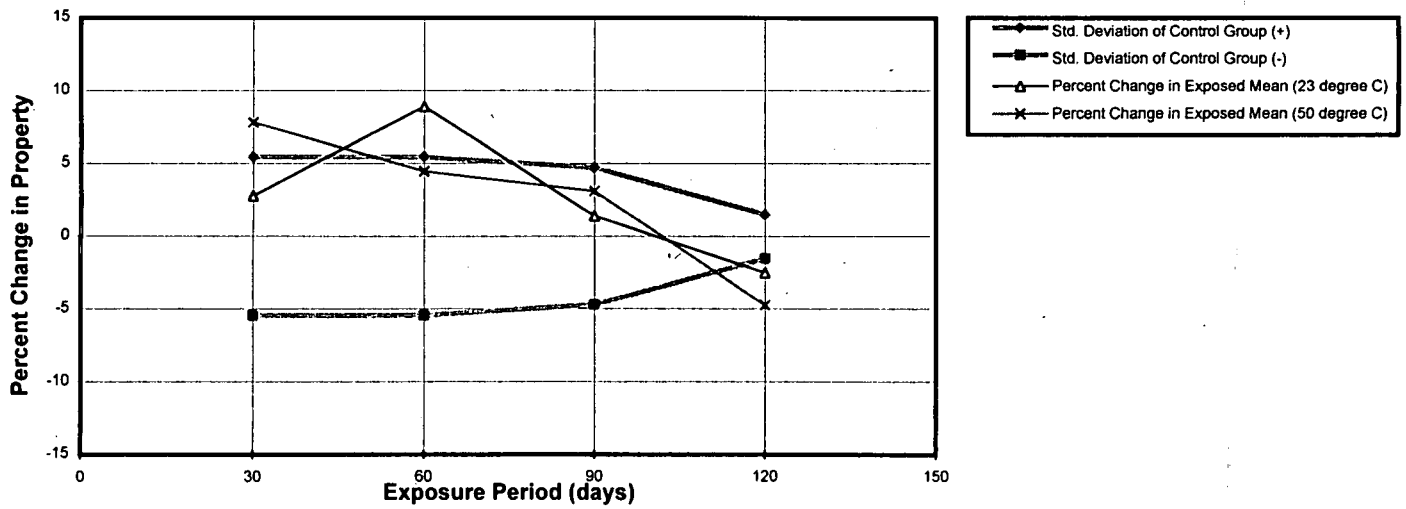
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D1004*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** INTITIAL TEARING RESISTANCE (lb)
**DIRECTION:** ROLL

| | Control Group for 30 and 60-day Exposures | *30-day* | | *60-day* | | *90-day* | | | *120-day* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 70.0 | 73.0 | 78.0 | 76.0 | 73.0 | 74.0 | 69.8 | 72.9 | 72.0 | 69.0 | 69.0 |
| | 66.0 | 75.0 | 80.0 | 79.0 | 76.0 | 76.0 | 74.9 | 74.9 | 73.0 | 70.0 | 68.0 |
| | 73.0 | 73.0 | 76.0 | 78.0 | 75.0 | 71.0 | 71.8 | 72.1 | 70.0 | 69.0 | 67.0 |
| | 76.0 | 74.0 | 74.0 | 79.0 | 75.0 | 68.0 | 73.9 | 72.5 | 72.0 | 72.0 | 71.0 |
| | 74.0 | 74.0 | 79.0 | 79.0 | 76.0 | 69.0 | 72.8 | 76.8 | 72.0 | 70.0 | 67.0 |
| Mean of Control Group= | 71.8 | | | | | 71.6 | | | 71.8 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 3.9 | | | | | 3.4 | | | 1.1 | | |
| Std. Deviation of Mean of Control Group as % = | 5.4 | | | | | 4.7 | | | 1.5 | | |
| Mean of Exposed Group= | | 73.8 | 77.4 | 78.2 | 75.0 | | 72.6 | 73.8 | | 70.0 | 68.4 |
| Change in Exposed Mean from Control Mean= | | 2.0 | 5.6 | 6.4 | 3.2 | | 1.0 | 2.2 | | -1.8 | -3.4 |
| Percent change in Exposed Mean from Control Mean= | | 2.79 | 7.80 | 8.91 | 4.46 | | 1.39 | 3.10 | | -2.51 | -4.74 |
| Is change less than one Std. Deviation of Control Group? | | Yes | No | No | Yes | | Yes | Yes | | No | No |




000295

906

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

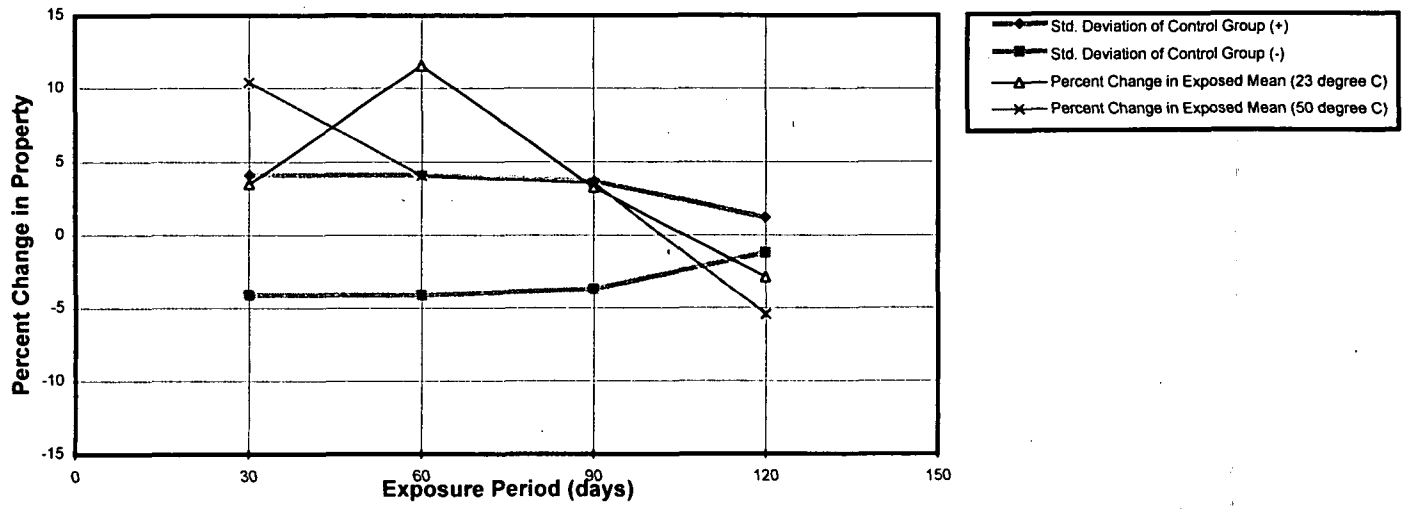
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D1004*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** INTITIAL TEARING RESISTANCE (lb)
**DIRECTION:** CROSS-ROLL

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 66.0 | 68.0 | 81.0 | 77.0 | 71.0 | 70.0 | 71.9 | 71.4 | 70.0 | 67.0 | 67.0 |
| | 66.0 | 74.0 | 75.0 | 74.0 | 75.0 | 69.0 | 70.6 | 69.3 | 71.0 | 67.0 | 70.0 |
| | 71.0 | 70.0 | 73.0 | 78.0 | 70.0 | 65.0 | 69.4 | 75.4 | 71.0 | 67.0 | 64.0 |
| | 72.0 | 72.0 | 74.0 | 78.0 | 73.0 | 72.0 | 71.6 | 70.4 | 70.0 | 70.0 | 64.0 |
| | 70.0 | 73.0 | 78.0 | 78.0 | 70.0 | 69.0 | 72.6 | 70.9 | 69.0 | 70.0 | 67.0 |
| Mean of Control Group= | 69.0 | | | | | 69.0 | | | 70.2 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 2.8 | | | | | 2.5 | | | 0.8 | | |
| Std. Deviation of Mean of Control Group as % = | 4.1 | | | | | 3.7 | | | 1.2 | | |
| Mean of Exposed Group= | | 71.4 | 76.2 | 77.0 | 71.8 | | 71.2 | 71.4 | | 68.2 | 66.4 |
| Change in Exposed Mean from Control Mean= | | 2.4 | 7.2 | 8.0 | 2.8 | | 2.2 | 2.4 | | -2.0 | -3.8 |
| Percent change in Exposed Mean from Control Mean= | | 3.48 | 10.43 | 11.59 | 4.06 | | 3.22 | 3.54 | | -2.85 | -5.41 |
| Is change less than one Std. Deviation of Control Group? | | Yes | No | No | Yes | | Yes | Yes | | No | No |



## 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*

The following observations were made regarding the percent changes in hardness of the five geomembranes.

GSE-SLT Geomembrane. The means of percent property changes showed variations of less than 3% for all exposure periods. The line of zero percent property change was within one standard deviation for all the exposure periods except the 30-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the percent change in property with exposure time or temperature.

NSC Geomembrane. The means of percent property changes showed variations of less than 3% for all exposure periods. The line of zero percent property change was within one standard deviation for all the exposure periods except the 30-day exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the percent change in property with exposure time or temperature.

GSE-Gundle Geomembrane. The means of percent property changes showed variations of less than 3% for all exposure periods. The line of zero percent property change was within one standard deviation for all the exposure periods except the 30-day and the 60-day exposures at 23°C. In general, the hardness of the geomembrane increased after exposure. The percent changes remained relatively constant with exposure time for exposures at 23°C, and increased linearly

for exposures at 50°C; however, no consistent trends were observed between temperatures.

PolyFlex Geomembrane. The means of percent property changes showed variations of less than 5% for all exposure periods. The line of zero percent property change was within one standard deviation for all the exposure periods except the 30-day and the 60-day exposures at 50°C. The results exhibited randomness, and no consistent trends were observed for the percent change in property with exposure time or temperature.

Serrot Geomembrane. The means of percent property changes showed variations of less than 4% for all exposure periods. The line of zero percent property change was within one standard deviation for all the exposure periods except the 30-day and the 60-day exposures at 50°C. The results exhibited randomness, and no consistent trends were observed for the percent change in property with exposure time or temperature.

*Conclusion*

The test leachate caused mean percent property changes of less than 4% for all the geomembranes. The line of zero percent property change was within one standard deviation for at least 5 out of 8 exposures for all the geomembranes. Therefore, no detrimental effects are expected to the tested property due to exposure to the leachate.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

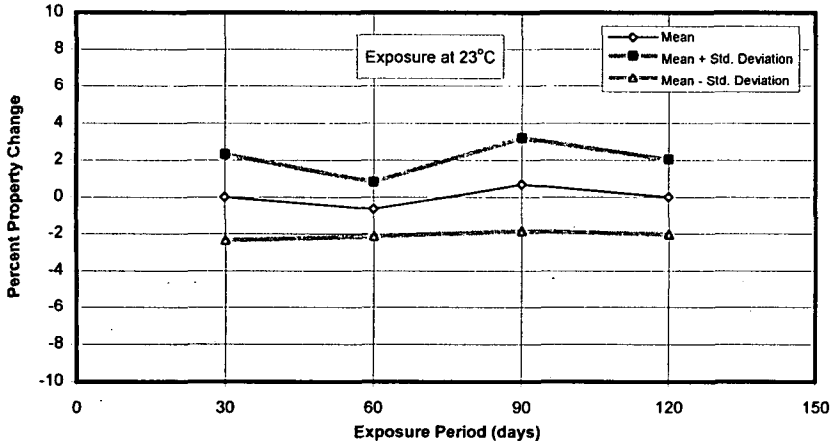
***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D2240*
***DATE TESTED:*** *6/14/96*

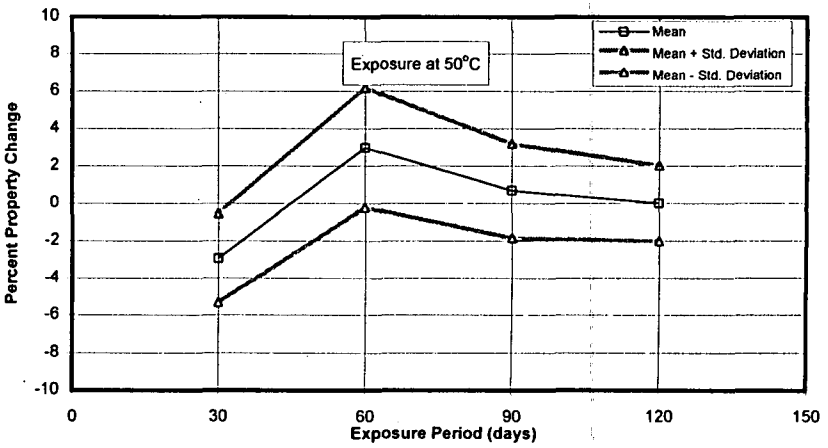
***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** HARDNESS (SHORE-D)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 61 | 60 | -1.64 | 61 | 59 | -3.28 | 60 | 60 | 0.00 | 61 | 61 | 0.00 |
| | 60 | 59 | -1.67 | 60 | 60 | 0.00 | 61 | 59 | -3.28 | 60 | 60 | 0.00 |
| | 62 | 61 | -1.61 | 62 | 62 | 0.00 | 59 | 61 | 3.39 | 59 | 60 | 1.69 |
| | 61 | 63 | 3.28 | 61 | 61 | 0.00 | 61 | 62 | 1.64 | 61 | 59 | -3.28 |
| | 60 | 61 | 1.67 | 60 | 60 | 0.00 | 60 | 61 | 1.67 | 60 | 61 | 1.67 |
| Mean of Percent Property Change= | | | 0.005 | | | -0.656 | | | 0.683 | | | 0.017 |
| Std. Deviation of Percent Property Change (+/-)= | | | 2.323 | | | 1.466 | | | 2.518 | | | 2.025 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 60 | 60 | 0.00 | 60 | 61 | 1.67 | 61 | 59 | -3.28 | 61 | 61 | 0.00 |
| | 61 | 59 | -3.28 | 61 | 62 | 1.64 | 59 | 59 | 0.00 | 60 | 60 | 0.00 |
| | 62 | 58 | -6.45 | 62 | 62 | 0.00 | 59 | 61 | 3.39 | 61 | 59 | -3.28 |
| | 61 | 59 | -3.28 | 61 | 63 | 3.28 | 60 | 61 | 1.67 | 59 | 60 | 1.69 |
| | 60 | 59 | -1.67 | 60 | 65 | 8.33 | 59 | 60 | 1.69 | 60 | 61 | 1.67 |
| Mean of Percent Property Change= | | | -2.935 | | | 2.984 | | | 0.695 | | | 0.017 |
| Std. Deviation of Percent Property Change (+/-)= | | | 2.389 | | | 3.207 | | | 2.524 | | | 2.025 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | Yes |




[1] *The same "Unexposed Specimen" was used as a control for 30-day and 60-day Exposures*

000500

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

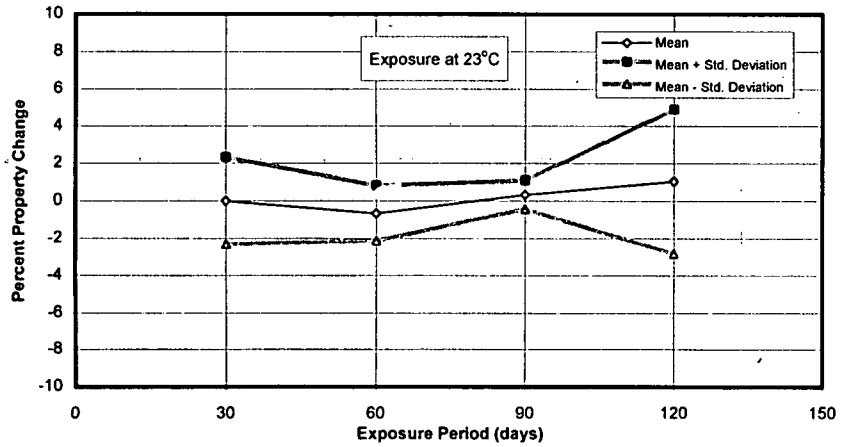
***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D2240*
***DATE TESTED:*** *6/14/96*

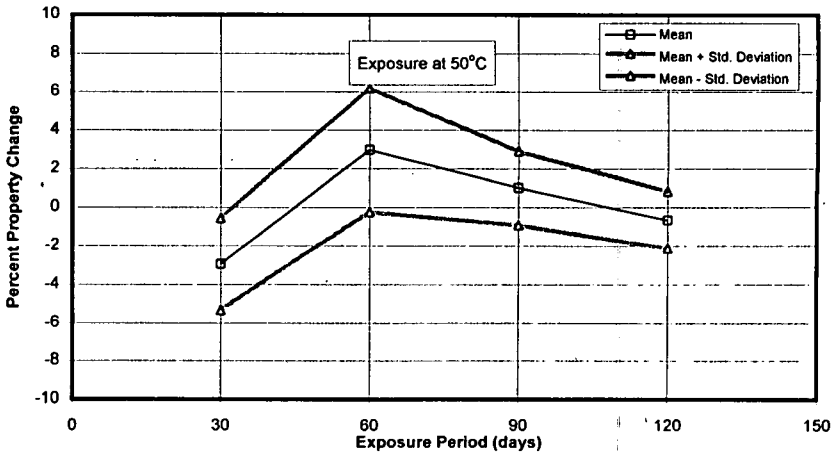
***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** HARDNESS (SHORE-D)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 61 | 60 | -1.64 | 61 | 59 | -3.28 | 59 | 60 | 1.69 | 59 | 63 | 6.78 |
| | 60 | 59 | -1.67 | 60 | 60 | 0.00 | 60 | 60 | 0.00 | 61 | 59 | -3.28 |
| | 62 | 61 | -1.61 | 62 | 62 | 0.00 | 61 | 61 | 0.00 | 60 | 61 | 1.67 |
| | 61 | 63 | 3.28 | 61 | 61 | 0.00 | 60 | 60 | 0.00 | 61 | 60 | -1.64 |
| | 60 | 61 | 1.67 | 60 | 60 | 0.00 | 60 | 60 | 0.00 | 60 | 61 | 1.67 |
| Mean of Percent Property Change= | | | 0.005 | | | -0.656 | | | 0.339 | | | 1.039 |
| Std. Deviation of Percent Property Change (+/-)= | | | 2.323 | | | 1.466 | | | 0.758 | | | 3.859 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 60 | 60 | 0.00 | 60 | 61 | 1.67 | 59 | 61 | 3.39 | 62 | 61 | -1.61 |
| | 61 | 59 | -3.28 | 61 | 62 | 1.64 | 61 | 62 | 1.64 | 61 | 60 | -1.64 |
| | 62 | 58 | -6.45 | 62 | 62 | 0.00 | 60 | 59 | -1.67 | 60 | 61 | 1.67 |
| | 61 | 59 | -3.28 | 61 | 63 | 3.28 | 59 | 60 | 1.69 | 61 | 60 | -1.64 |
| | 60 | 59 | -1.67 | 60 | 65 | 8.33 | 60 | 60 | 0.00 | 60 | 60 | 0.00 |
| Mean of Percent Property Change= | | | -2.935 | | | 2.984 | | | 1.011 | | | -0.645 |
| Std. Deviation of Percent Property Change (+/-)= | | | 2.389 | | | 3.207 | | | 1.918 | | | 1.473 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | Yes | | | Yes | | | Yes |




[1] *The same "Unexposed Specimen" was used as a control for 30-day and 60-day Exposures*

000301

906

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

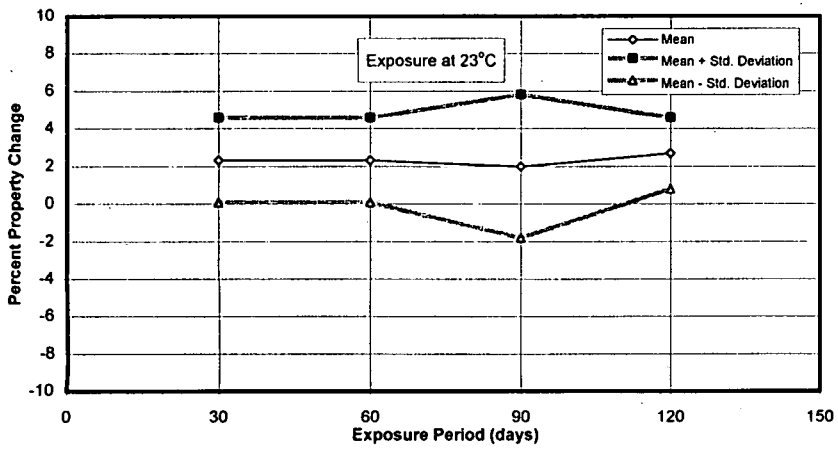
***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D2240*
***DATE TESTED:*** *6/14/96*

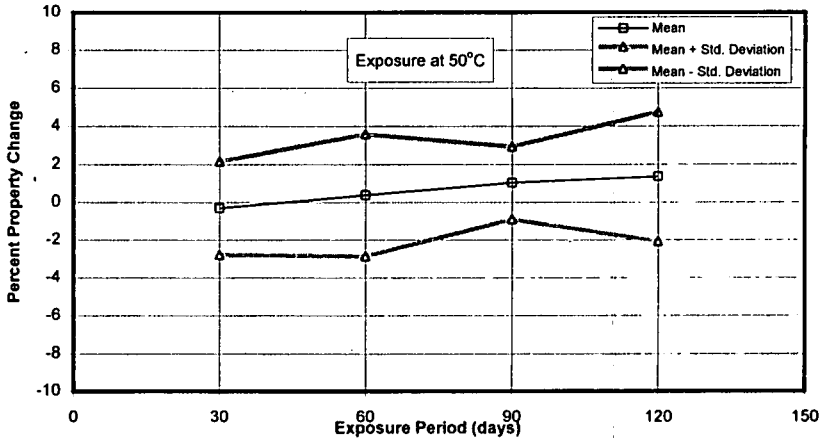
***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** HARDNESS (SHORE-D)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 61 | 61 | 0.00 | 61 | 61 | 0.00 | 59 | 63 | 6.78 | 59 | 60 | 1.69 |
| | 60 | 62 | 3.33 | 60 | 62 | 3.33 | 61 | 60 | -1.64 | 59 | 59 | 0.00 |
| | 61 | 63 | 3.28 | 61 | 63 | 3.28 | 60 | 59 | -1.67 | 59 | 61 | 3.39 |
| | 59 | 62 | 5.08 | 59 | 62 | 5.08 | 61 | 64 | 4.92 | 60 | 63 | 5.00 |
| | 60 | 60 | 0.00 | 60 | 60 | 0.00 | 60 | 61 | 1.67 | 59 | 61 | 3.39 |
| Mean of Percent Property Change= | | | 2.339 | | | 2.339 | | | 2.012 | | | 2.695 |
| Std. Deviation of Percent Property Change (+/-)= | | | 2.256 | | | 2.256 | | | 3.813 | | | 1.907 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | No | | | Yes | | | No |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 62 | 62 | 0.00 | 62 | 62 | 0.00 | 60 | 61 | 1.67 | 61 | 62 | 1.64 |
| | 59 | 61 | 3.39 | 59 | 62 | 5.08 | 59 | 61 | 3.39 | 60 | 64 | 6.67 |
| | 62 | 61 | -1.61 | 62 | 61 | -1.61 | 59 | 60 | 1.69 | 62 | 61 | -1.61 |
| | 60 | 60 | 0.00 | 60 | 61 | 1.67 | 60 | 60 | 0.00 | 61 | 60 | -1.64 |
| | 61 | 59 | -3.28 | 61 | 59 | -3.28 | 60 | 59 | -1.67 | 60 | 61 | 1.67 |
| Mean of Percent Property Change= | | | -0.300 | | | 0.372 | | | 1.017 | | | 1.344 |
| Std. Deviation of Percent Property Change (+/-)= | | | 2.469 | | | 3.213 | | | 1.920 | | | 3.397 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | Yes |




[1] *The same "Unexposed Specimen" was used as a control for 30-day and 60-day Exposures*

000302

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

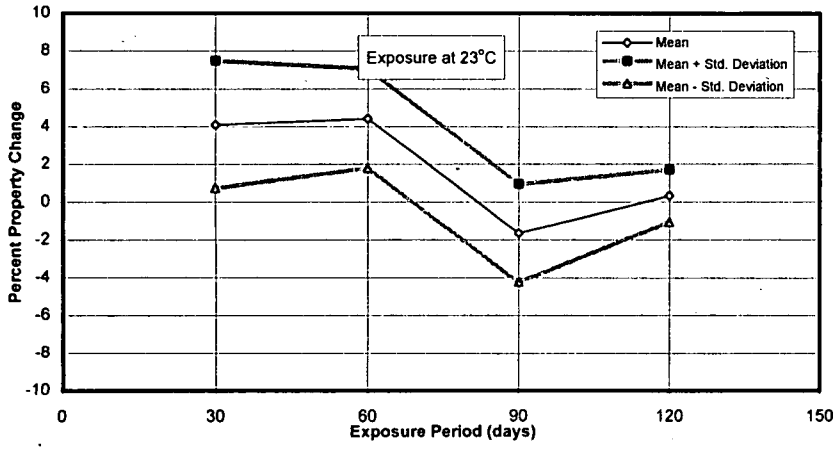
***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D2240*
***DATE TESTED:*** *6/14/96*

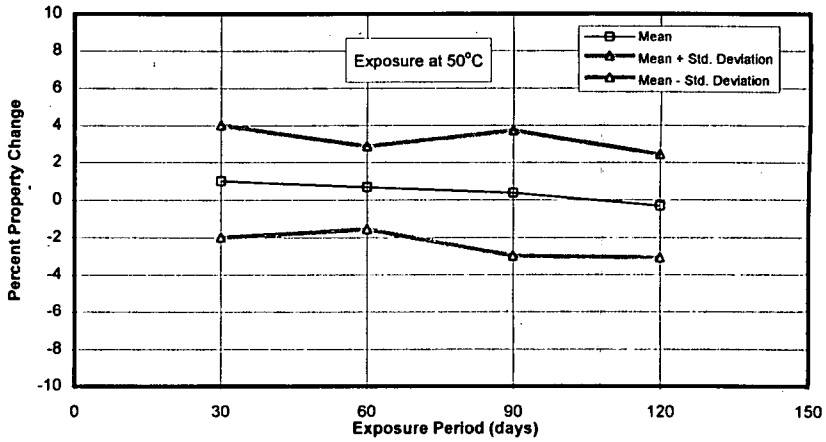
***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** HARDNESS (SHORE-D)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 60 | 61 | 1.67 | 60 | 61 | 1.67 | 62 | 60 | -3.23 | 61 | 62 | 1.64 |
| | 59 | 62 | 5.08 | 59 | 62 | 5.08 | 61 | 62 | 1.64 | 60 | 61 | 1.67 |
| | 58 | 63 | 8.62 | 58 | 63 | 8.62 | 59 | 59 | 0.00 | 61 | 60 | -1.64 |
| | 60 | 60 | 0.00 | 60 | 62 | 3.33 | 61 | 58 | -4.92 | 61 | 61 | 0.00 |
| | 58 | 61 | 5.17 | 58 | 60 | 3.45 | 60 | 59 | -1.67 | 61 | 61 | 0.00 |
| Mean of Percent Property Change= | | | 4.109 | | | 4.431 | | | -1.634 | | | 0.333 |
| Std. Deviation of Percent Property Change (+/-)= | | | 3.365 | | | 2.638 | | | 2.584 | | | 1.378 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | No | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 60 | 62 | 3.33 | 60 | 62 | 3.33 | 62 | 59 | -4.84 | 60 | 59 | -1.67 |
| | 61 | 61 | 0.00 | 61 | 62 | 1.64 | 60 | 62 | 3.33 | 59 | 61 | 3.39 |
| | 62 | 61 | -1.61 | 62 | 61 | -1.61 | 61 | 61 | 0.00 | 59 | 60 | 1.69 |
| | 61 | 60 | -1.64 | 61 | 60 | -1.64 | 59 | 61 | 3.39 | 60 | 59 | -1.67 |
| | 60 | 63 | 5.00 | 60 | 61 | 1.67 | 60 | 60 | 0.00 | 60 | 58 | -3.33 |
| Mean of Percent Property Change= | | | 1.016 | | | 0.677 | | | 0.377 | | | -0.316 |
| Std. Deviation of Percent Property Change (+/-)= | | | 3.010 | | | 2.212 | | | 3.365 | | | 2.763 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | Yes |




[1] *The same "Unexposed Specimen" was used as a control for 30-day and 60-day Exposures*

000303

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

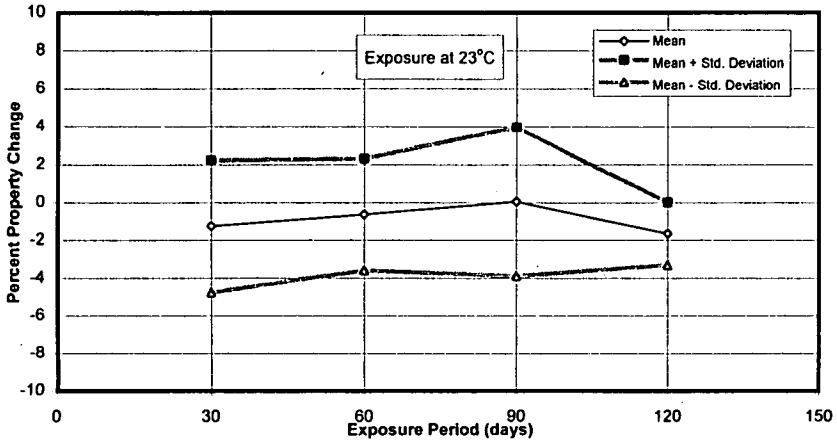
***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D2240*
***DATE TESTED:*** *6/14/96*

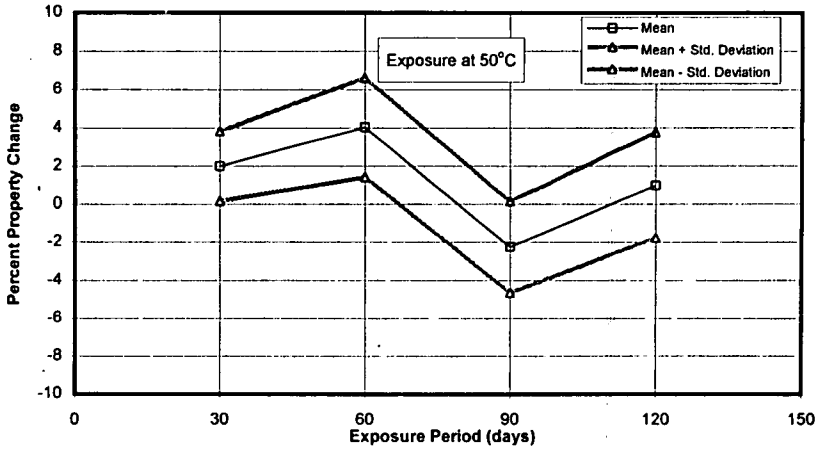
***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** HARDNESS (SHORE-D)
**DIRECTION:** N/A

| | Exposure at 23°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 61 | 61 | 0.00 | 61 | 59 | -3.28 | 61 | 60 | -1.64 | 60 | 58 | -3.33 |
| | 61 | 60 | -1.64 | 61 | 63 | 3.28 | 59 | 63 | 6.78 | 59 | 59 | 0.00 |
| | 63 | 59 | -6.35 | 63 | 62 | -1.59 | 61 | 61 | 0.00 | 62 | 60 | -3.23 |
| | 60 | 62 | 3.33 | 60 | 61 | 1.67 | 62 | 60 | -3.23 | 61 | 60 | -1.64 |
| | 63 | 62 | -1.59 | 63 | 61 | -3.17 | 61 | 60 | -1.64 | 61 | 61 | 0.00 |
| Mean of Percent Property Change= | | | -1.249 | | | -0.619 | | | 0.055 | | | -1.640 |
| Std. Deviation of Percent Property Change (+/-)= | | | 3.494 | | | 2.956 | | | 3.928 | | | 1.640 |
| Is Zero Percent Property Change within One Std. Deviation? | | | Yes | | | Yes | | | Yes | | | Yes |

| | Exposure at 50°C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *30-day* | | | *60-day* | | | *90-day* | | | *120-day* | | |
| | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen[1] | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change | Unexposed Specimen | Exposed Specimen | % Property Change |
| | 61 | 63 | 3.28 | 61 | 62 | 1.64 | 59 | 59 | 0.00 | 61 | 61 | 0.00 |
| | 59 | 61 | 3.39 | 59 | 63 | 6.78 | 61 | 60 | -1.64 | 61 | 62 | 1.64 |
| | 60 | 62 | 3.33 | 60 | 61 | 1.67 | 63 | 59 | -6.35 | 61 | 59 | -3.28 |
| | 60 | 60 | 0.00 | 60 | 62 | 3.33 | 62 | 61 | -1.61 | 60 | 62 | 3.33 |
| | 59 | 59 | 0.00 | 59 | 63 | 6.78 | 61 | 60 | -1.64 | 60 | 62 | 3.33 |
| Mean of Percent Property Change= | | | 2.000 | | | 4.040 | | | -2.248 | | | 1.005 |
| Std. Deviation of Percent Property Change (+/-)= | | | 1.827 | | | 2.594 | | | 2.399 | | | 2.766 |
| Is Zero Percent Property Change within One Std. Deviation? | | | No | | | No | | | Yes | | | Yes |




[1] *The same "Unexposed Specimen" was used as a control for 30-day and 60-day Exposures*

000301

2.12 PUNCTURE RESISTANCE

## 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 percent changes in puncture resistance of the five geomembranes.

GSE-SLT Geomembrane. The percent changes in puncture resistance due to exposure were not within one standard deviation of the control means for any of the exposures except the 30-day, the 60-day and the 90-day exposures at 23°C. In general, the exposures at 23°C resulted in less percent change as compared to the exposures at 50°C. The results exhibited randomness, and no consistent trends were observed for the change in property with exposure time or temperature.

NSC Geomembrane. The percent changes in puncture resistance due to exposure were not within one standard deviation of the control means for any of the exposures. The percent change in property decreased with exposure time for exposures at both temperatures; however, this trend was not consistent between temperatures.

GSE-Gundle Geomembrane. The percent changes in puncture resistance due to exposure were within one standard deviation of the control means for all of the exposures except the 30-day and the 120-day exposures at 23°C. The percent change in property remained relatively constant with exposure time and temperature.

PolyFlex Geomembrane. The percent changes in puncture resistance due to exposure were within one standard deviation of the control means for all of the exposures except the 120-day exposure at 23°C, and the 60-day exposure at 50°C. The percent change in property decreased with exposure time for exposures at

23°C; however, this was contradicted by an increasing trend with exposure time for exposures at 50°C.

Serrot Geomembrane. The percent changes in puncture resistance due to exposure were not within one standard deviation of the control means for any of the exposures except the 120-day exposures at 23°C and 50°C. The percent change in property decreased with exposure time for exposures at both temperatures; however, this trend was not consistent between temperatures.

*Conclusion*

The means of the percent changes in puncture resistance were less than one standard deviation of the control means for at least 5 out of 8 exposures for the GSE-Gundle and Polyflex geomembranes. Randomness in data or inconsistent trends were observed in means of the percent changes in puncture resistance for GSE-SLT, NSC and Serrot geomembranes. Therefore, no detrimental effects are expected to the tested property due to exposure to the leachate.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

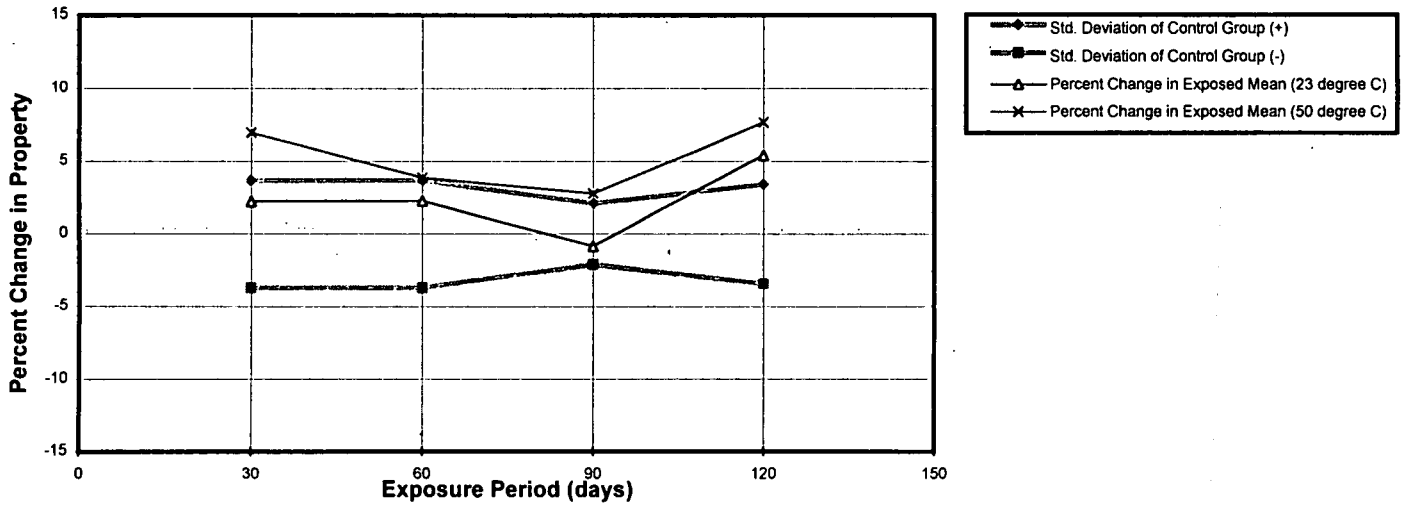
# CHEMICAL COMPATIBILITY TEST RESULTS

**CLIENT:** FERMCO
**METHOD:** FTMS 101C (METHOD 2065)
**DATE TESTED:** 6/14/96

**GEOSYNTEC JOB NO.:** GE3900
**MATERIAL TYPE:** GSE-SLT
**CHARACTERISTICS:** 80 mil HDPE Geomembrane
**IMMERSION MEDIUM:** Perched Ground Water

**PROPERTY (UNIT):** PUNCTURE RESISTANCE (lb)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 138.4 | 136.0 | 149.9 | 138.3 | 141.8 | 131.0 | 128.0 | 133.0 | 119.5 | 128.6 | 135.9 |
| | 139.5 | 143.3 | 150.3 | 141.7 | 136.7 | 134.8 | 131.0 | 128.2 | 127.4 | 126.0 | 133.4 |
| | 127.4 | 143.6 | 147.3 | 139.9 | 139.5 | 130.6 | 129.7 | 138.5 | 125.1 | 136.4 | 134.1 |
| | 139.0 | 130.8 | 138.5 | 137.1 | 144.6 | 128.3 | 131.2 | 139.3 | 124.9 | 133.4 | 136.1 |
| | 136.9 | 142.6 | 142.9 | 139.5 | 145.0 | 128.0 | 127.3 | 131.8 | 131.3 | 138.1 | 136.9 |
| Mean of Control Group= | 136.2 | | | | | 130.5 | | | 125.6 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 5.0 | | | | | 2.7 | | | 4.3 | | |
| Std. Deviation of Mean of Control Group as % = | 3.7 | | | | | 2.1 | | | 3.4 | | |
| Mean of Exposed Group= | | 139.3 | 145.8 | 139.3 | 141.5 | | 129.4 | 134.2 | | 132.5 | 135.3 |
| Change in Exposed Mean from Control Mean= | | 3.0 | 9.5 | 3.1 | 5.3 | | -1.1 | 3.6 | | 6.9 | 9.6 |
| Percent change in Exposed Mean from Control Mean= | | 2.22 | 7.00 | 2.25 | 3.88 | | -0.84 | 2.77 | | 5.46 | 7.67 |
| Is change less than one Std. Deviation of Control Group? | | Yes | No | Yes | No | | Yes | No | | No | No |




000307

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

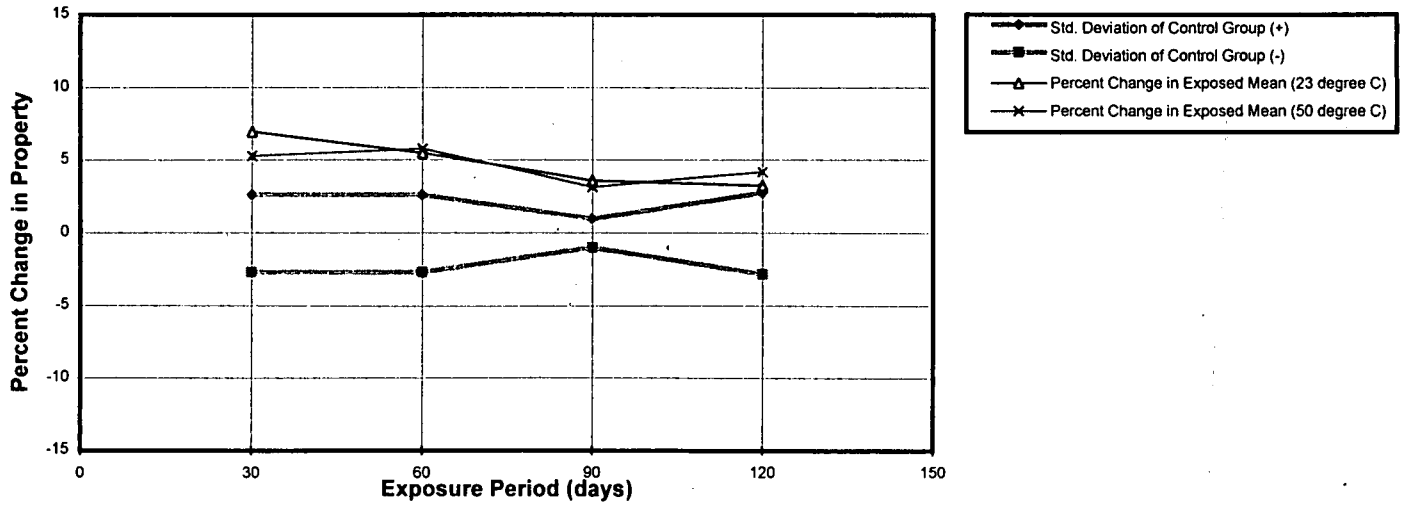
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *FTMS 101C (METHOD 2065)*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** PUNCTURE RESISTANCE (lb)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 130.4 | 137.7 | 138.5 | 139.4 | 135.7 | 122.0 | 130.6 | 126.7 | 130.0 | 132.3 | 125.8 |
| | 125.3 | 137.1 | 136.2 | 136.1 | 139.3 | 124.3 | 128.5 | 128.3 | 122.0 | 129.0 | 131.7 |
| | 132.1 | 139.3 | 135.1 | 139.2 | 136.3 | 124.7 | 129.6 | 129.3 | 127.3 | 130.0 | 134.3 |
| | 133.5 | 139.4 | 136.3 | 135.0 | 137.3 | 125.1 | 126.0 | 127.7 | 123.2 | 129.7 | 133.2 |
| | 126.9 | 139.7 | 136.3 | 134.1 | 137.1 | 123.3 | 127.0 | 127.1 | 129.0 | 131.2 | 132.9 |
| Mean of Control Group= | 129.6 | | | | | 123.9 | | | 126.3 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 3.5 | | | | | 1.2 | | | 3.5 | | |
| Std. Deviation of Mean of Control Group as % = | 2.7 | | | | | 1.0 | | | 2.8 | | |
| Mean of Exposed Group= | | 138.6 | 136.5 | 136.8 | 137.1 | | 128.3 | 127.8 | | 130.4 | 131.6 |
| Change in Exposed Mean from Control Mean= | | 9.0 | 6.8 | 7.1 | 7.5 | | 4.5 | 3.9 | | 4.1 | 5.3 |
| Percent change in Exposed Mean from Control Mean= | | 6.94 | 5.28 | 5.49 | 5.79 | | 3.60 | 3.18 | | 3.28 | 4.18 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | No | No | | No | No |




000308

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *FTMS 101C (METHOD 2065)*
***DATE TESTED:*** *6/14/96*

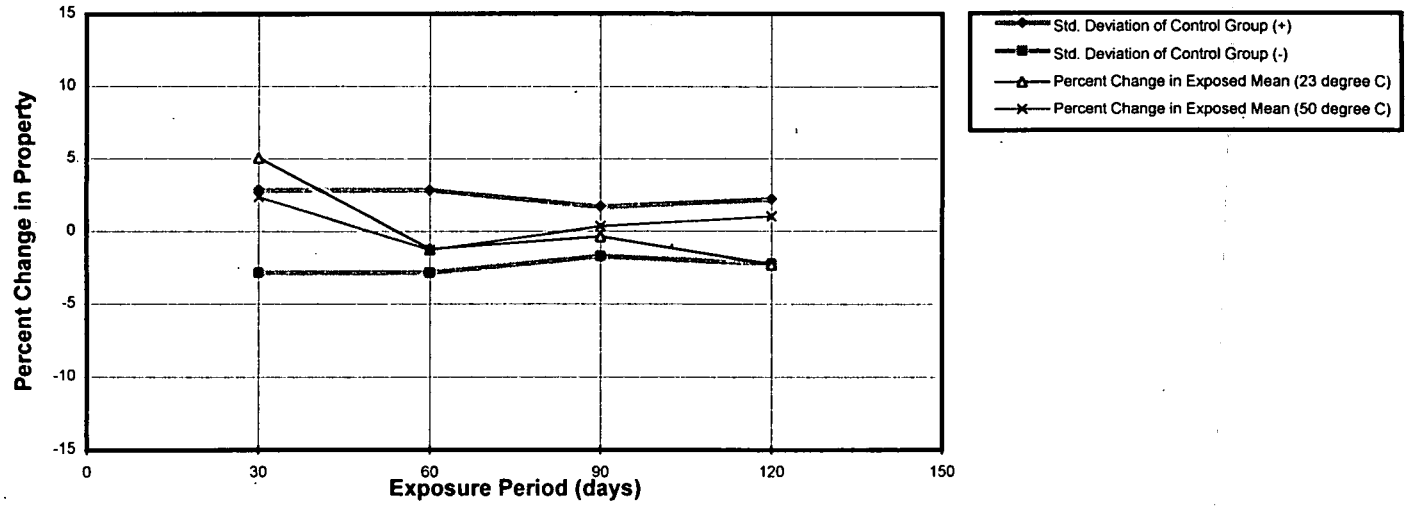
***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** PUNCTURE RESISTANCE (lb)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 132.8 | 143.3 | 136.6 | 133.4 | 131.8 | 130.0 | 135.5 | 134.0 | 135.5 | 132.6 | 136.1 |
| | 139.2 | 139.9 | 140.5 | 129.3 | 132.7 | 127.3 | 129.5 | 131.1 | 136.6 | 129.4 | 137.5 |
| | 129.7 | 143.4 | 137.4 | 141.8 | 134.2 | 132.2 | 126.8 | 131.0 | 130.1 | 132.7 | 135.6 |
| | 136.5 | 142.5 | 136.4 | 130.6 | 134.6 | 132.7 | 128.5 | 128.1 | 135.3 | 132.7 | 136.9 |
| | 137.4 | 140.8 | 140.7 | 132.4 | 133.8 | 129.3 | 129.0 | 129.5 | 137.9 | 132.8 | 136.4 |
| Mean of Control Group= | 135.1 | | | | | 130.3 | | | 135.1 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 3.8 | | | | | 2.2 | | | 3.0 | | |
| Std. Deviation of Mean of Control Group as % = | 2.8 | | | | | 1.7 | | | 2.2 | | |
| Mean of Exposed Group= | | 142.0 | 138.3 | 133.5 | 133.4 | | 129.9 | 130.7 | | 132.0 | 136.5 |
| Change in Exposed Mean from Control Mean= | | 6.9 | 3.2 | -1.6 | -1.7 | | -0.4 | 0.4 | | -3.0 | 1.4 |
| Percent change in Exposed Mean from Control Mean= | | 5.08 | 2.37 | -1.20 | -1.26 | | -0.34 | 0.34 | | -2.25 | 1.05 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | Yes | Yes | | Yes | Yes | | No | Yes |

1.28

+5.08




000309

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

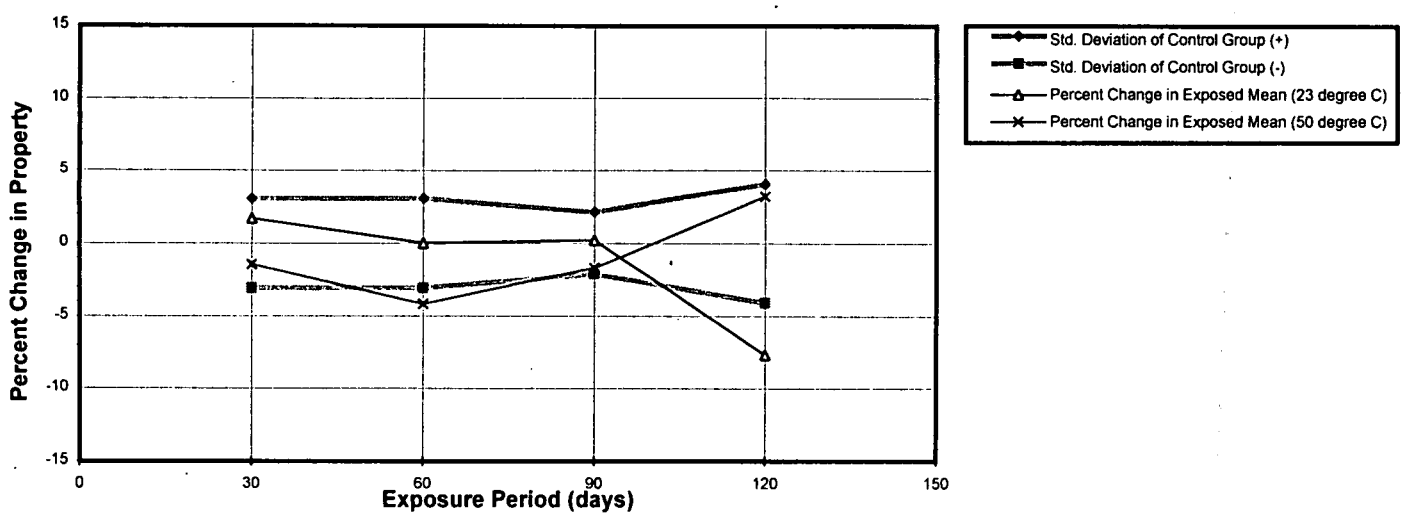
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *FTMS 101C (METHOD 2065)*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** PUNCTURE RESISTANCE (lb)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 142.4 | 137.5 | 133.1 | 136.3 | 137.8 | 124.1 | 113.8 | 127.5 | 136.8 | 127.0 | 135.0 |
| | 142.0 | 140.2 | 132.1 | 145.4 | 134.5 | 118.1 | 125.0 | 116.5 | 142.6 | 125.5 | 138.1 |
| | 140.0 | 146.6 | 140.3 | 134.6 | 131.5 | 121.6 | 123.8 | 116.0 | 138.1 | 125.3 | 142.1 |
| | 137.5 | 145.6 | 140.5 | 134.9 | 128.4 | 122.6 | 125.1 | 117.0 | 127.3 | 125.5 | 141.8 |
| | 132.0 | 135.9 | 137.7 | 142.8 | 132.8 | 118.6 | 118.7 | 117.8 | 136.7 | 126.1 | 146.4 |
| Mean of Control Group= | 138.8 | | | | | 121.0 | | | 136.3 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 4.3 | | | | | 2.6 | | | 5.6 | | |
| Std. Deviation of Mean of Control Group as % = | 3.1 | | | | | 2.1 | | | 4.1 | | |
| Mean of Exposed Group= | | 141.2 | 136.7 | 138.8 | 133.0 | | 121.3 | 119.0 | | 125.9 | 140.7 |
| Change in Exposed Mean from Control Mean= | | 2.4 | -2.0 | 0.0 | -5.8 | | 0.3 | -2.0 | | -10.4 | 4.4 |
| Percent change in Exposed Mean from Control Mean= | | 1.71 | -1.47 | 0.01 | -4.16 | | 0.23 | -1.69 | | -7.64 | 3.21 |
| Is change less than one Std. Deviation of Control Group? | | Yes | Yes | Yes | No | | Yes | Yes | | No | Yes |



**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

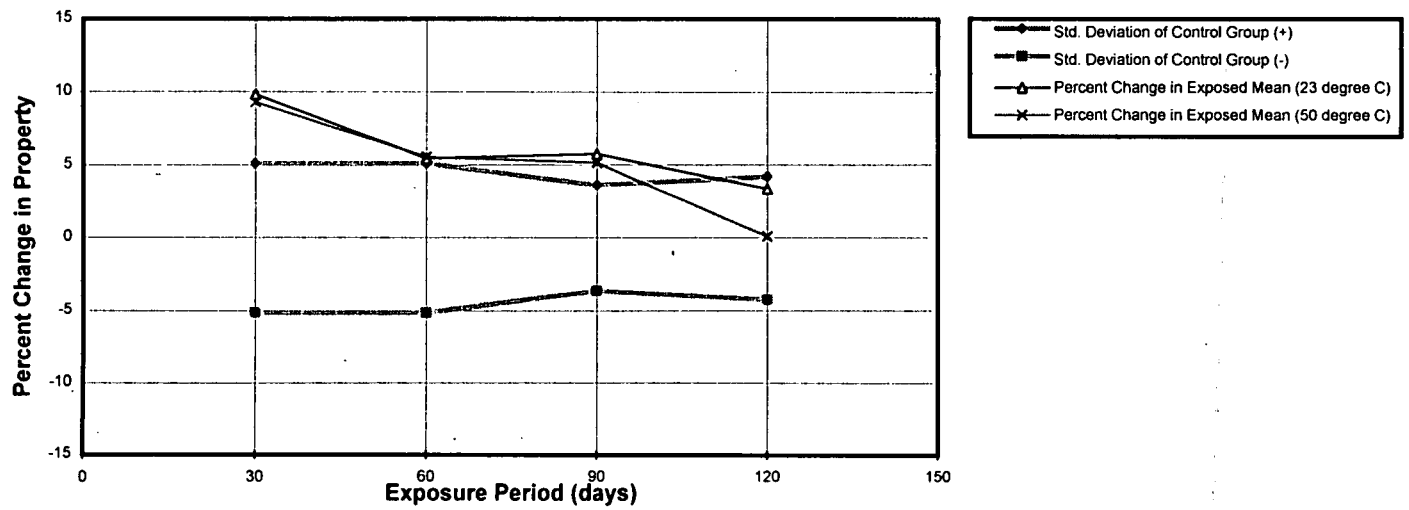
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *FTMS 101C (METHOD 2065)*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** PUNCTURE RESISTANCE (lb)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 120.7 | 136.2 | 139.2 | 130.8 | 134.1 | 126.3 | 130.0 | 129.8 | 129.6 | 135.0 | 129.2 |
| | 129.7 | 140.2 | 138.2 | 133.8 | 133.6 | 125.7 | 129.5 | 128.5 | 122.4 | 134.0 | 130.0 |
| | 117.7 | 140.5 | 140.1 | 133.4 | 131.1 | 118.2 | 127.3 | 128.8 | 124.4 | 135.5 | 129.7 |
| | 129.3 | 138.6 | 134.9 | 132.5 | 133.2 | 116.3 | 129.6 | 127.7 | 135.8 | 131.1 | 127.8 |
| | 132.7 | 136.4 | 136.2 | 134.0 | 133.0 | 122.2 | 127.3 | 125.3 | 131.8 | 130.3 | 127.9 |
| Mean of Control Group= | 126.0 | | | | | 121.7 | | | 128.8 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 6.5 | | | | | 4.4 | | | 5.5 | | |
| Std. Deviation of Mean of Control Group as % = | 5.1 | | | | | 3.6 | | | 4.2 | | |
| Mean of Exposed Group= | | 138.4 | 137.7 | 132.9 | 133.0 | | 128.7 | 128.0 | | 133.2 | 128.9 |
| Change in Exposed Mean from Control Mean= | | 12.4 | 11.7 | 6.9 | 7.0 | | 7.0 | 6.3 | | 4.4 | 0.1 |
| Percent change in Exposed Mean from Control Mean= | | 9.81 | 9.28 | 5.46 | 5.54 | | 5.75 | 5.16 | | 3.40 | 0.09 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | No | No | | Yes | Yes |




000311

2.13 MULLEN BURST STRENGTH

## 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 following observations were made regarding the percent changes in Mullen burst strength of the five geomembranes.

GSE-SLT Geomembrane. The percent changes in Mullen burst strength due to exposure were not within one standard deviation of the control means for any of the exposures except the 60-day exposure at 23°C. The percent change in property decreased with exposure time for exposures at both temperatures; however, this trend was contradicted between temperatures.

NSC Geomembrane. The percent changes in Mullen burst strength due to exposure were not within one standard deviation of the control means for any of the exposures except the 60-day exposure at 23°C, and the 90-day exposure at 50°C. The percent change in property decreased with exposure time for exposures at both temperatures; however, this trend was contradicted between temperatures.

GSE-Gundle Geomembrane. The percent changes in Mullen burst strength due to exposure were not within one standard deviation of the control means for any of the exposures except the 60-day exposure at 23°C, and the 60-day and the 120-day exposures at 50°C. The percent change in property decreased with exposure time for exposures at both temperatures; however, this trend was not consistent between temperatures.

PolyFlex Geomembrane. The percent changes in Mullen burst strength due to exposure were within one standard deviation of the control means for all of the exposures except the 30-day and the 120-day exposures at 23°C, and the 60-day

exposure at 50°C. The results exhibited randomness, and no consistent trends were observed for the change in property with exposure time or temperature.

Serrot Geomembrane. The percent changes in Mullen burst strength due to exposure were within one standard deviation of the control means for all of the exposures except the 90-day and the 120-day exposures at 23°C and 50°C. The percent change in property decreased with exposure time for exposures at both temperatures; however, this trend was not consistent between temperatures.

*Conclusion*

The means of the percent changes in Mullen burst strength were less than one standard deviation of the control means for at least 5 out of 8 exposures for the Polyflex geomembrane. Trends were observed with exposure time for GSE-SLT, NSC, GSE-Gundle and Serrot geomembranes; however, these trends were not consistent with the trends that were exhibited with temperature. Therefore, no detrimental effects are expected to the tested property due to exposure to the leachate.

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

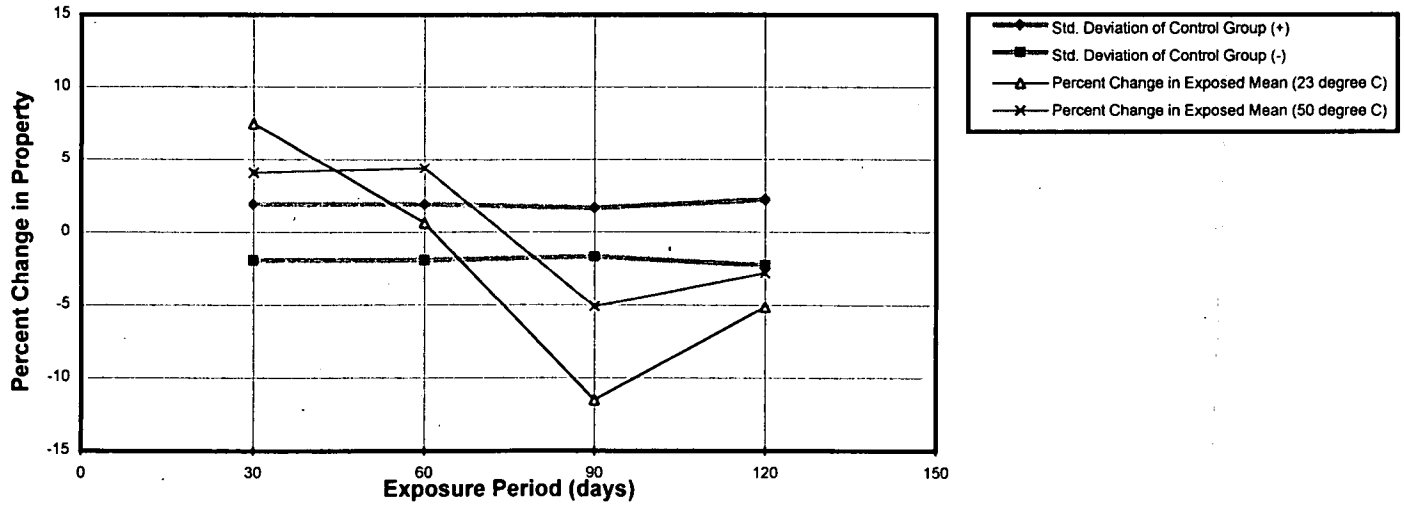
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D3786*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-SLT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** MULLEN BURST STRENGTH (psi)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 660.0 | 680.0 | 670.0 | 640.0 | 660.0 | 700.0 | 610.0 | 660.0 | 660.0 | 620.0 | 630.0 |
| | 640.0 | 680.0 | 650.0 | 650.0 | 680.0 | 690.0 | 615.0 | 660.0 | 635.0 | 580.0 | 640.0 |
| | 630.0 | 700.0 | 670.0 | 640.0 | 670.0 | 680.0 | 620.0 | 645.0 | 630.0 | 590.0 | 620.0 |
| | 640.0 | 680.0 | 670.0 | 640.0 | 670.0 | 670.0 | 600.0 | 650.0 | 630.0 | 630.0 | 610.0 |
| | 630.0 | 700.0 | 670.0 | 650.0 | 660.0 | 690.0 | 590.0 | 640.0 | 655.0 | 625.0 | 620.0 |
| Mean of Control Group= | 640.0 | | | | | 686.0 | | | 642.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 12.2 | | | | | 11.4 | | | 14.4 | | |
| Std. Deviation of Mean of Control Group as % = | 1.9 | | | | | 1.7 | | | 2.2 | | |
| Mean of Exposed Group= | | 688.0 | 666.0 | 644.0 | 668.0 | | 607.0 | 651.0 | | 609.0 | 624.0 |
| Change in Exposed Mean from Control Mean= | | 48.0 | 26.0 | 4.0 | 28.0 | | -79.0 | -35.0 | | -33.0 | -18.0 |
| Percent change in Exposed Mean from Control Mean= | | 7.50 | 4.06 | 0.63 | 4.38 | | -11.52 | -5.10 | | -5.14 | -2.80 |
| Is change less than one Std. Deviation of Control Group? | | No | No | Yes | No | | No | No | | No | No |




000311

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

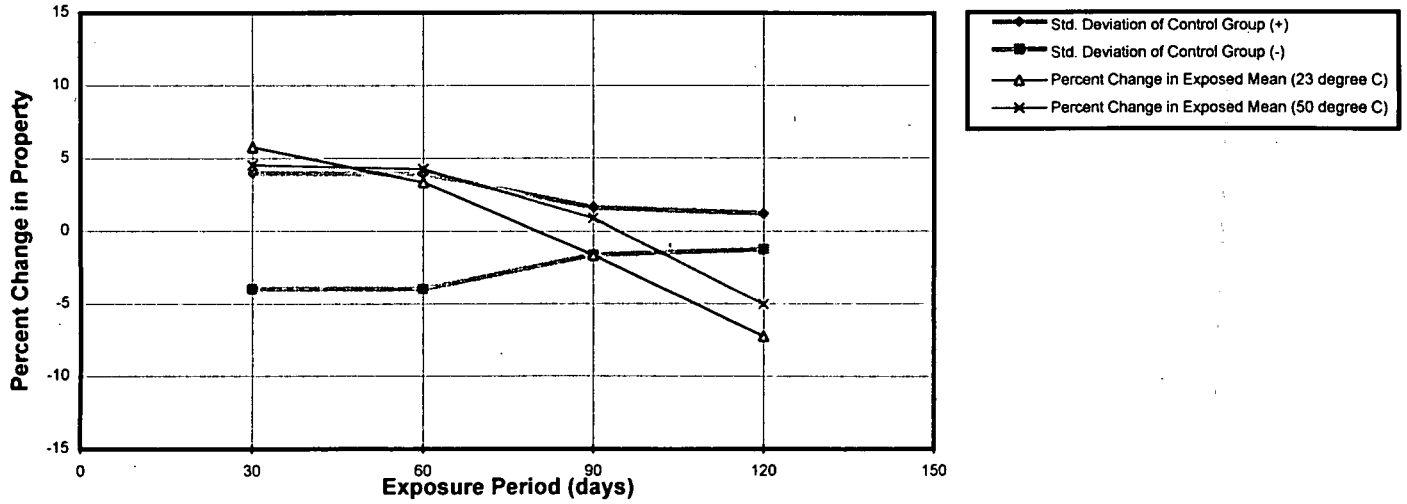
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D3786*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *NSC*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** MULLEN BURST STRENGTH (psi)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 650.0 | 690.0 | 690.0 | 690.0 | 680.0 | 670.0 | 670.0 | 690.0 | 675.0 | 650.0 | 660.0 |
| | 700.0 | 690.0 | 670.0 | 680.0 | 680.0 | 660.0 | 645.0 | 680.0 | 670.0 | 610.0 | 645.0 |
| | 650.0 | 690.0 | 690.0 | 670.0 | 680.0 | 670.0 | 670.0 | 665.0 | 670.0 | 625.0 | 640.0 |
| | 630.0 | 700.0 | 690.0 | 680.0 | 690.0 | 690.0 | 660.0 | 665.0 | 690.0 | 610.0 | 620.0 |
| | 650.0 | 700.0 | 690.0 | 670.0 | 690.0 | 670.0 | 660.0 | 690.0 | 680.0 | 645.0 | 650.0 |
| Mean of Control Group= | 656.0 | | | | | 672.0 | | | 677.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 26.1 | | | | | 11.0 | | | 8.4 | | |
| Std. Deviation of Mean of Control Group as % = | 4.0 | | | | | 1.6 | | | 1.2 | | |
| Mean of Exposed Group= | | 694.0 | 686.0 | 678.0 | 684.0 | | 661.0 | 678.0 | | 628.0 | 643.0 |
| Change in Exposed Mean from Control Mean= | | 38.0 | 30.0 | 22.0 | 28.0 | | -11.0 | 6.0 | | -49.0 | -34.0 |
| Percent change in Exposed Mean from Control Mean= | | 5.79 | 4.57 | 3.35 | 4.27 | | -1.64 | 0.89 | | -7.24 | -5.02 |
| Is change less than one Std. Deviation of Control Group? | | No | No | Yes | No | | No | Yes | | No | No |




000315

902

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

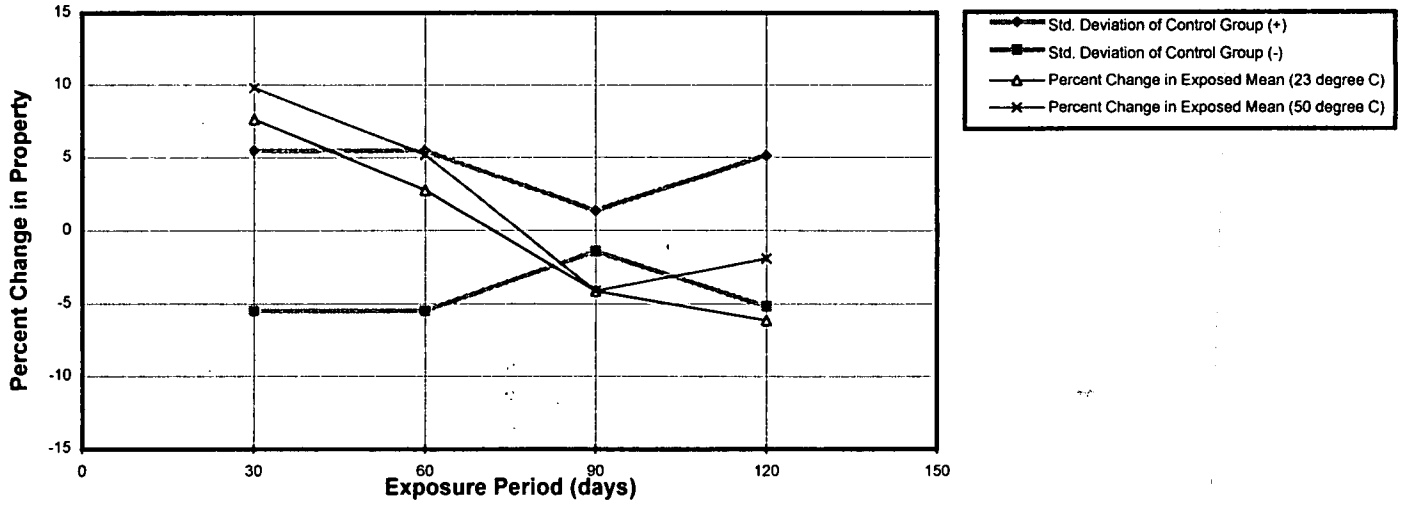
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D3786*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *GSE-Gundle*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** MULLEN BURST STRENGTH (psi)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 600.0 | 700.0 | 720.0 | 650.0 | 680.0 | 715.0 | 680.0 | 655.0 | 740.0 | 665.0 | 660.0 |
| | 690.0 | 700.0 | 710.0 | 680.0 | 690.0 | 700.0 | 675.0 | 690.0 | 660.0 | 650.0 | 660.0 |
| | 640.0 | 710.0 | 720.0 | 690.0 | 690.0 | 710.0 | 665.0 | 690.0 | 695.0 | 635.0 | 670.0 |
| | 680.0 | 710.0 | 730.0 | 680.0 | 690.0 | 690.0 | 680.0 | 665.0 | 650.0 | 630.0 | 680.0 |
| | 660.0 | 700.0 | 710.0 | 660.0 | 690.0 | 700.0 | 670.0 | 670.0 | 680.0 | 635.0 | 690.0 |
| Mean of Control Group= | 654.0 | | | | | 703.0 | | | 685.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 35.8 | | | | | 9.7 | | | 35.4 | | |
| Std. Deviation of Mean of Control Group as % = | 5.5 | | | | | 1.4 | | | 5.2 | | |
| Mean of Exposed Group= | | 704.0 | 718.0 | 672.0 | 688.0 | | 674.0 | 674.0 | | 643.0 | 672.0 |
| Change in Exposed Mean from Control Mean= | | 50.0 | 64.0 | 18.0 | 34.0 | | -29.0 | -29.0 | | -42.0 | -13.0 |
| Percent change in Exposed Mean from Control Mean= | | 7.65 | 9.79 | 2.75 | 5.20 | | -4.13 | -4.13 | | -6.13 | -1.90 |
| Is change less than one Std. Deviation of Control Group? | | No | No | Yes | Yes | | No | No | | No | Yes |




000316

706

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

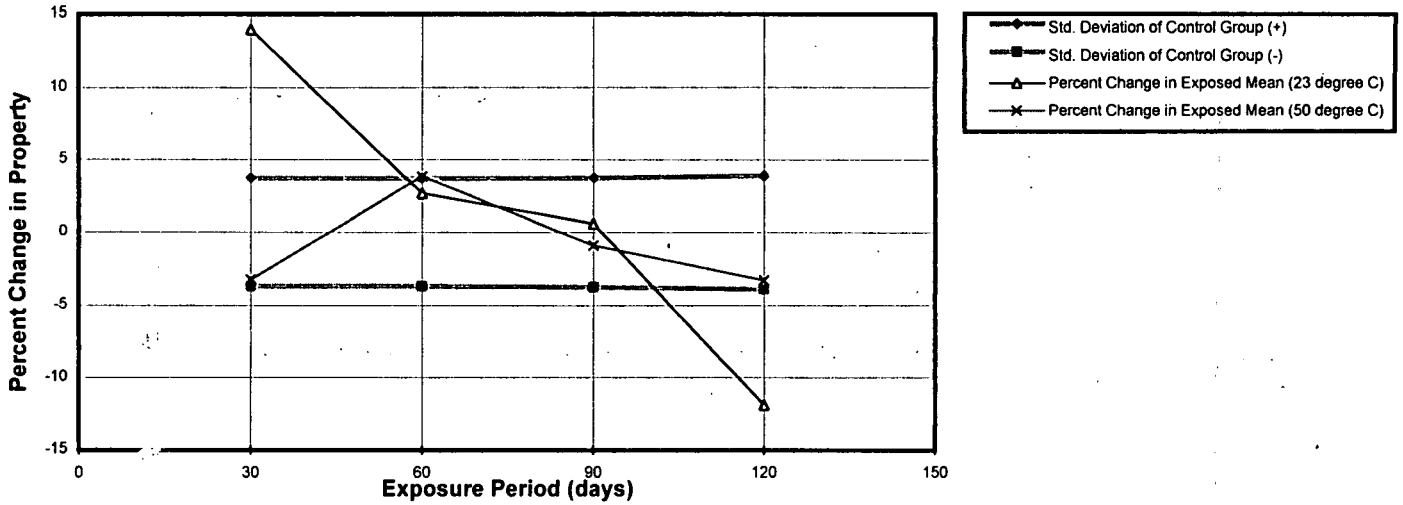
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D3786*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *POLYFLEX*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** MULLEN BURST STRENGTH (psi)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 710.0 | 760.0 | 650.0 | 700.0 | 700.0 | 630.0 | 670.0 | 700.0 | 690.0 | 615.0 | 645.0 |
| | 660.0 | 750.0 | 670.0 | 690.0 | 680.0 | 680.0 | 660.0 | 650.0 | 700.0 | 610.0 | 665.0 |
| | 690.0 | 790.0 | 660.0 | 680.0 | 680.0 | 640.0 | 690.0 | 600.0 | 730.0 | 610.0 | 700.0 |
| | 660.0 | 770.0 | 640.0 | 690.0 | 690.0 | 680.0 | 660.0 | 650.0 | 720.0 | 620.0 | 720.0 |
| | 650.0 | 770.0 | 640.0 | 700.0 | 750.0 | 680.0 | 650.0 | 680.0 | 660.0 | 630.0 | 655.0 |
| Mean of Control Group= | 674.0 | | | | | 662.0 | | | 700.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 25.1 | | | | | 24.9 | | | 27.4 | | |
| Std. Deviation of Mean of Control Group as % = | 3.7 | | | | | 3.8 | | | 3.9 | | |
| Mean of Exposed Group= | | 768.0 | 652.0 | 692.0 | 700.0 | | 666.0 | 656.0 | | 617.0 | 677.0 |
| Change in Exposed Mean from Control Mean= | | 94.0 | -22.0 | 18.0 | 26.0 | | 4.0 | -6.0 | | -83.0 | -23.0 |
| Percent change in Exposed Mean from Control Mean= | | 13.95 | -3.26 | 2.67 | 3.86 | | 0.60 | -0.91 | | -11.86 | -3.29 |
| Is change less than one Std. Deviation of Control Group? | | No | Yes | Yes | No | | Yes | Yes | | No | Yes |




000312

906

**GEOSYNTEC CONSULTANTS**
Materials Testing Laboratory

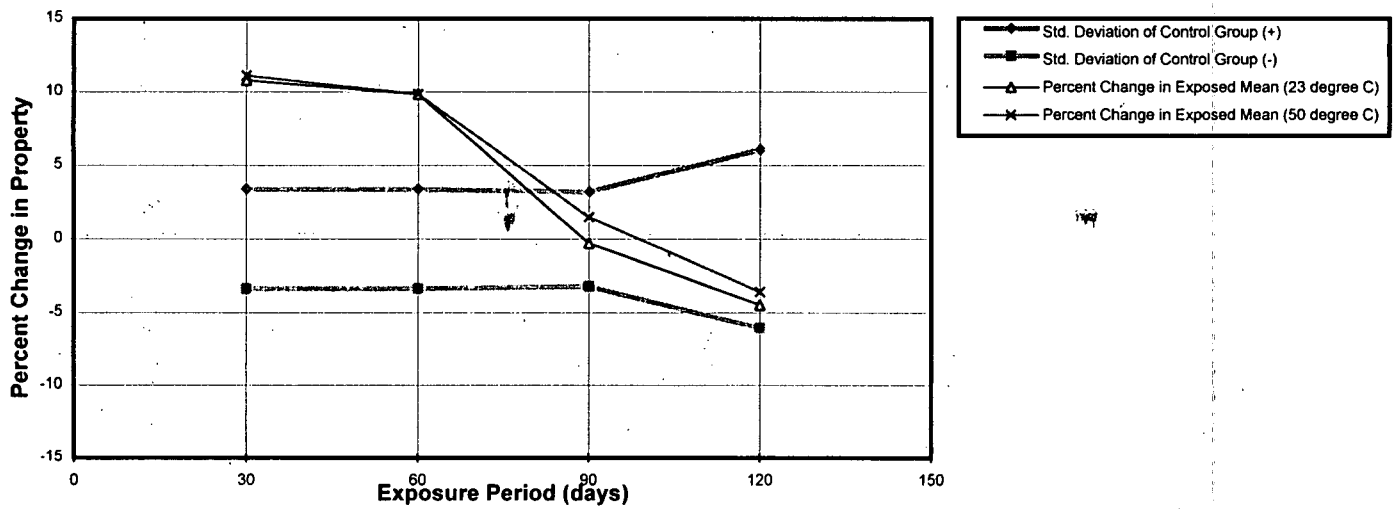
# CHEMICAL COMPATIBILITY TEST RESULTS

***CLIENT:*** *FERMCO*
***METHOD:*** *ASTM D3786*
***DATE TESTED:*** *6/14/96*

***GEOSYNTEC JOB NO.:*** *GE3900*
***MATERIAL TYPE:*** *SERROT*
***CHARACTERISTICS:*** *80 mil HDPE Geomembrane*
***IMMERSION MEDIUM:*** *Perched Ground Water*

**PROPERTY (UNIT):** MULLEN BURST STRENGTH (psi)
**DIRECTION:** N/A

| | Control Group for 30 and 60-day Exposures | 30-day | | 60-day | | 90-day | | | 120-day | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Exposed Group @ 23°C | Exposed Group @ 50°C | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C | Control Group | Exposed Group @ 23°C | Exposed Group @ 50°C |
| | 640.0 | 700.0 | 700.0 | 690.0 | 690.0 | 680.0 | 660.0 | 690.0 | 610.0 | 640.0 | 640.0 |
| | 630.0 | 690.0 | 710.0 | 690.0 | 690.0 | 650.0 | 650.0 | 680.0 | 700.0 | 645.0 | 645.0 |
| | 610.0 | 700.0 | 700.0 | 690.0 | 690.0 | 680.0 | 680.0 | 680.0 | 710.0 | 640.0 | 655.0 |
| | 610.0 | 710.0 | 700.0 | 700.0 | 700.0 | 650.0 | 680.0 | 670.0 | 650.0 | 640.0 | 655.0 |
| | 660.0 | 690.0 | 690.0 | 690.0 | 690.0 | 700.0 | 680.0 | 690.0 | 680.0 | 635.0 | 635.0 |
| Mean of Control Group= | 630.0 | | | | | 672.0 | | | 670.0 | | |
| Std. Deviation of Mean of Control Group (+/-)= | 21.2 | | | | | 21.7 | | | 40.6 | | |
| Std. Deviation of Mean of Control Group as % = | 3.4 | | | | | 3.2 | | | 6.1 | | |
| Mean of Exposed Group= | | 698.0 | 700.0 | 692.0 | 692.0 | | 670.0 | 682.0 | | 640.0 | 646.0 |
| Change in Exposed Mean from Control Mean= | | 68.0 | 70.0 | 62.0 | 62.0 | | -2.0 | 10.0 | | -30.0 | -24.0 |
| Percent change in Exposed Mean from Control Mean= | | 10.79 | 11.11 | 9.84 | 9.84 | | -0.30 | 1.49 | | -4.48 | -3.58 |
| Is change less than one Std. Deviation of Control Group? | | No | No | No | No | | Yes | Yes | | Yes | Yes |




000315

# APPENDIX C

# APPENDIX C

# RESIN AND ROLL CERTIFICATIONS

# 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. O. Hrn

| 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 |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |
| | | / | | | | | | | | | | | | | | |

000320

706

**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: DKDB-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

706

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 | |
| *BREAK 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 1/16/96 #8 QA

CUSTOMER:
JOB NO.
COMMENTS

DATE SHIPPED

20061118

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 713-647-3885 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 MMA #22 1/10/96 QA

706

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 Bayport Road, Deer Park, Texas 77536 Mailing Address: P.O. Box 1000, Deer Park, Texas 77536-1000 1-800-[illegible] Fax 713 476 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

000329

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 | 0.6 | 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

# APPENDIX D

## FOURIER-TRANSFORM INFRARED SURFACE ANALYSIS RESULTS

**Part I:** Rationale, Results and Discussions, and Conclusions

**Part II:** Fourier-Transform Infrared Spectra

# Part I: Rationale, Results and Discussions, and Conclusions

# 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.

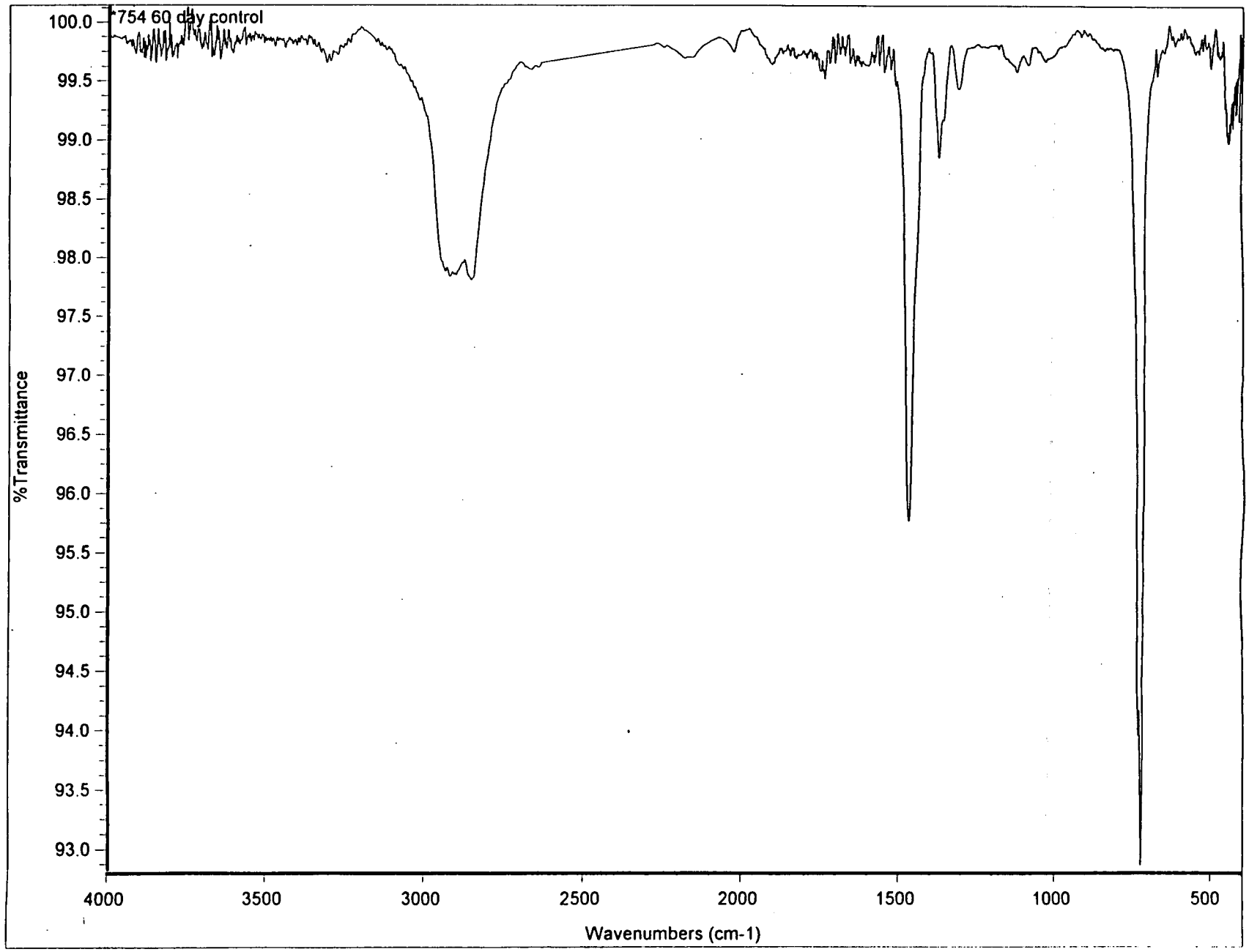
# Part II: Fourier-Transform Infrared Spectra

# 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:

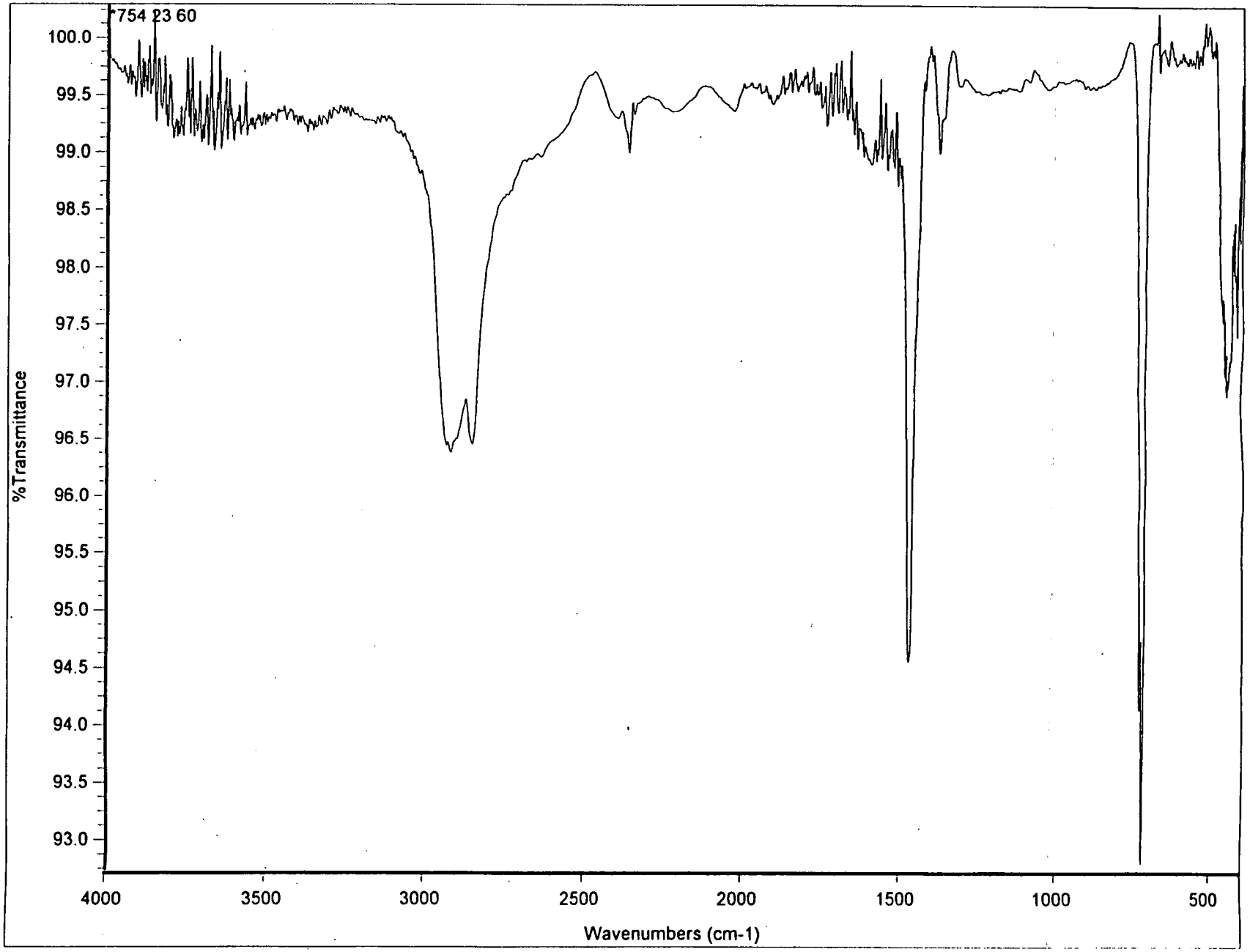
- 754 = GSE-SLT;
- 755 = NSC;
- 756 = GSE Gundle;
- 757 = POLYFLEX;
- 758 = SERROT;
- 60 = 60-day exposure test;
- 120 = 120-day exposure test;
- 23 = Exposure at 23°C;
- 50 = Exposure at 50°C; and
- Control = control.



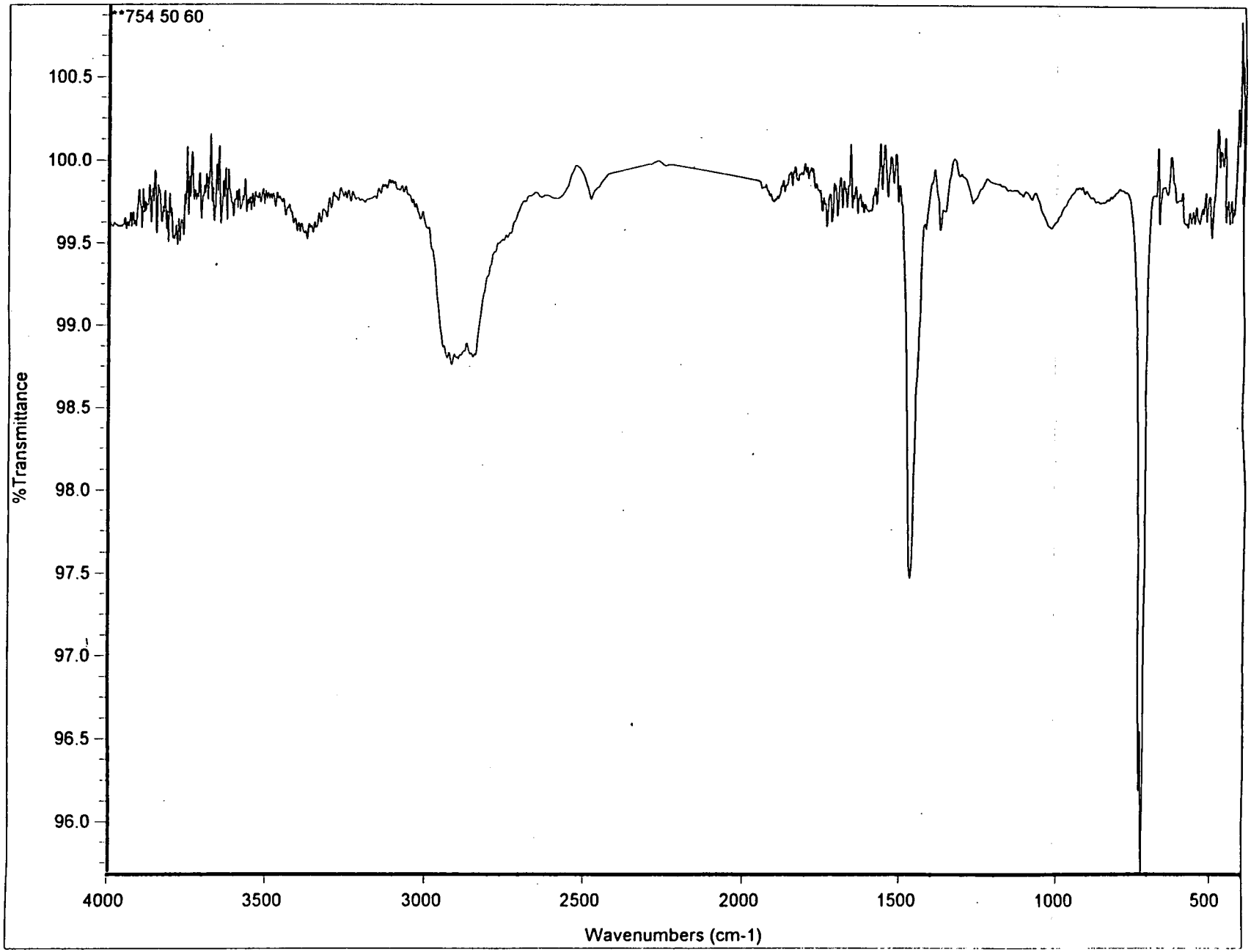

GeoSyntec Consultants

000338

906



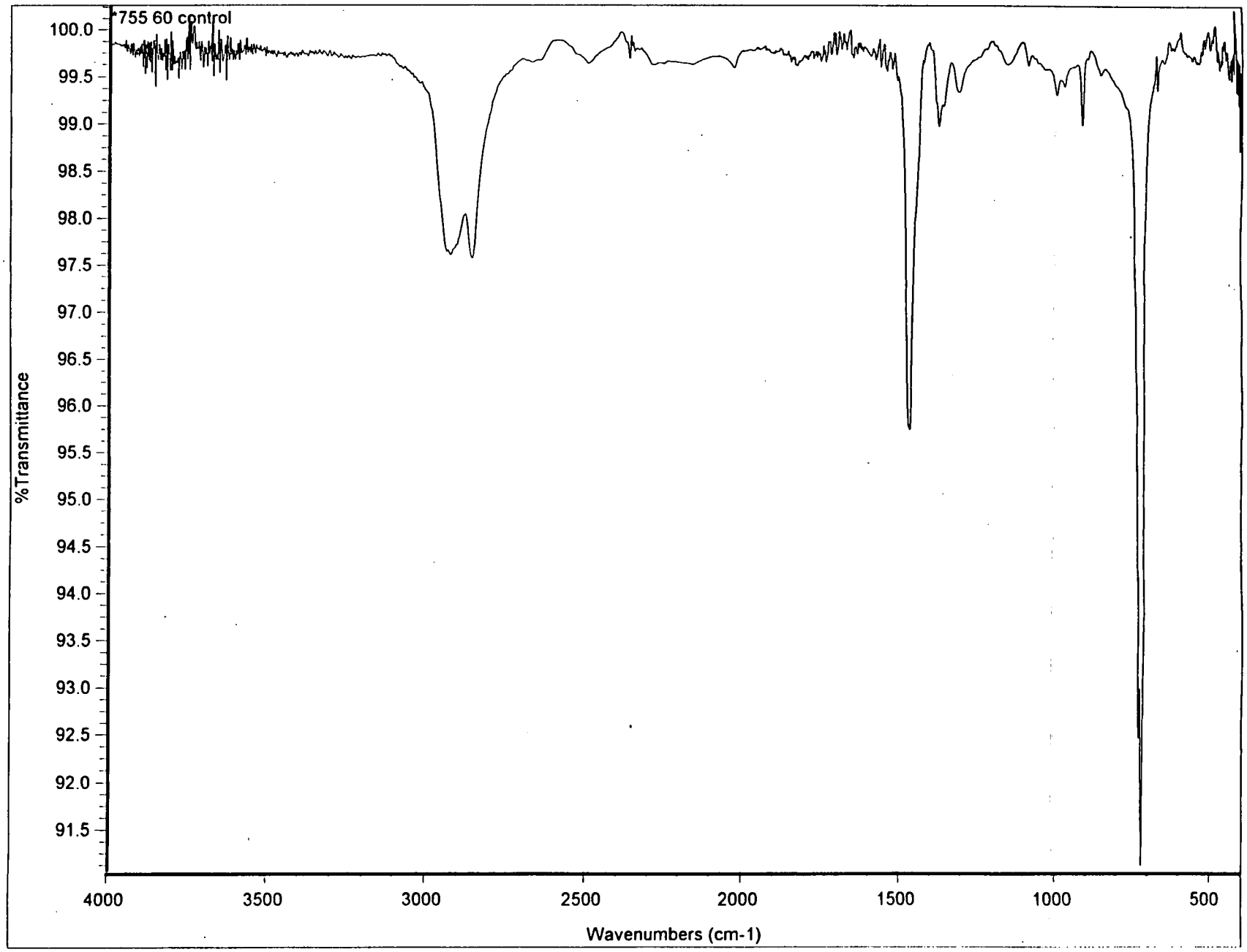

GeoSyntec Consultants




GeoSyntec Consultants



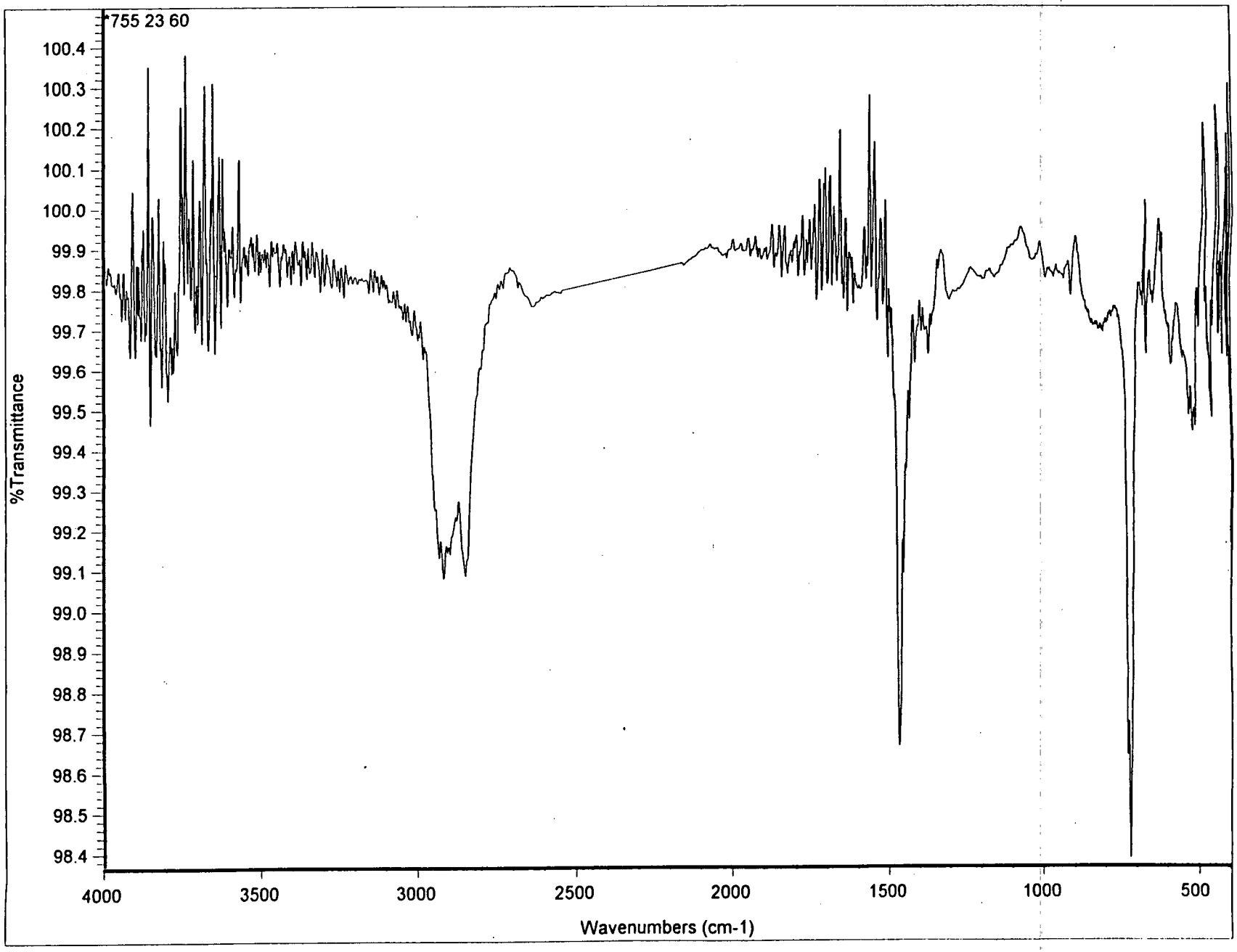
000340




GeoSyntec Consultants



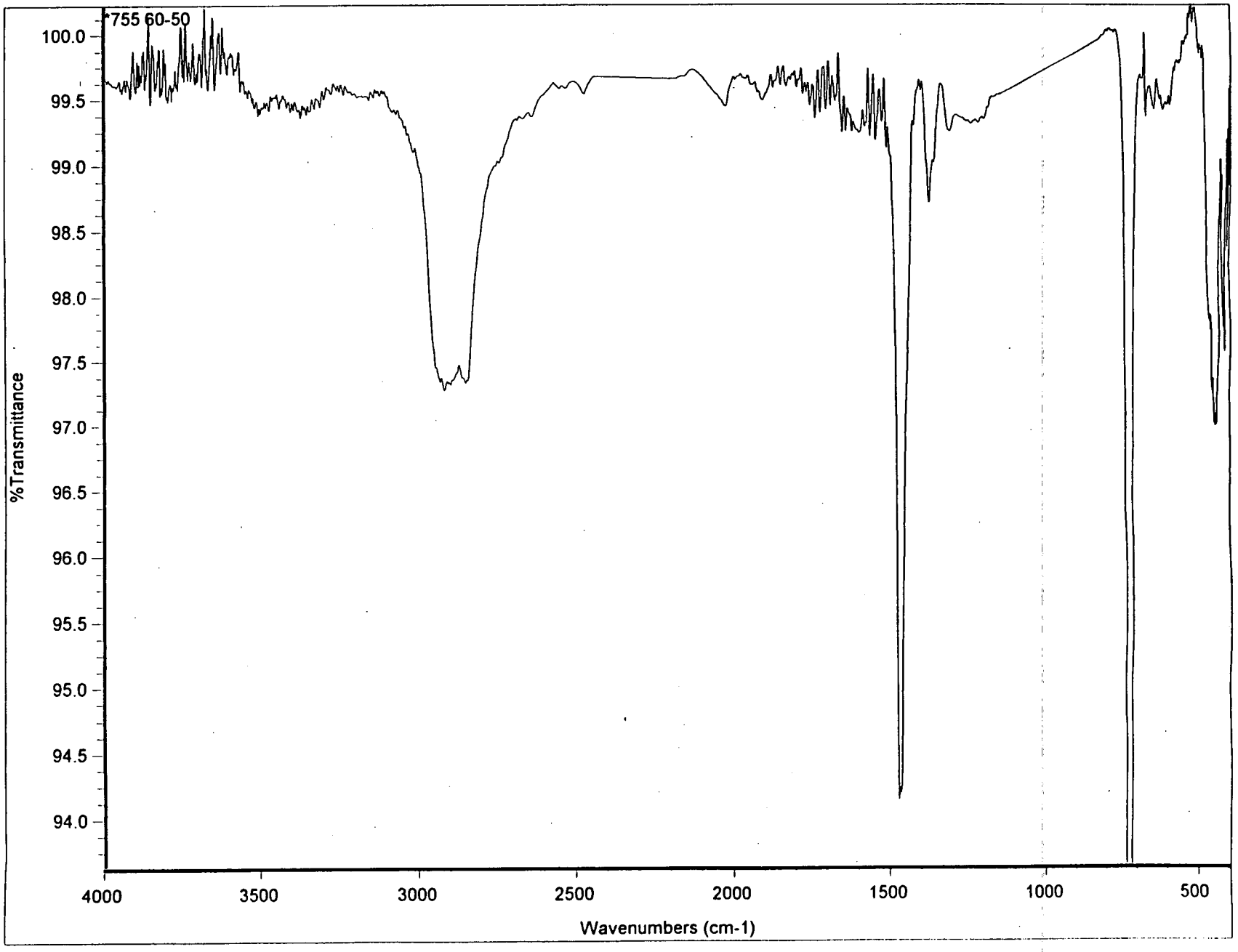
000341



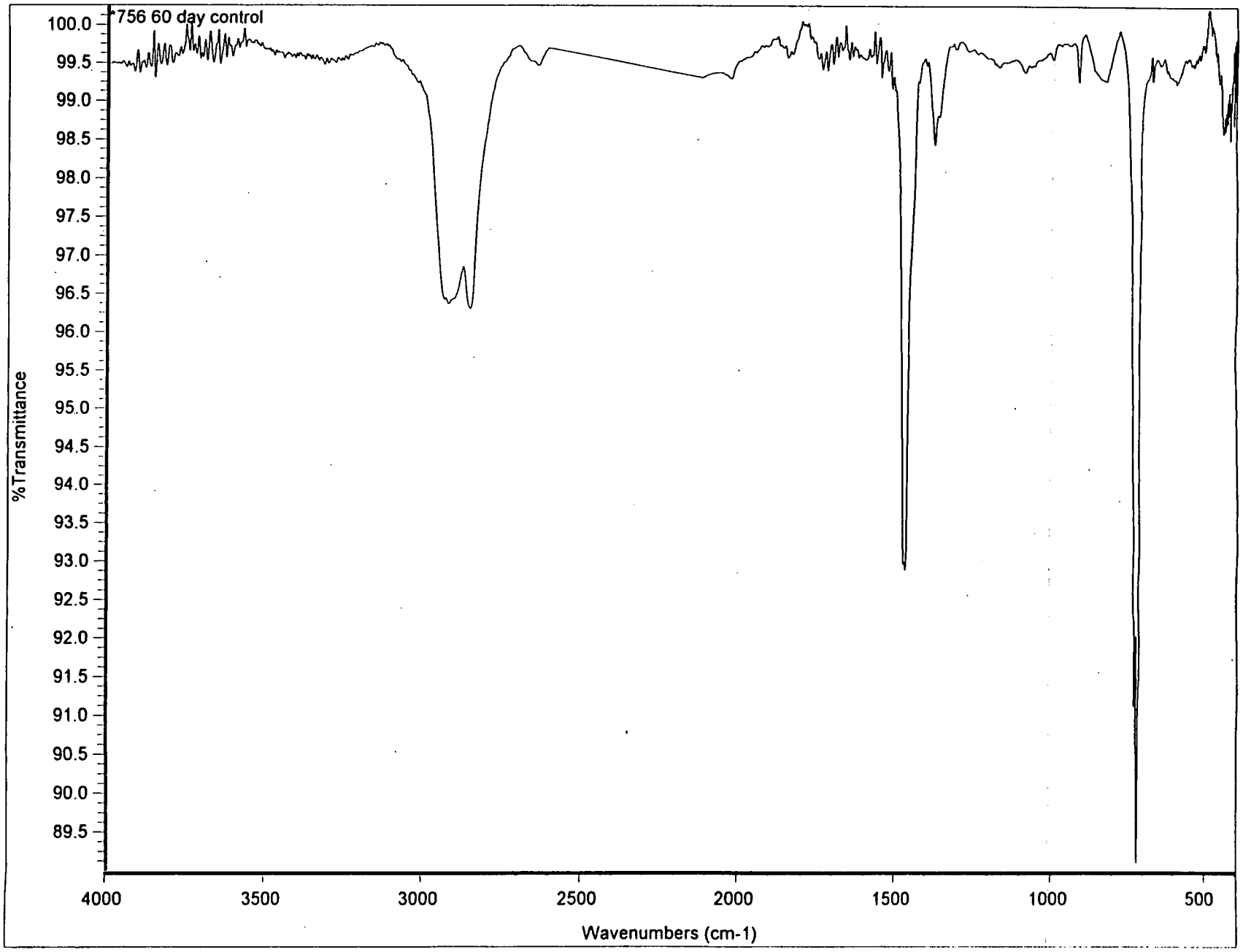

GeoSyntec Consultants



000342



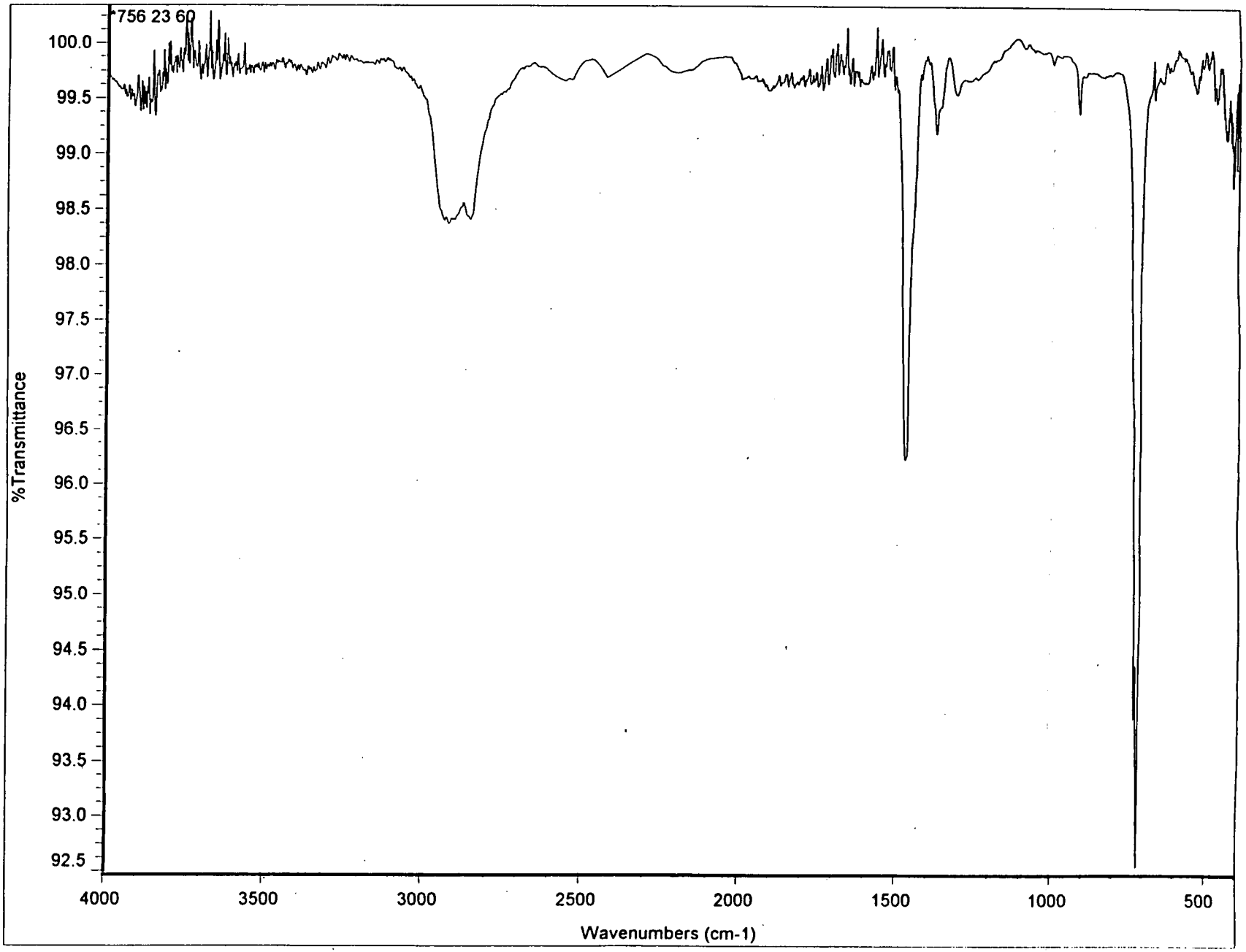

GeoSyntec Consultants



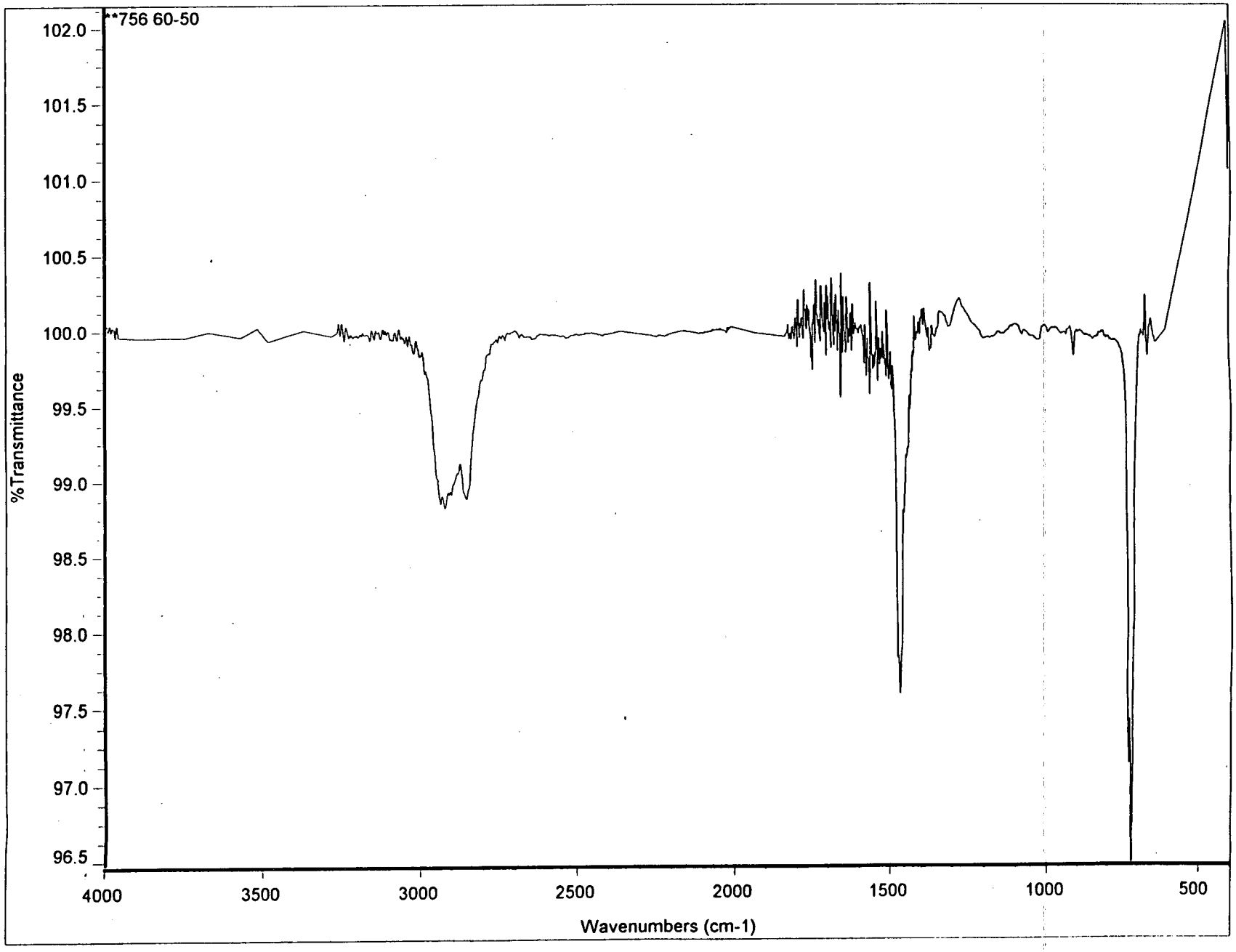

GeoSyntec Consultants



000341



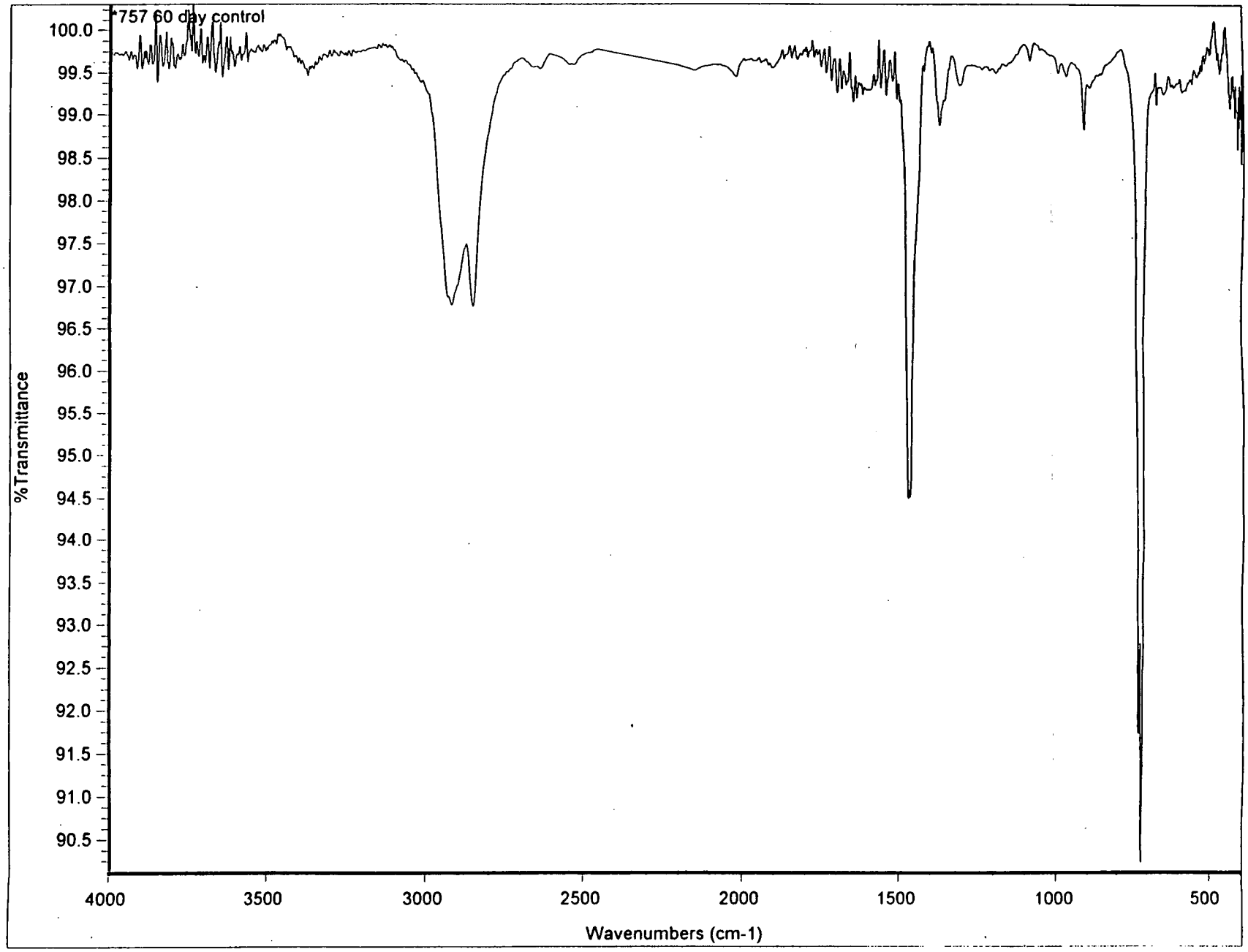

GeoSyntec Consultants



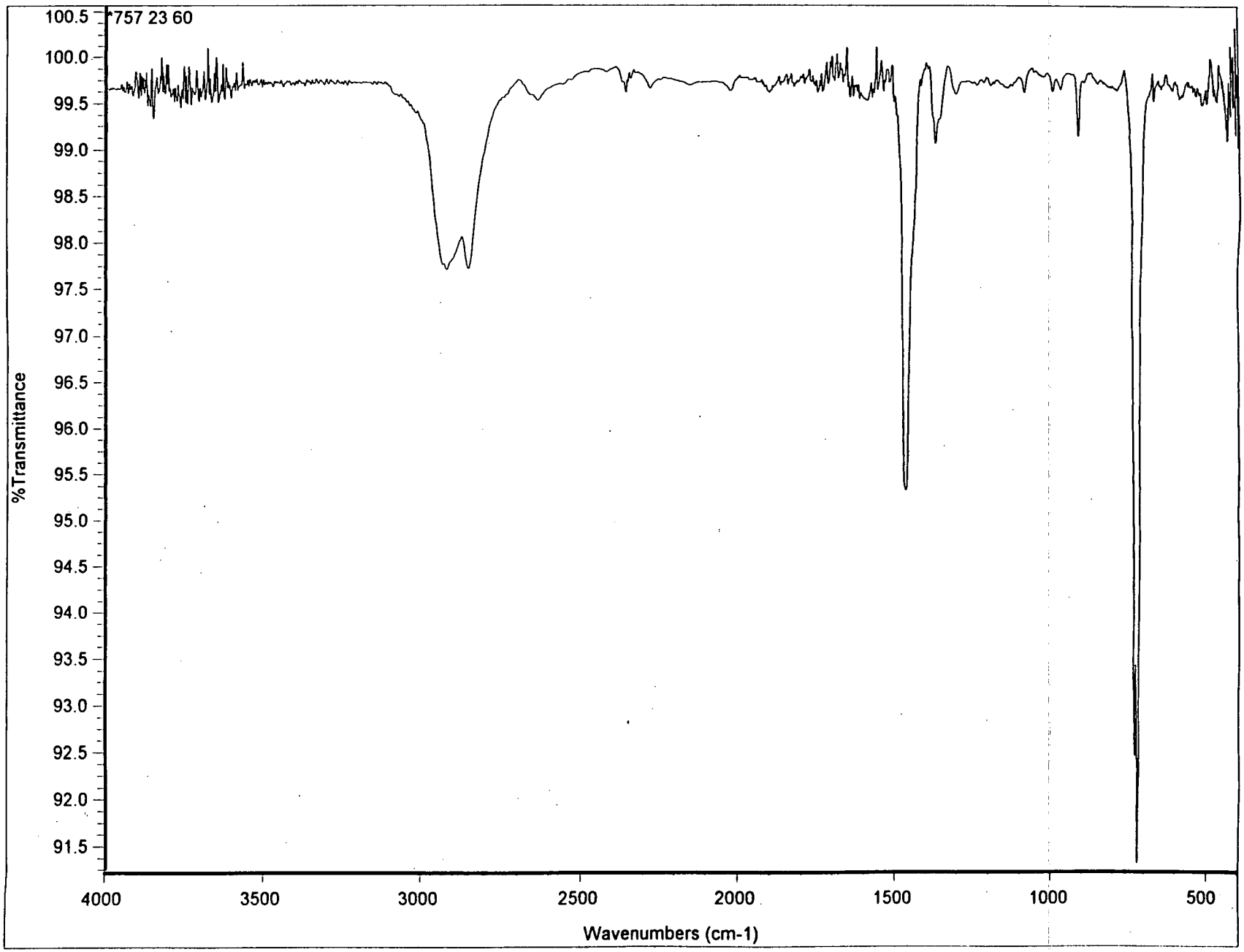

GeoSyntec Consultants

000346

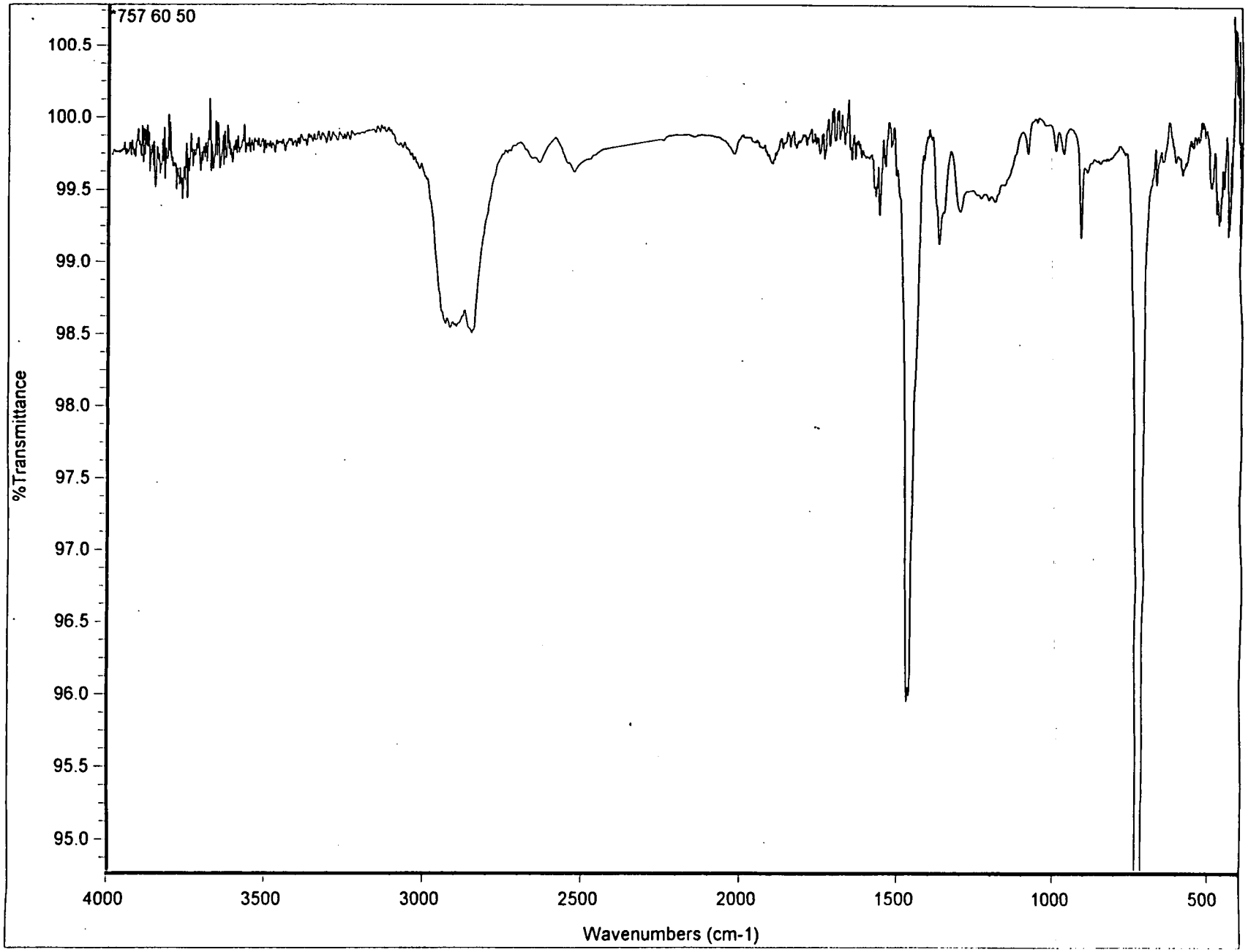
706




GeoSyntec Consultants



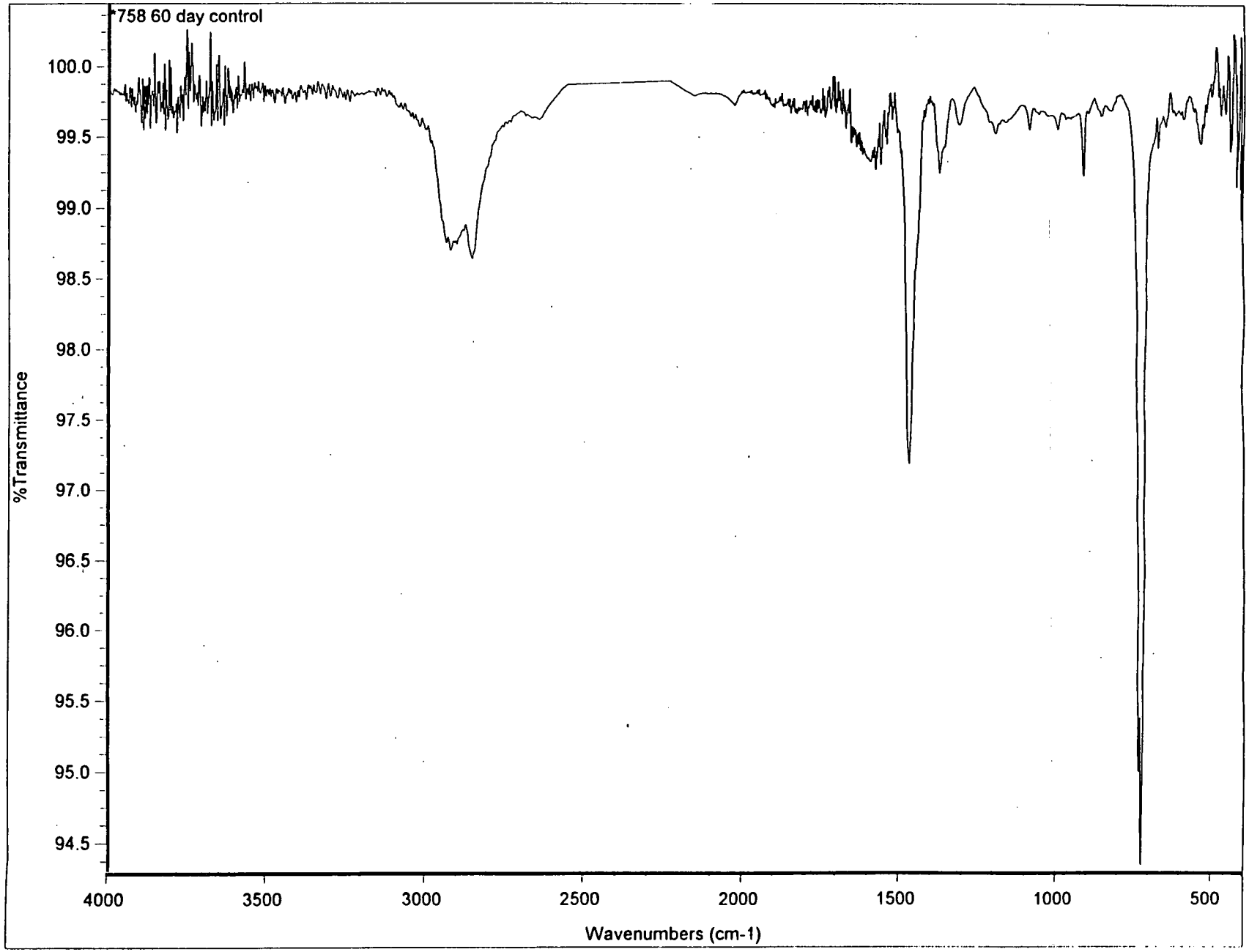

GeoSyntec Consultants



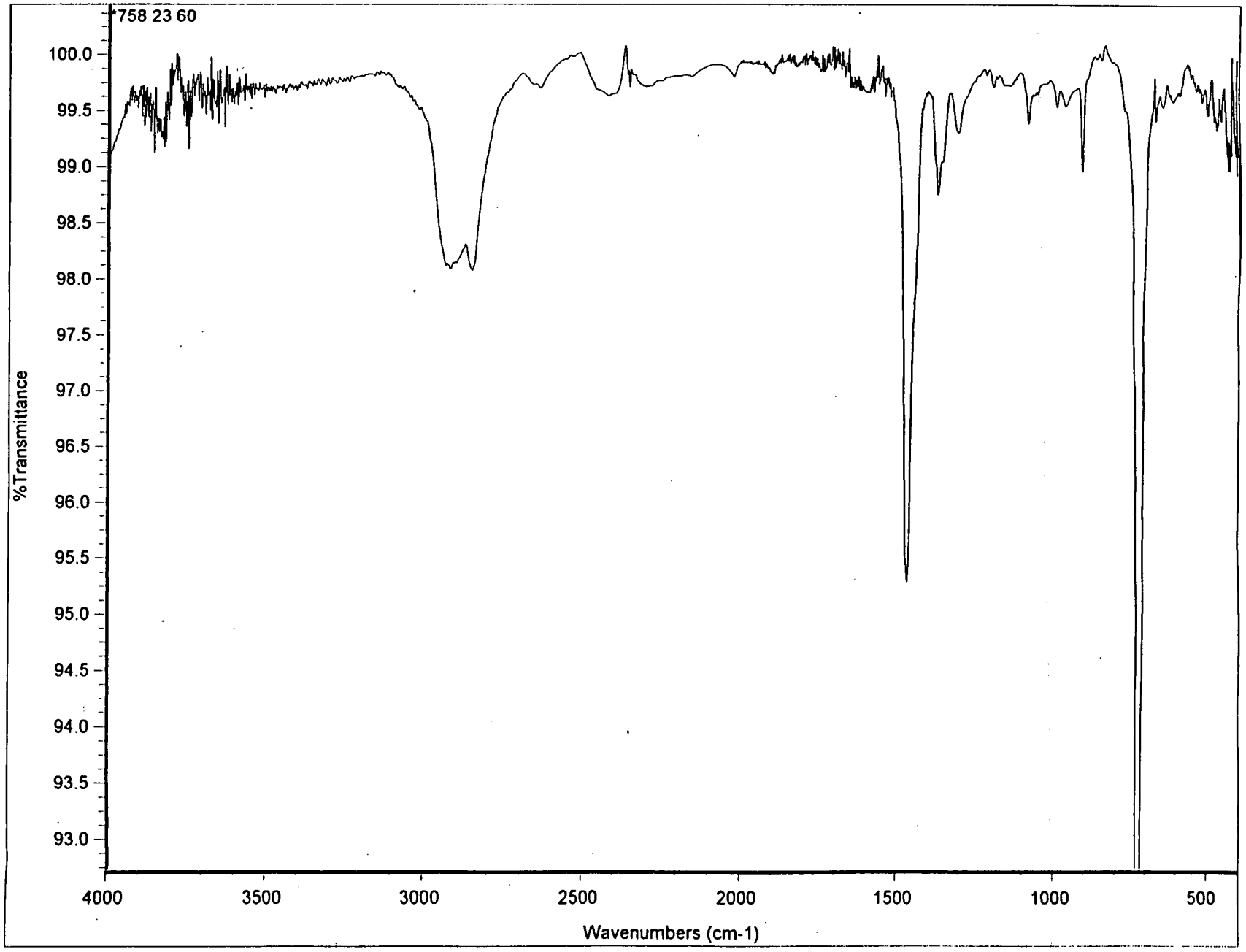

GeoSyntec Consultants

000349

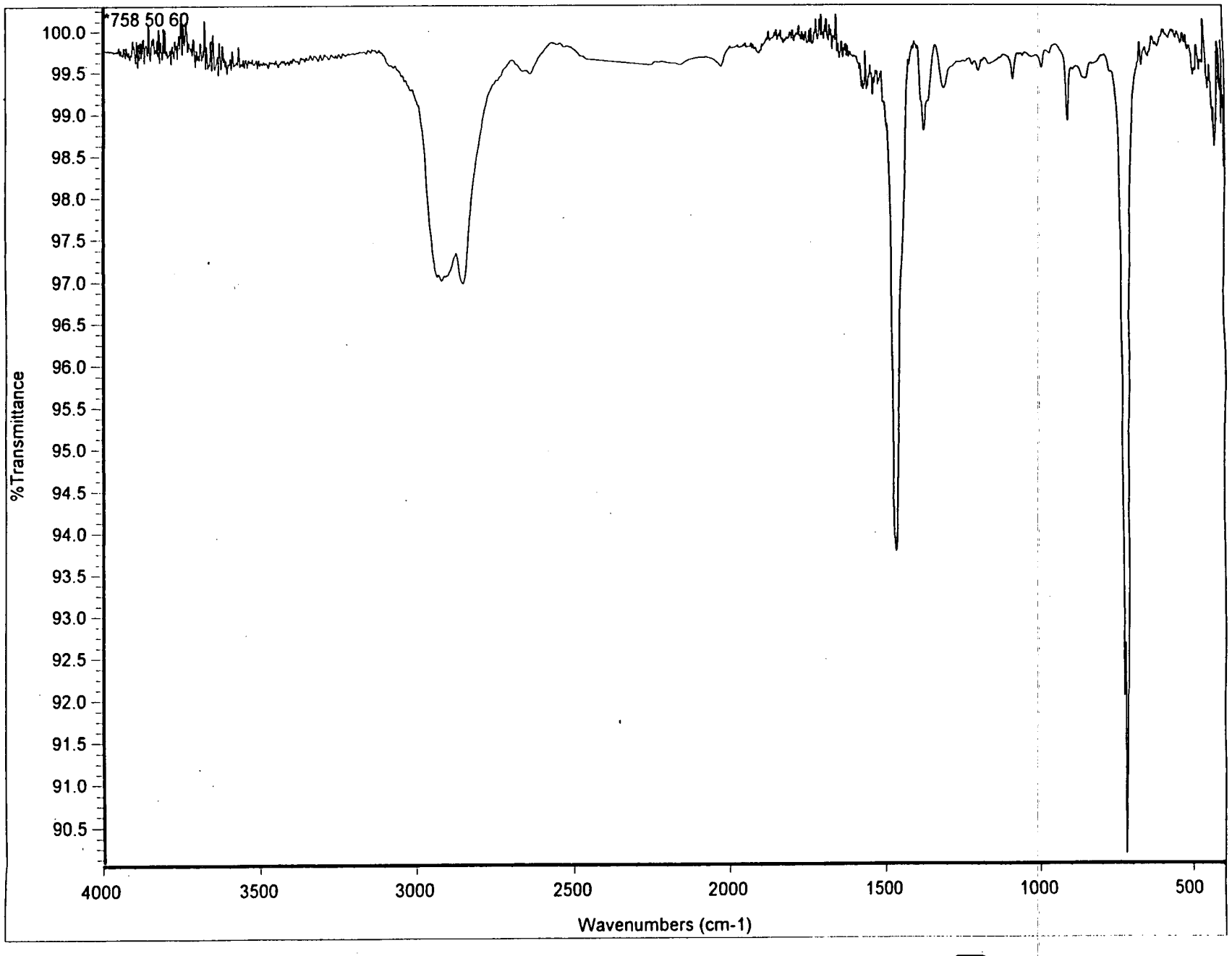
902



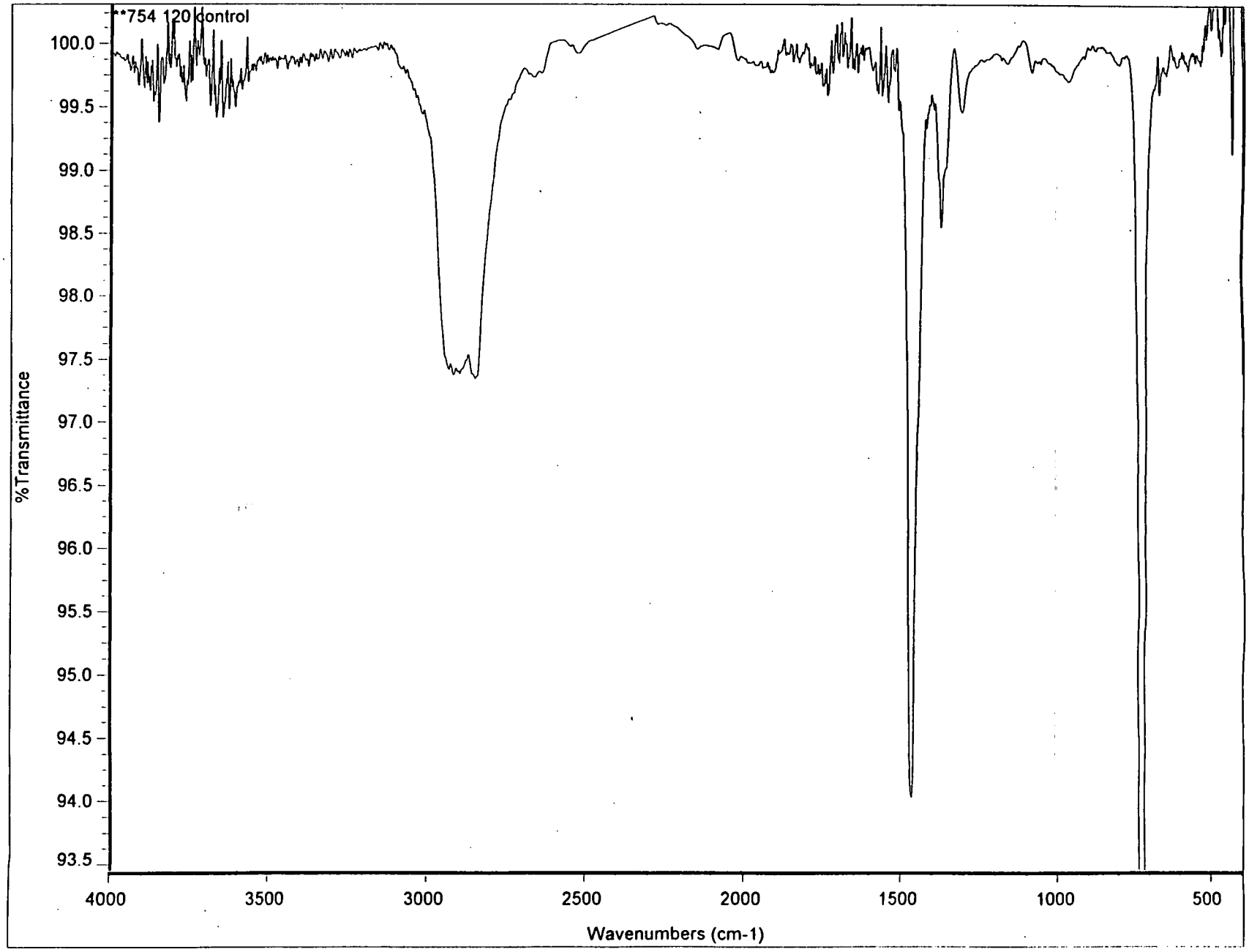

GeoSyntec Consultants



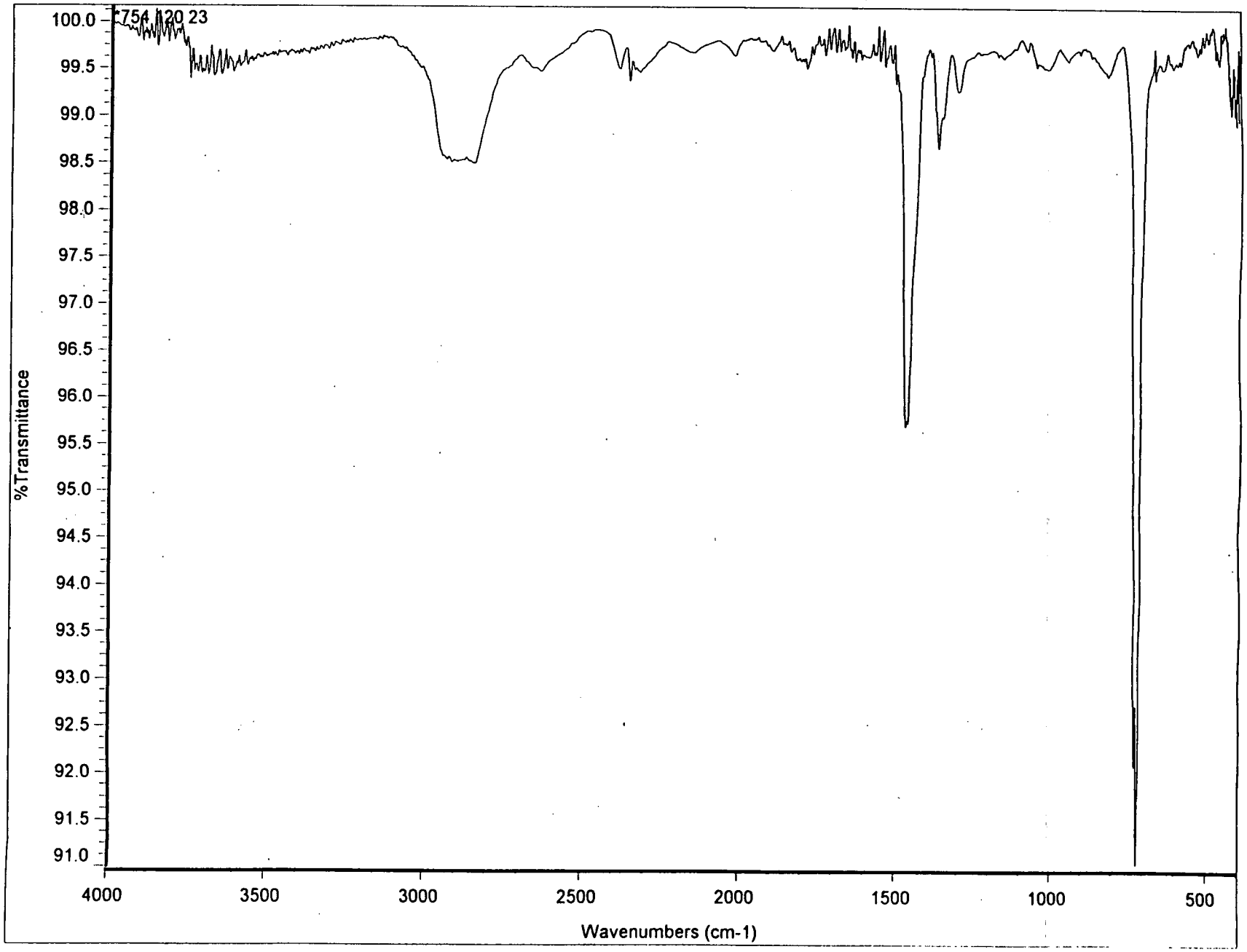

GeoSyntec Consultants



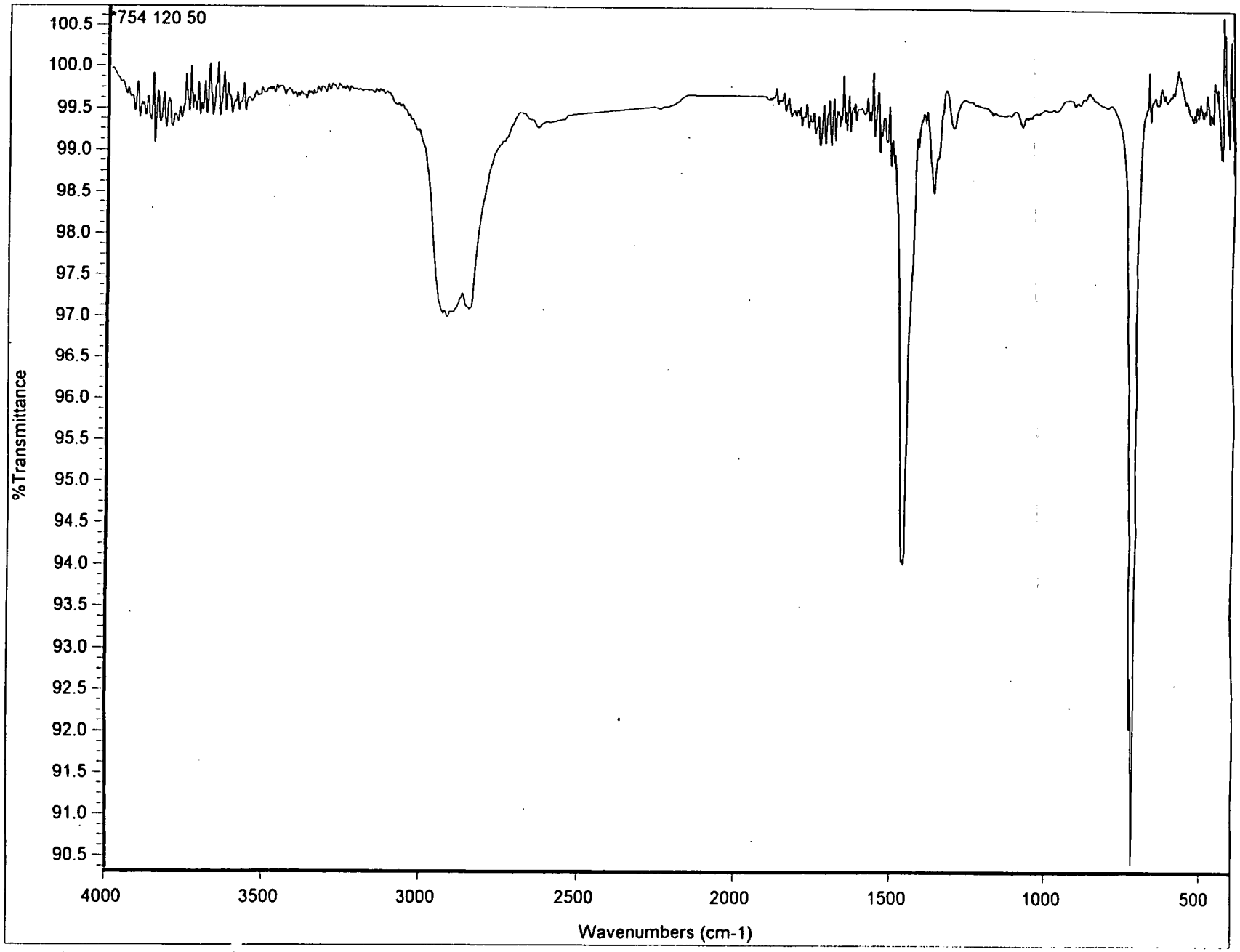

GeoSyntec Consultants



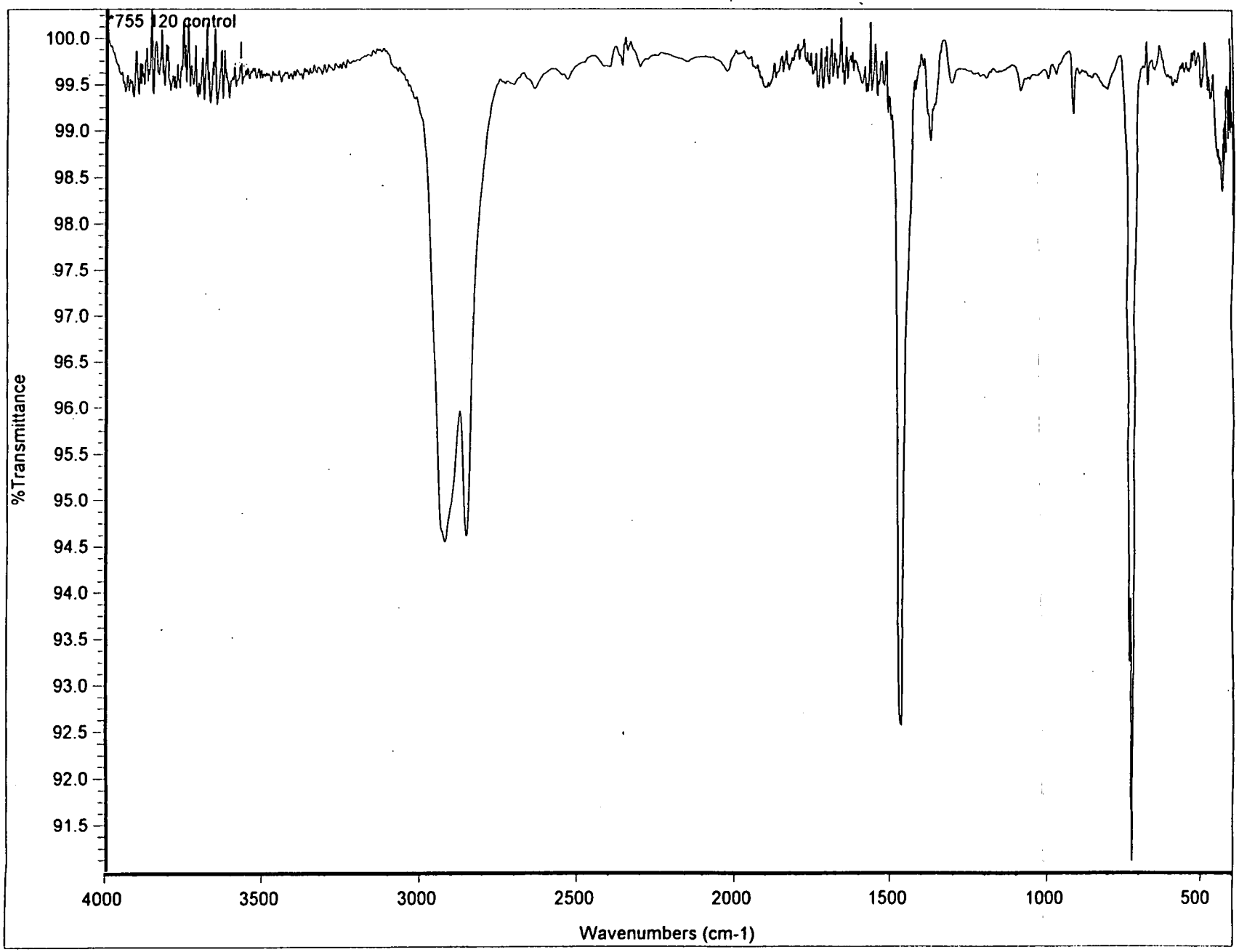

GeoSyntec Consultants




GeoSyntec Consultants



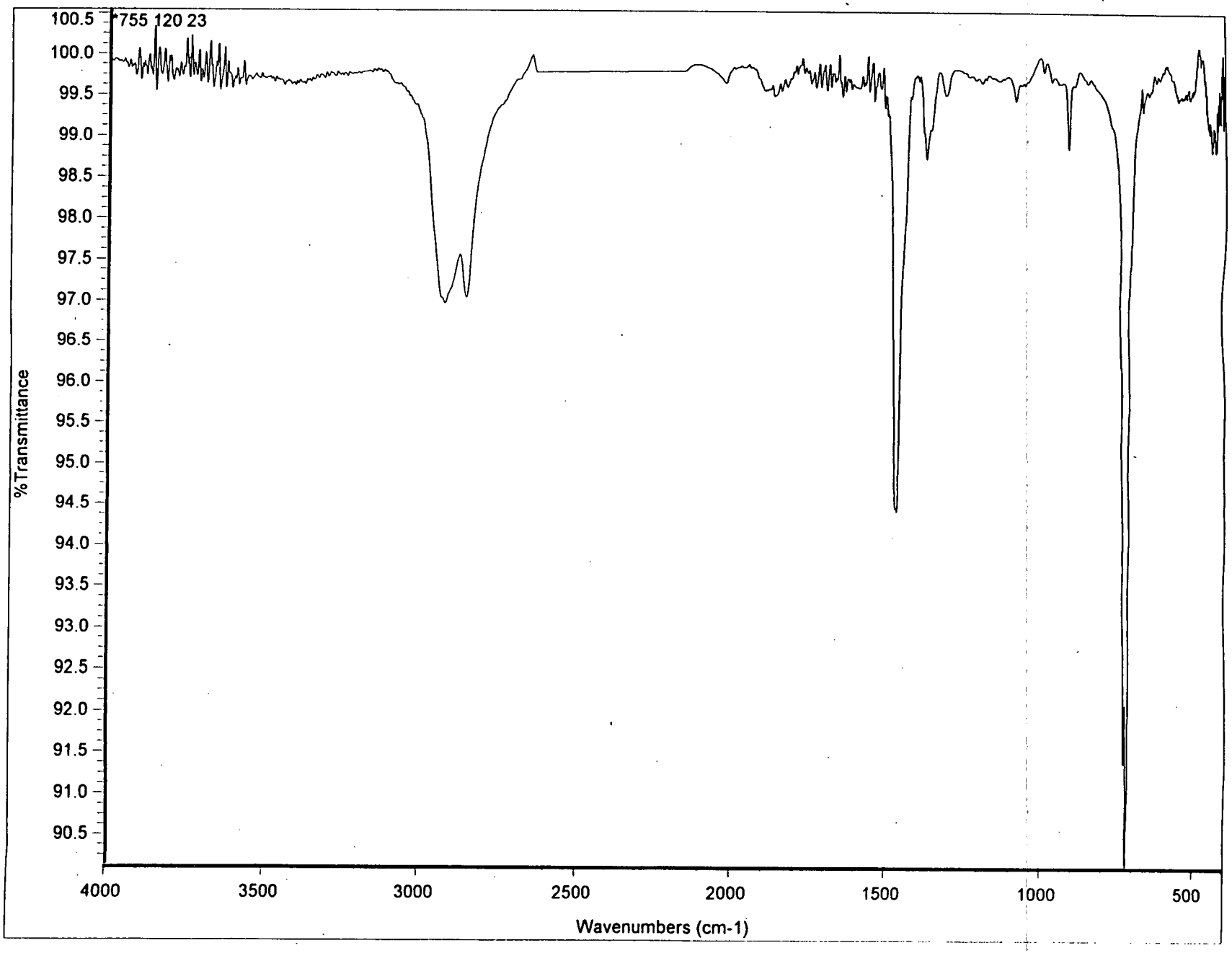

GeoSyntec Consultants




GeoSyntec Consultants



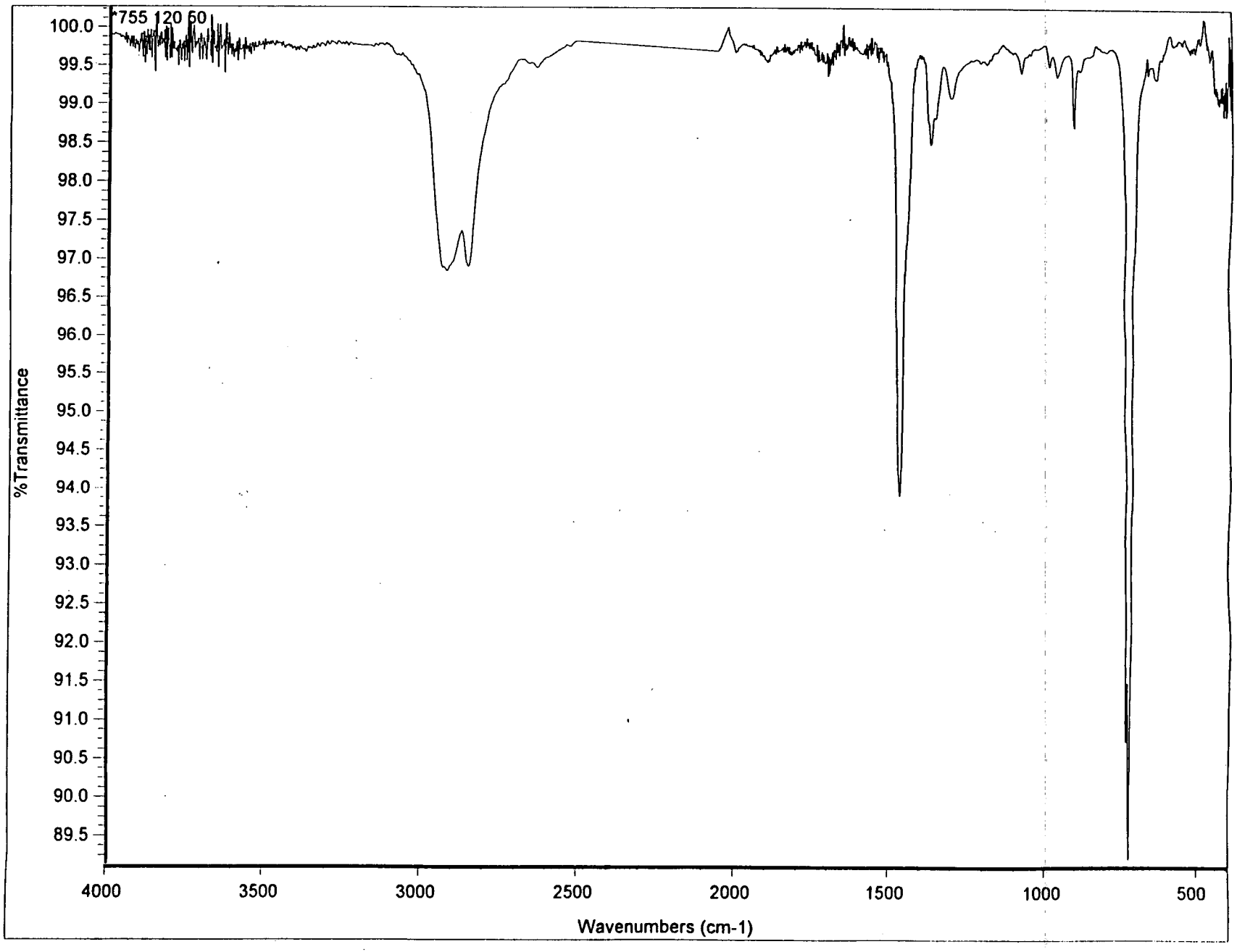
000356



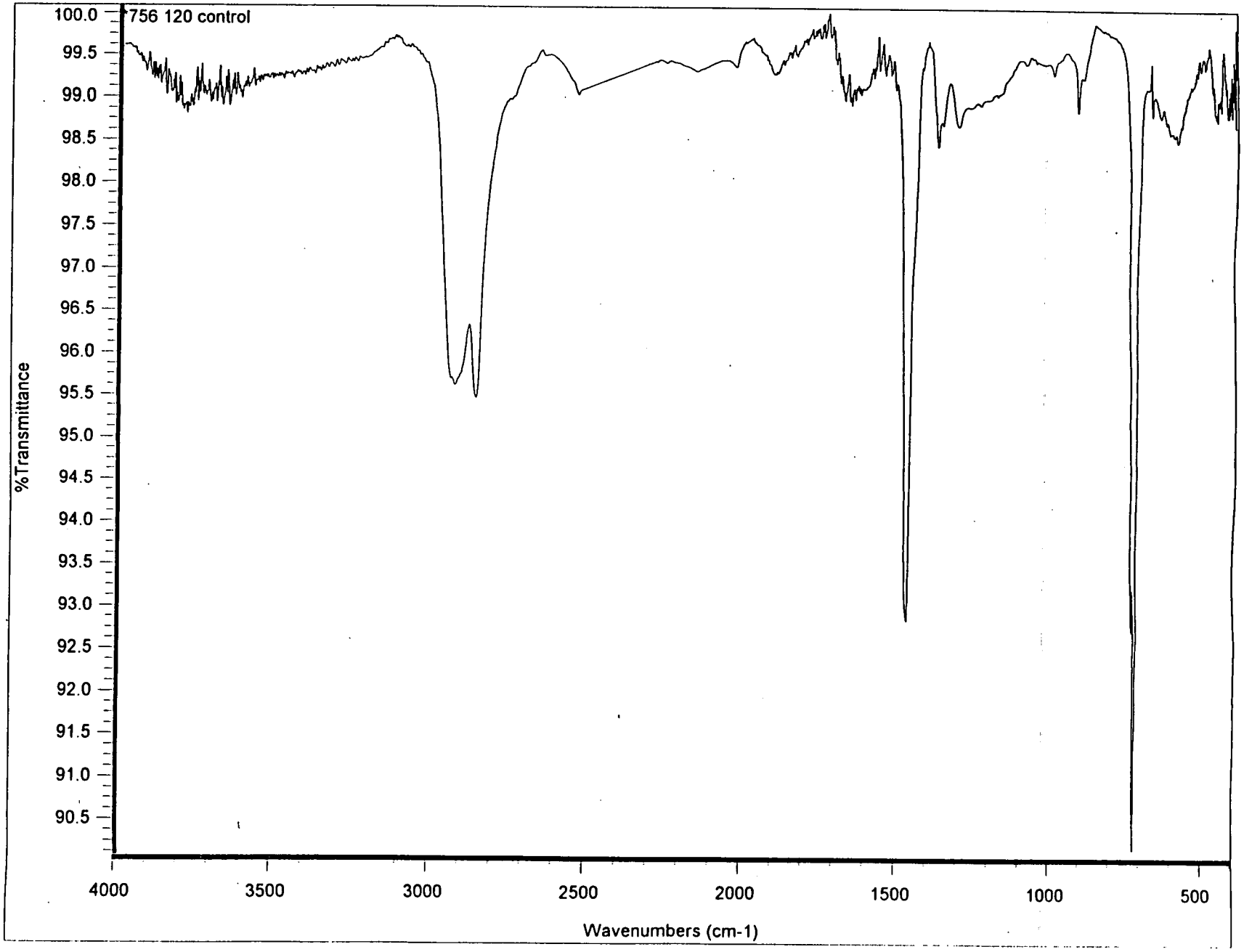

GeoSyntec Consultants

000357

206



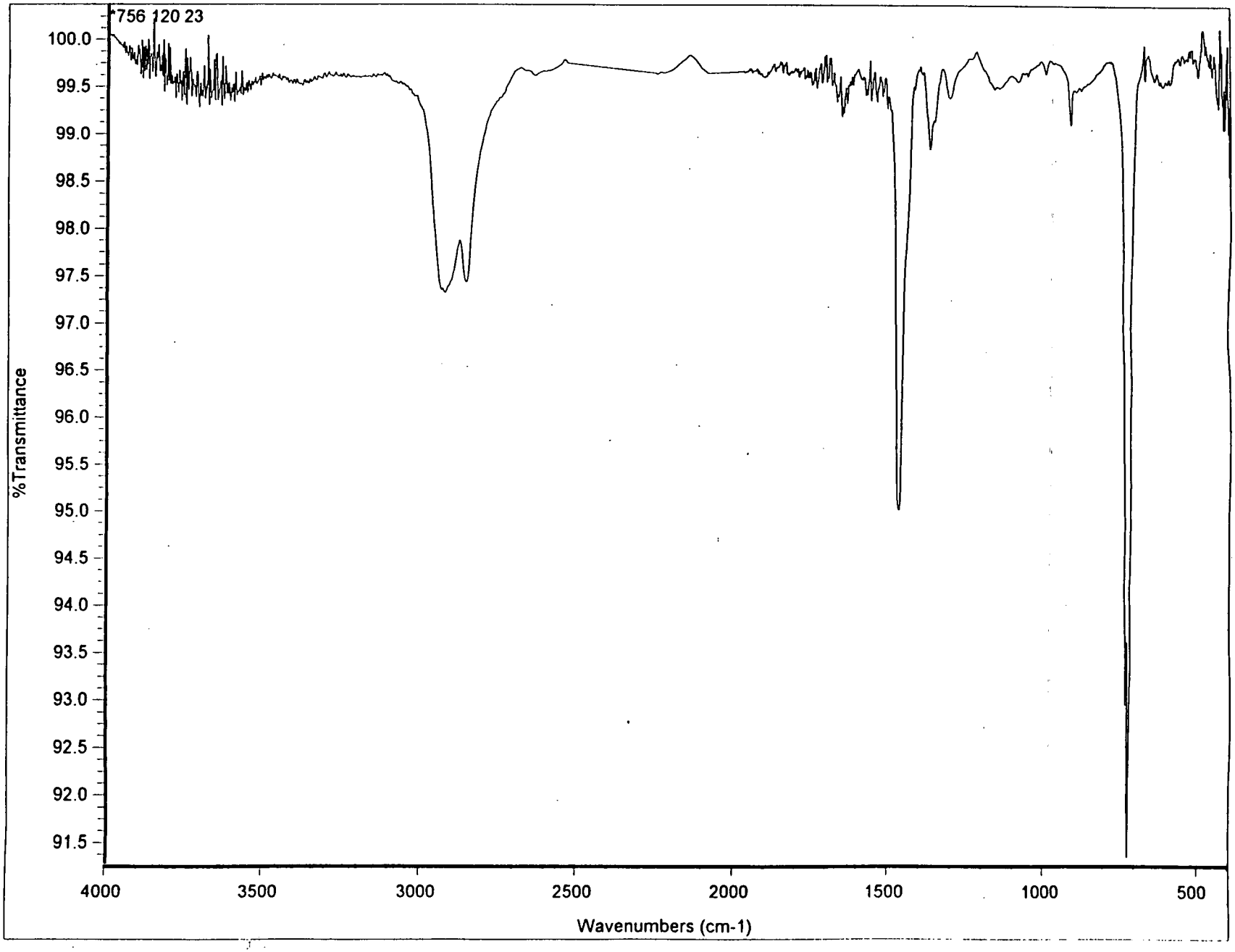

GeoSyntec Consultants




GeoSyntec Consultants

000359

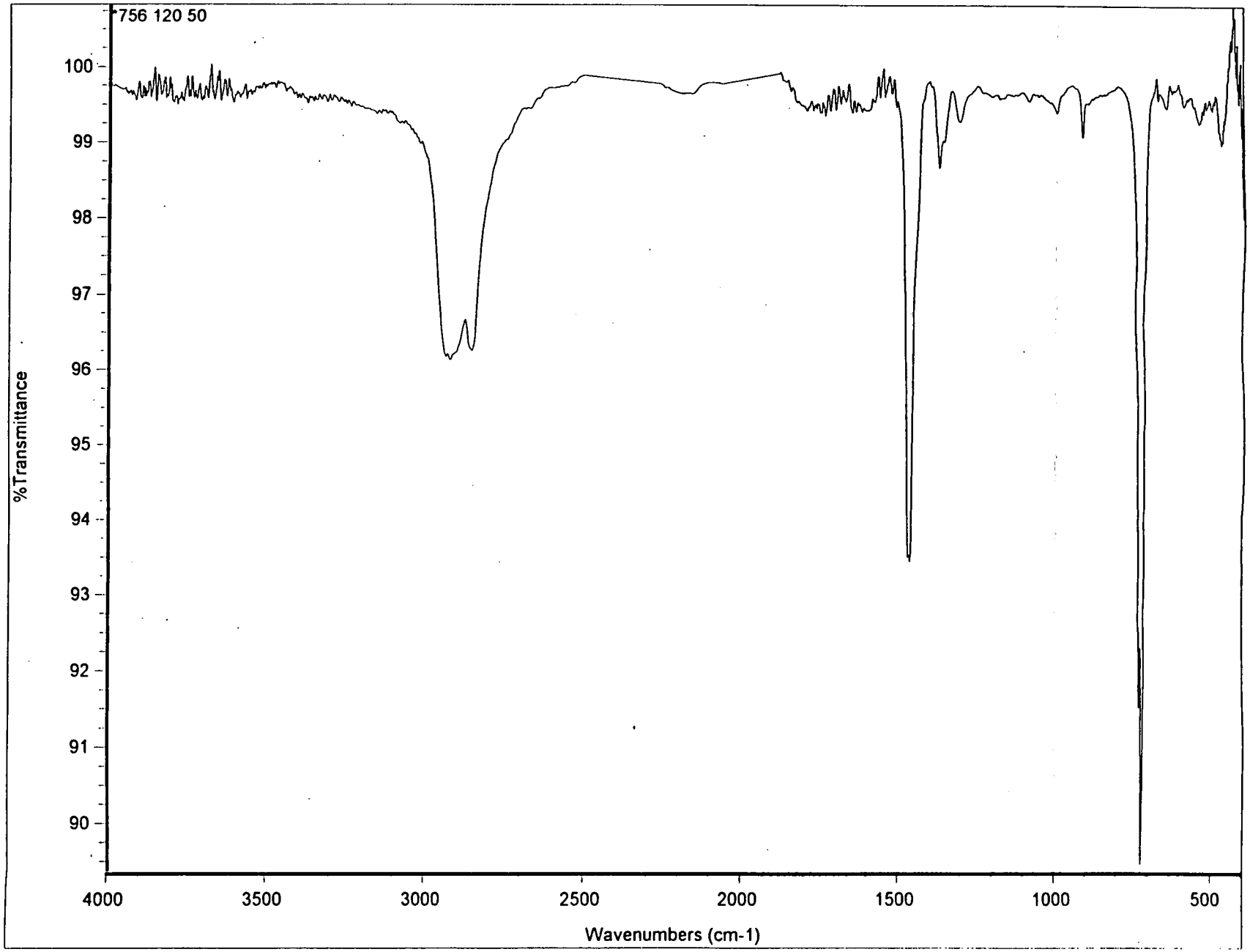
902



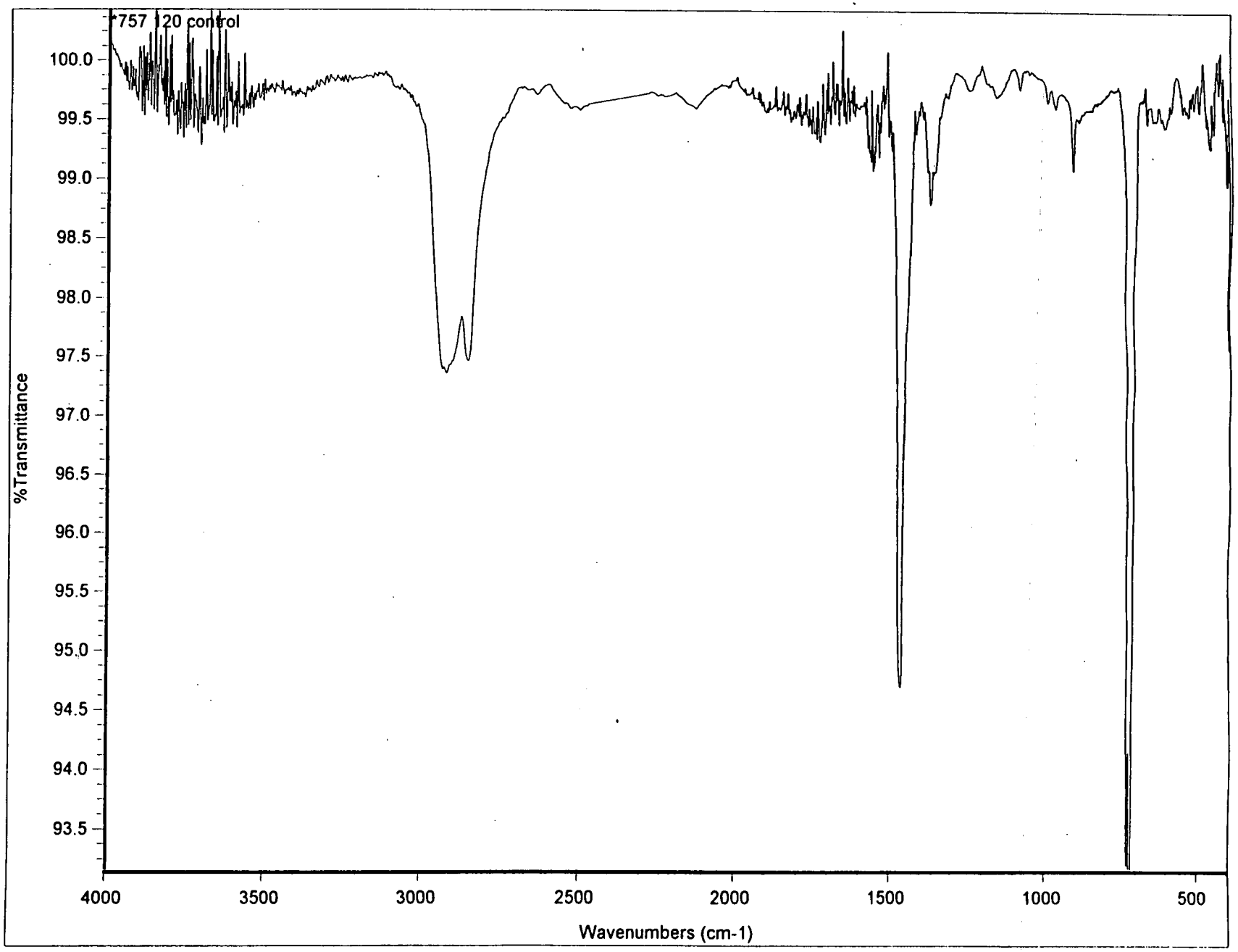

GeoSyntec Consultants



000360



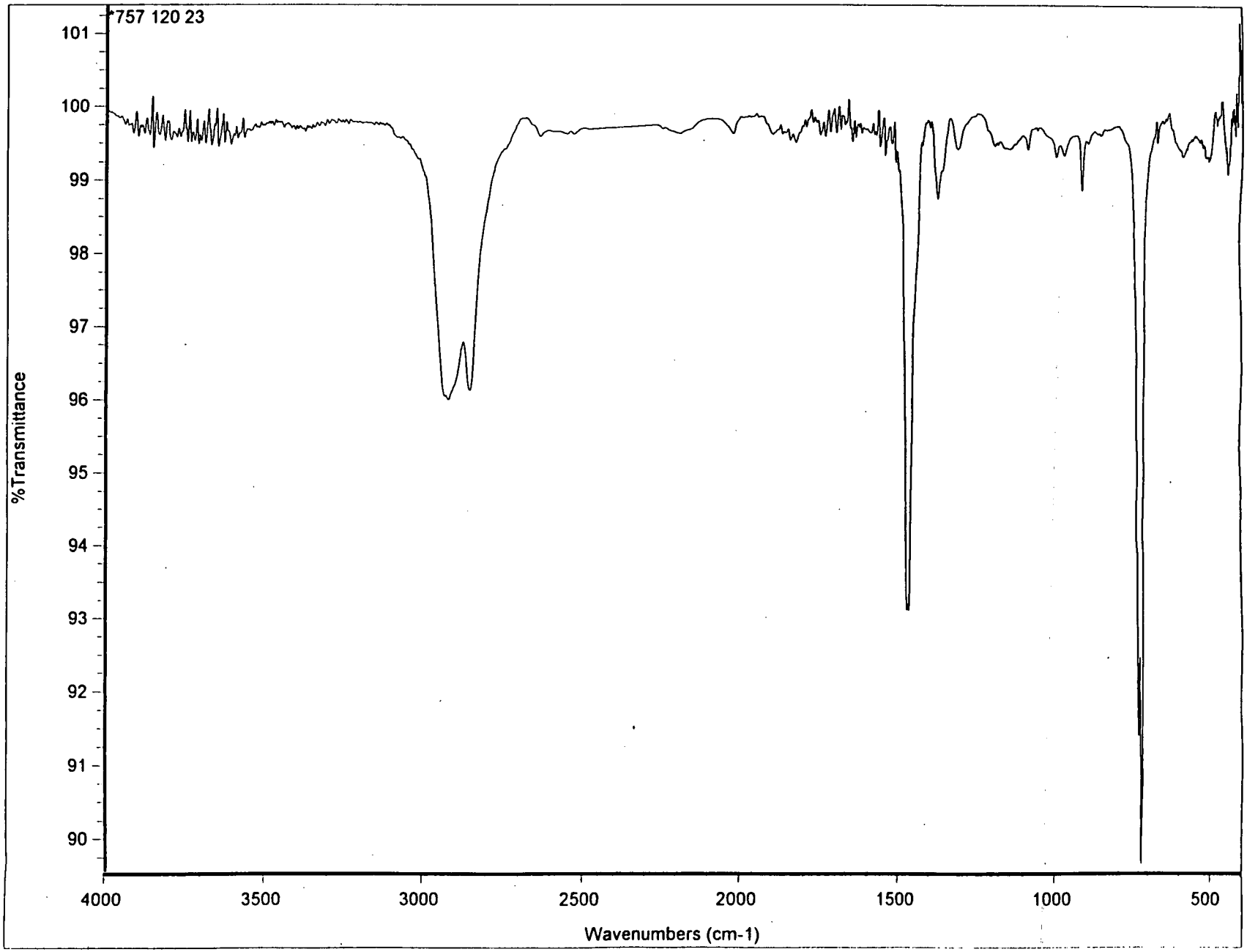

GeoSyntec Consultants



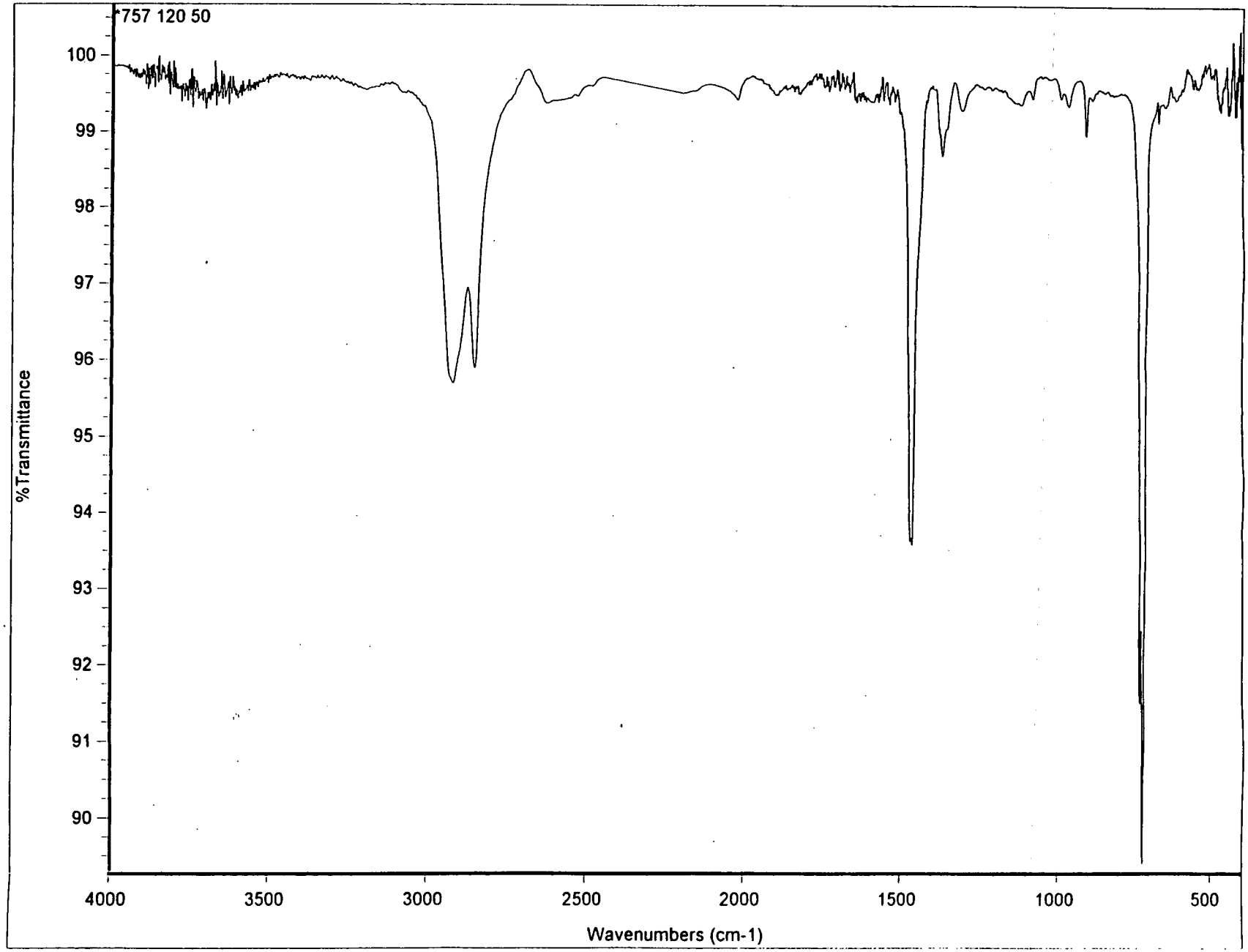

GeoSyntec Consultants



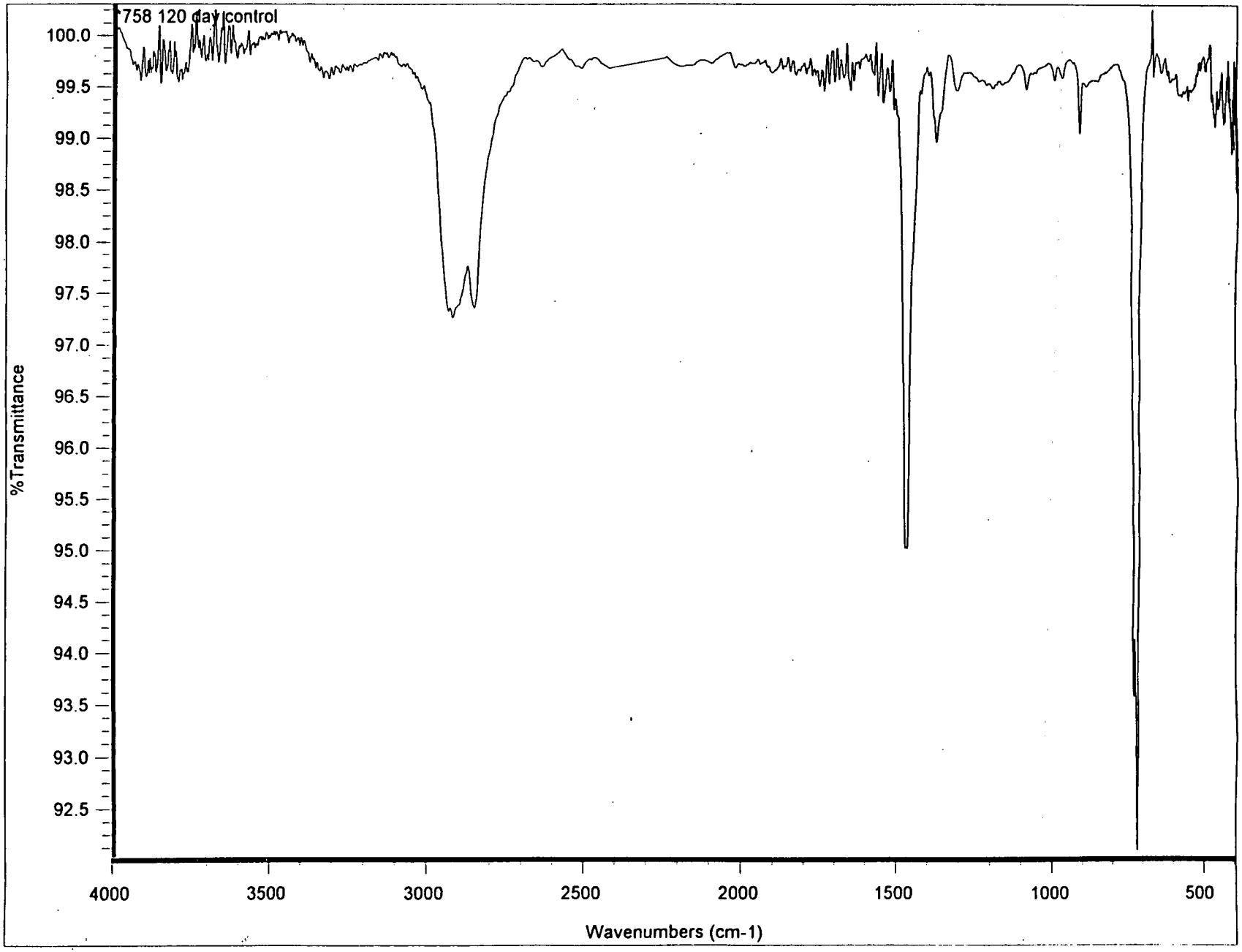
0003662



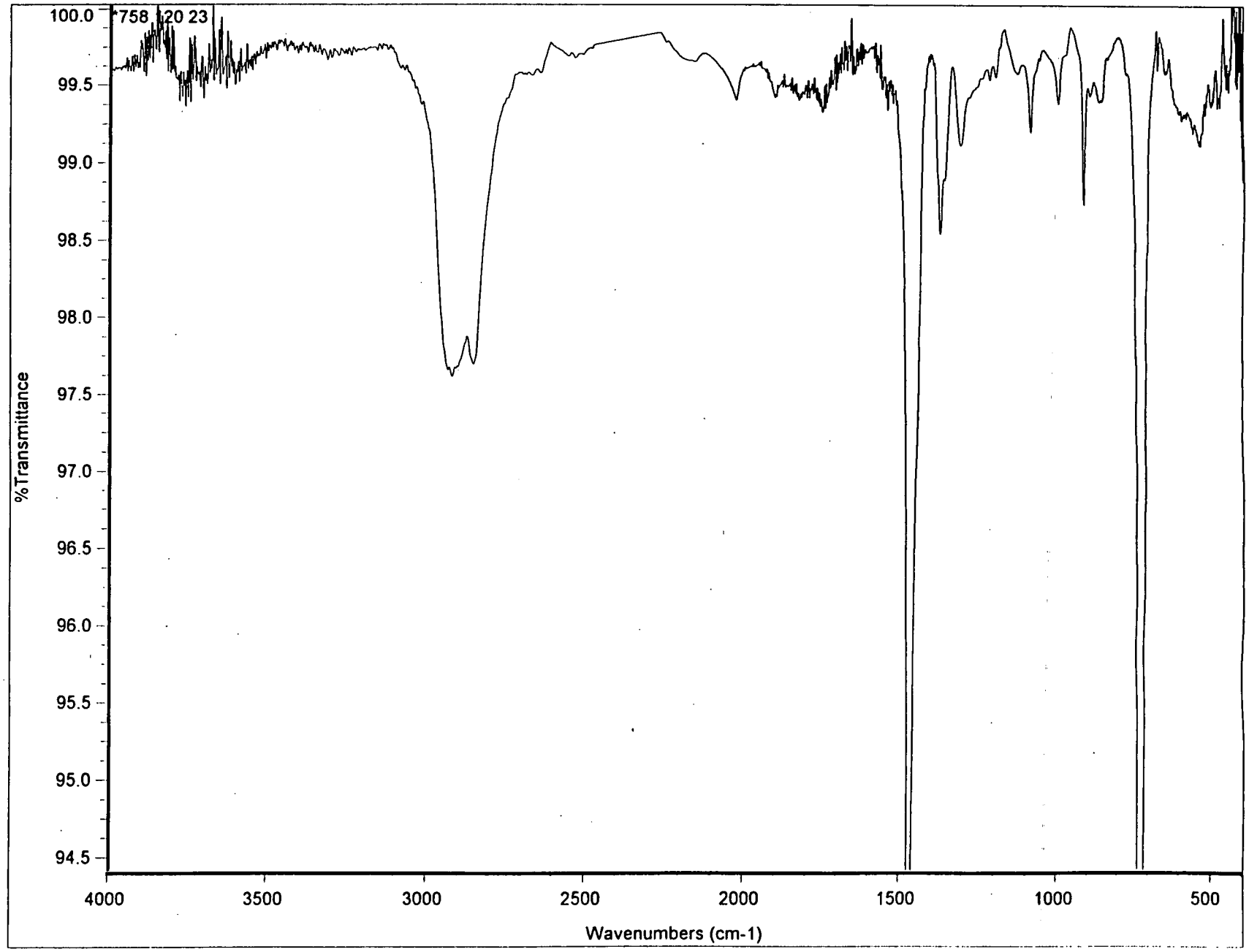

GeoSyntec Consultants



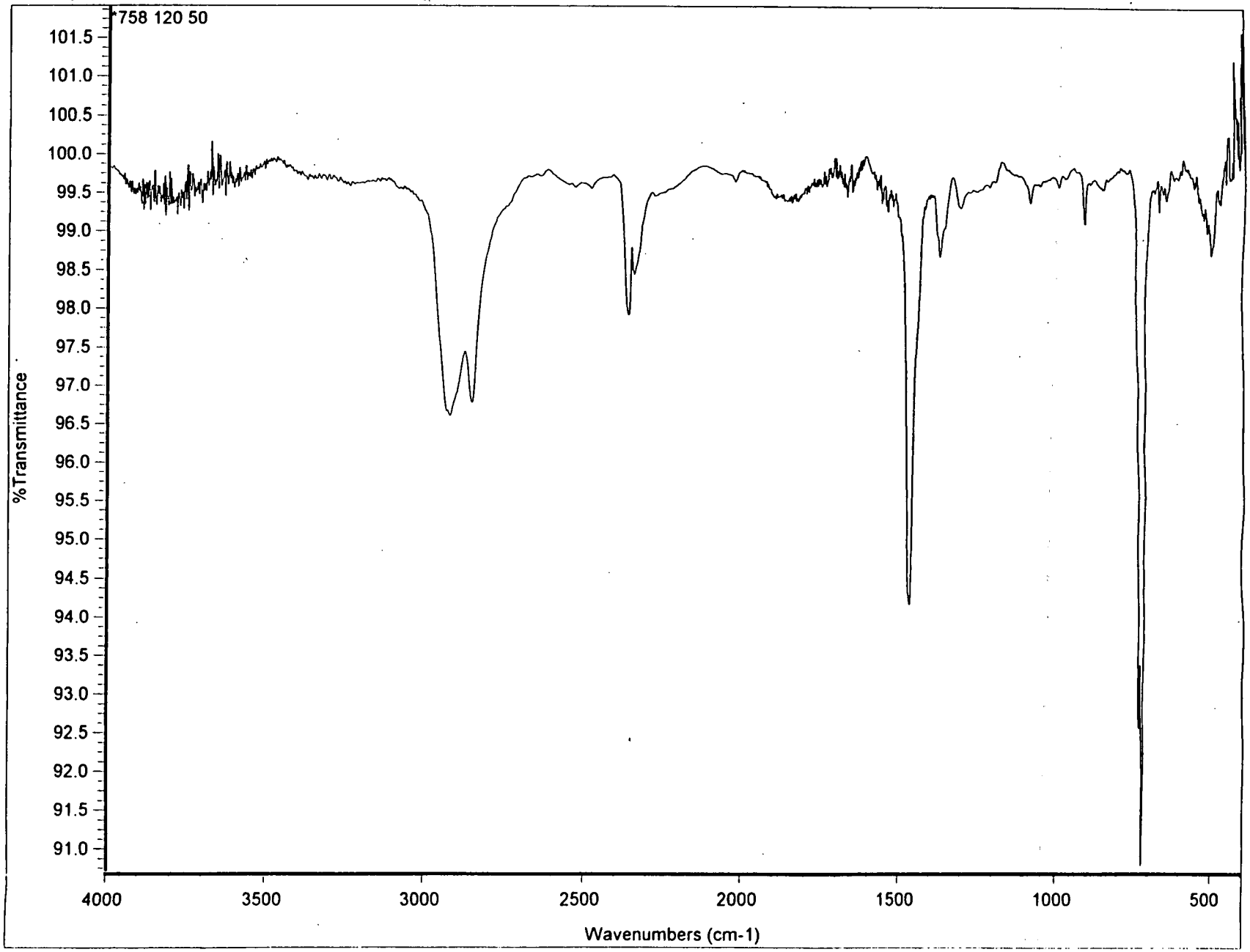

GeoSyntec Consultants




GeoSyntec Consultants



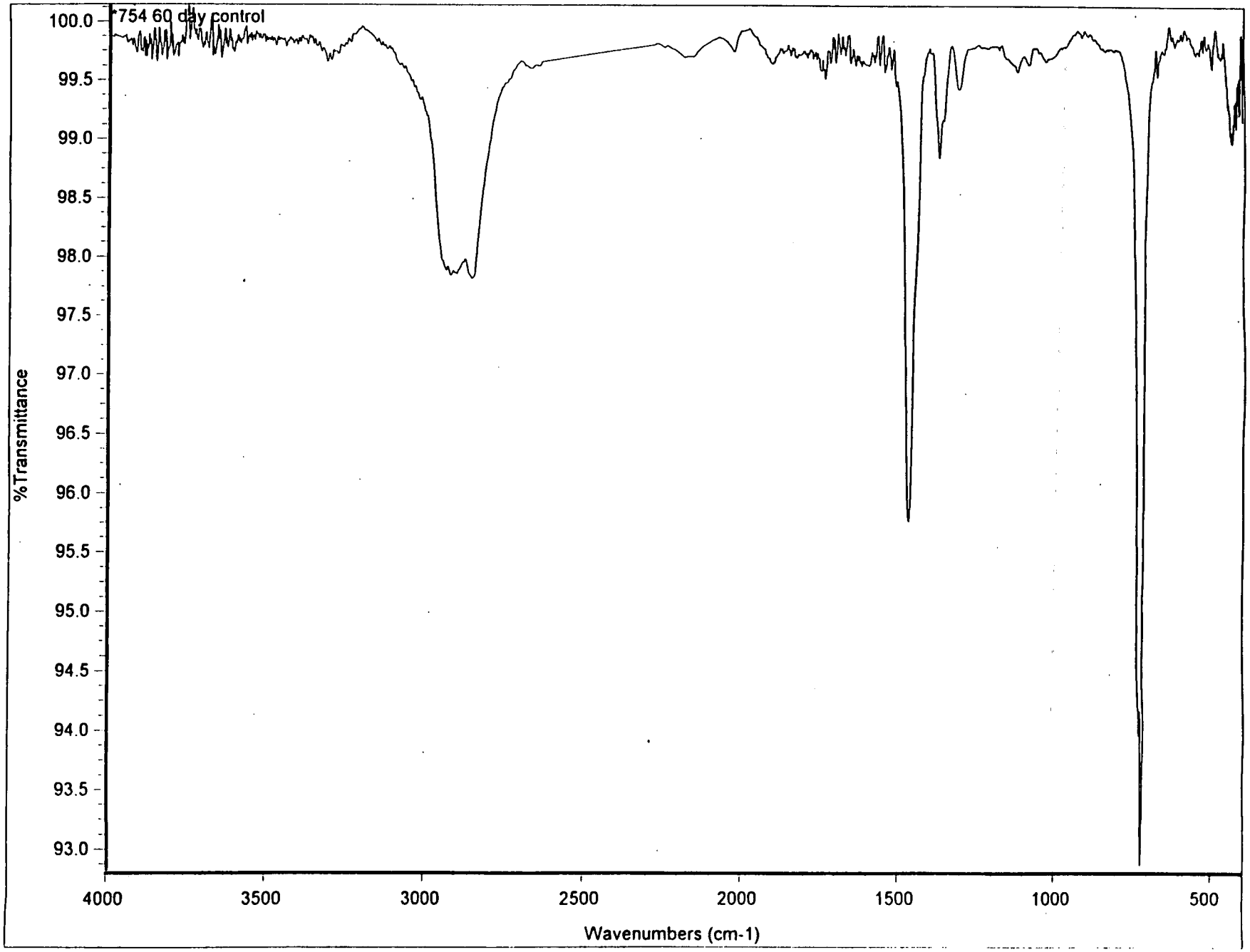

GeoSyntec Consultants




GeoSyntec Consultants



000367




000368

GeoSyntec Consultants

APPENDIX E

# APPENDIX E

# STRESS CRACK RESISTANCE

**Part I:** Rationale, Results and Discussions, and Conclusions

**Part II:** Stress-Time Curves

# APPENDIX E

## STRESS CRACK RESISTANCE

*Environmental Stress Crack Resistance*

Environmental stress crack 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 crack 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 crack resistance of a material.

*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 crack resistance than the NSC geomembrane because specimens that have higher stress levels have not yet ruptured, compared to the NSC geomembrane. Specimens having higher stresses tend to rupture

# 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<br>NR[1] | 588 psi<br>NR | 705 psi<br>NR | 823 psi<br>NR | 940 psi<br>1564[3] | 1058 psi<br>361 hr | 1176 psi<br>244 hr | 1293 psi<br>180 hr | 1411 psi<br>4 hr | 1528 psi<br>0.1 hr |
| NSC | 2,814 psi | 563 psi<br>NR | 704 psi<br>NR | 844 psi<br>1412 hr | 985 psi<br>109 hr | 1126 psi<br>58 hr | 1266 psi<br>21 hr | 1407 psi<br>3 hr | 1548 psi<br>0.2 hr | 1688 psi<br>0.04 hr | 1829 psi<br>0.01 hr |
| GSE-Gundle | 2,851 psi | 570 psi<br>NR | 713 psi<br>805 hr | 855 psi<br>564 hr | 998 psi<br>478 hr | 1140 psi<br>184 hr | 1283 psi<br>56 hr | 1426 psi<br>28 hr | 1568 psi<br>0.7 hr | 1711 psi<br>0.02 hr | 1853 psi<br>0.008 hr |
| Polyflex | 3,086 psi | 617 psi<br>1451 hr | 772 psi<br>393 hr | 926 psi<br>182 hr | 1080 psi<br>81 hr | 1234 psi<br>49 hr | 1389 psi<br>5.1 hr | 1343 psi<br>3 hr | 1697 psi<br>0.1 hr | 1852 psi<br>0.03 hr | 2,000 psi<br>0.004 hr |
| Serrot | 2,600 psi | 520 psi<br>NR | 650 psi<br>883 hr | 780 psi<br>468 hr | 910 psi<br>556 hr | 1040 psi<br>155 hr | 1170 psi<br>73 hr | 1300 psi<br>8 hr | 1430 psi<br>8 hr | 1360 psi<br>0.2 hr | 1690 psi<br>0.03 hr |

Notes: (1) NR = specimen did not rupture.
(2) Hours are an average of three specimens.
(3) Single specimen.







0003272

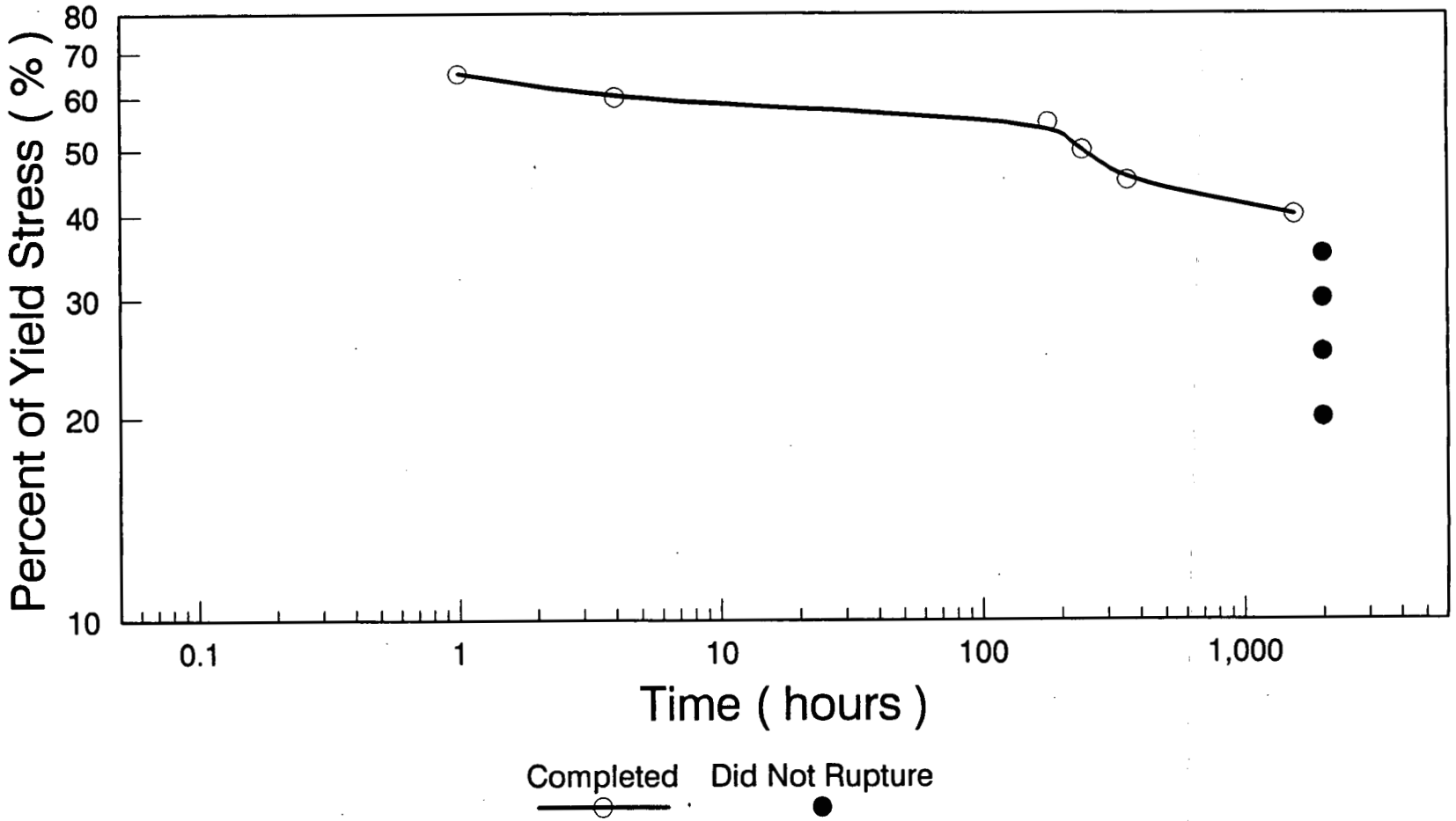
in a ductile mode and rupture more quickly than specimens having lower stresses, which take longer to rupture and tend to rupture in a brittle mode. In addition, from Table E-1, the Polyflex geomembrane has values that are well below those of any of the other geomembranes, appearing inferior, in terms of stress crack 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.

# NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

**Sample: 754 (GSE - SLT)**

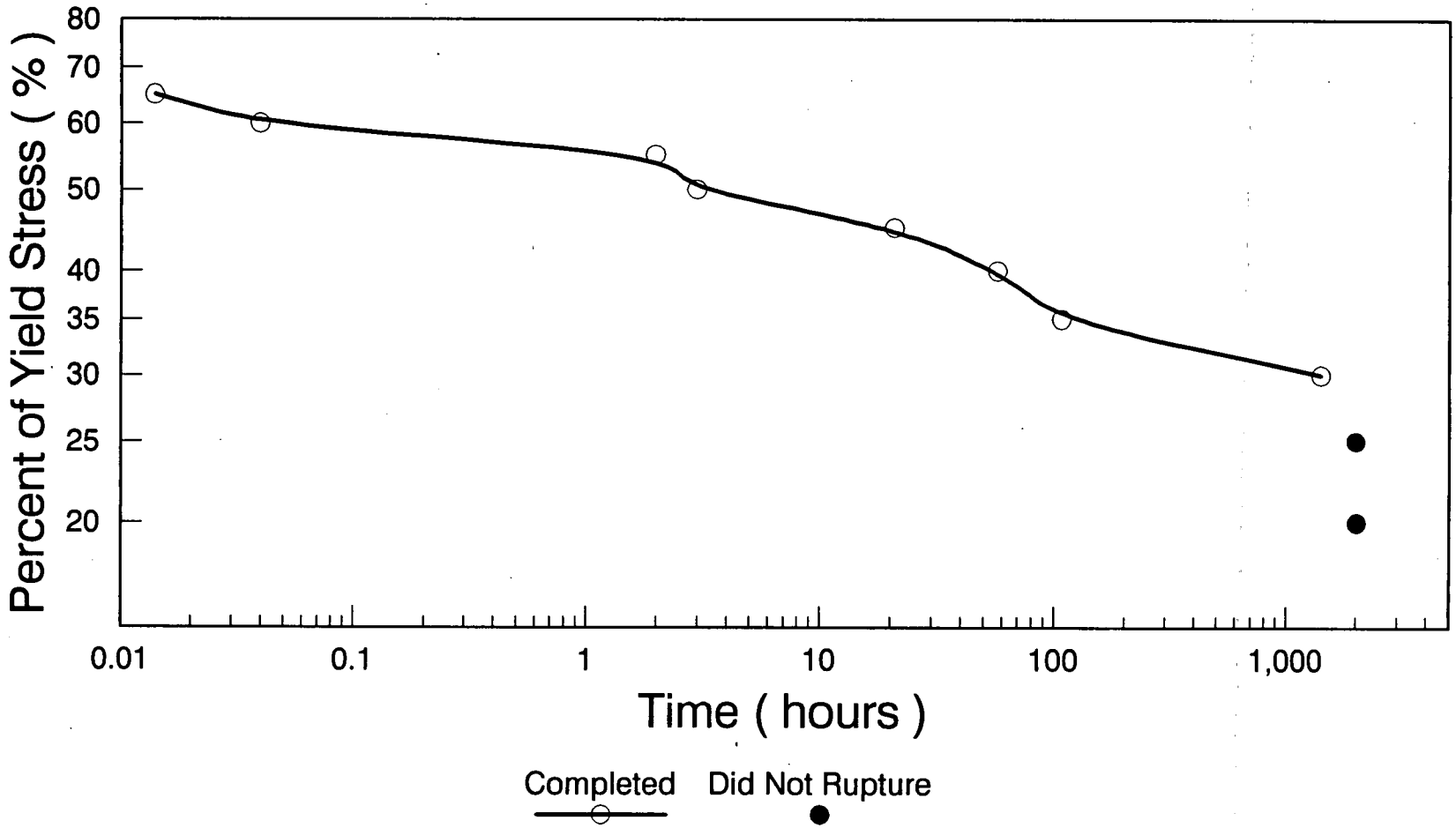



Yield Stress = 2351psi

August 12, 1996

# NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

**Sample: 755 (NSC)**

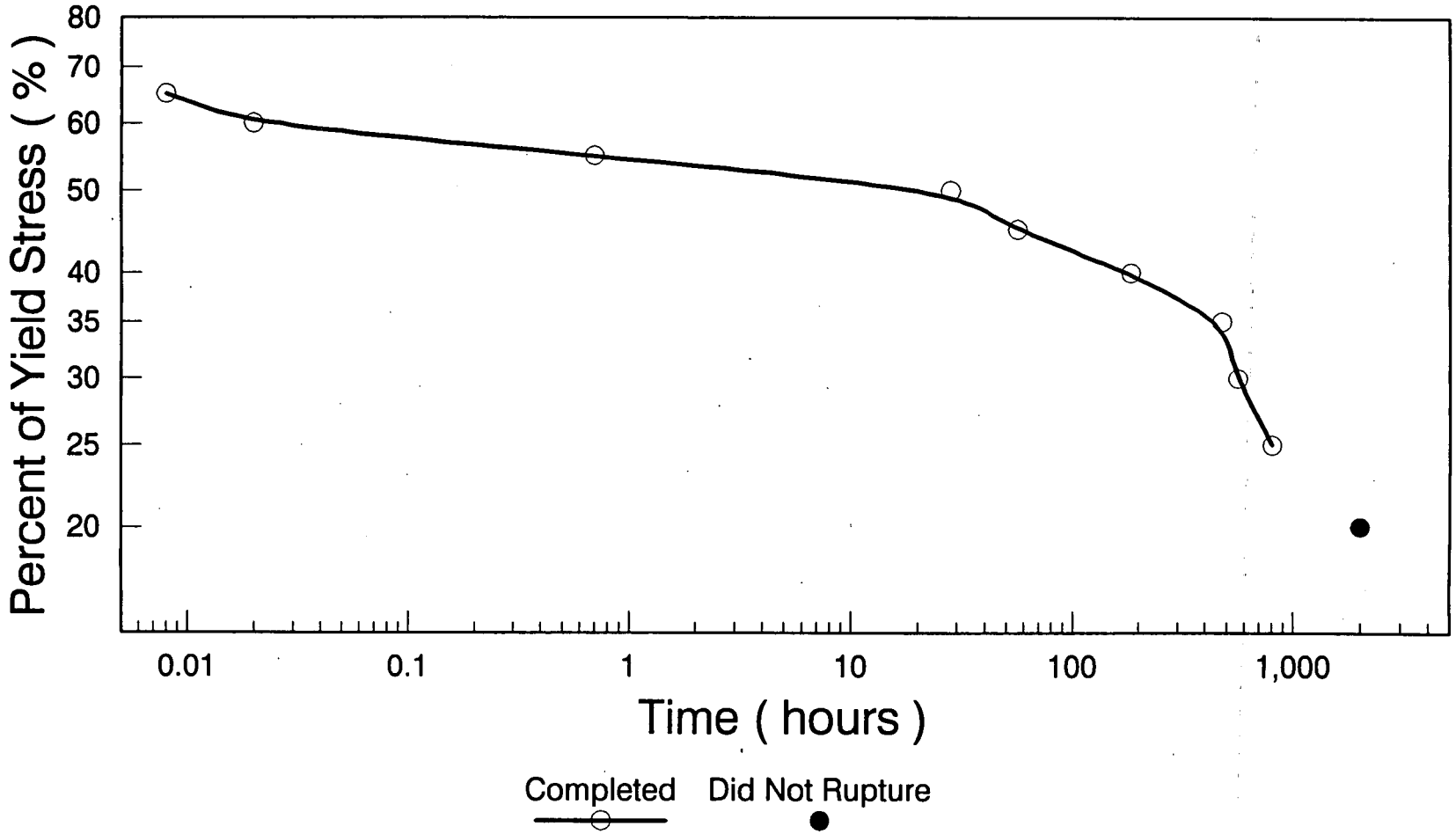



Yield Stress=2814 psi

August 12, 1996

# NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

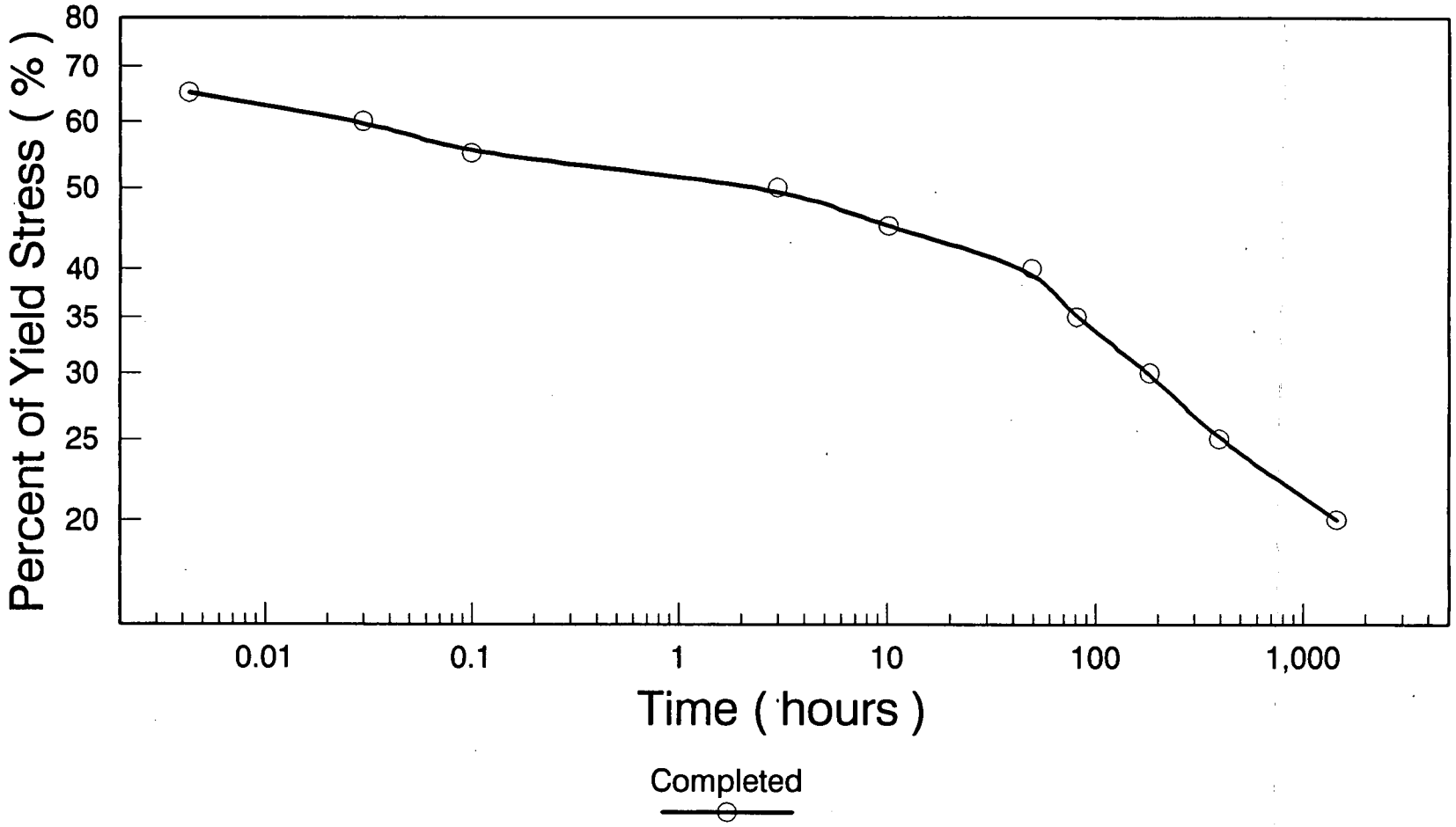
**Sample: 756 (GSE - GUNDLE)**




Yield Stress=2851 psi
August 12, 1996

# NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

**Sample: 757 (POLYFLEX)**

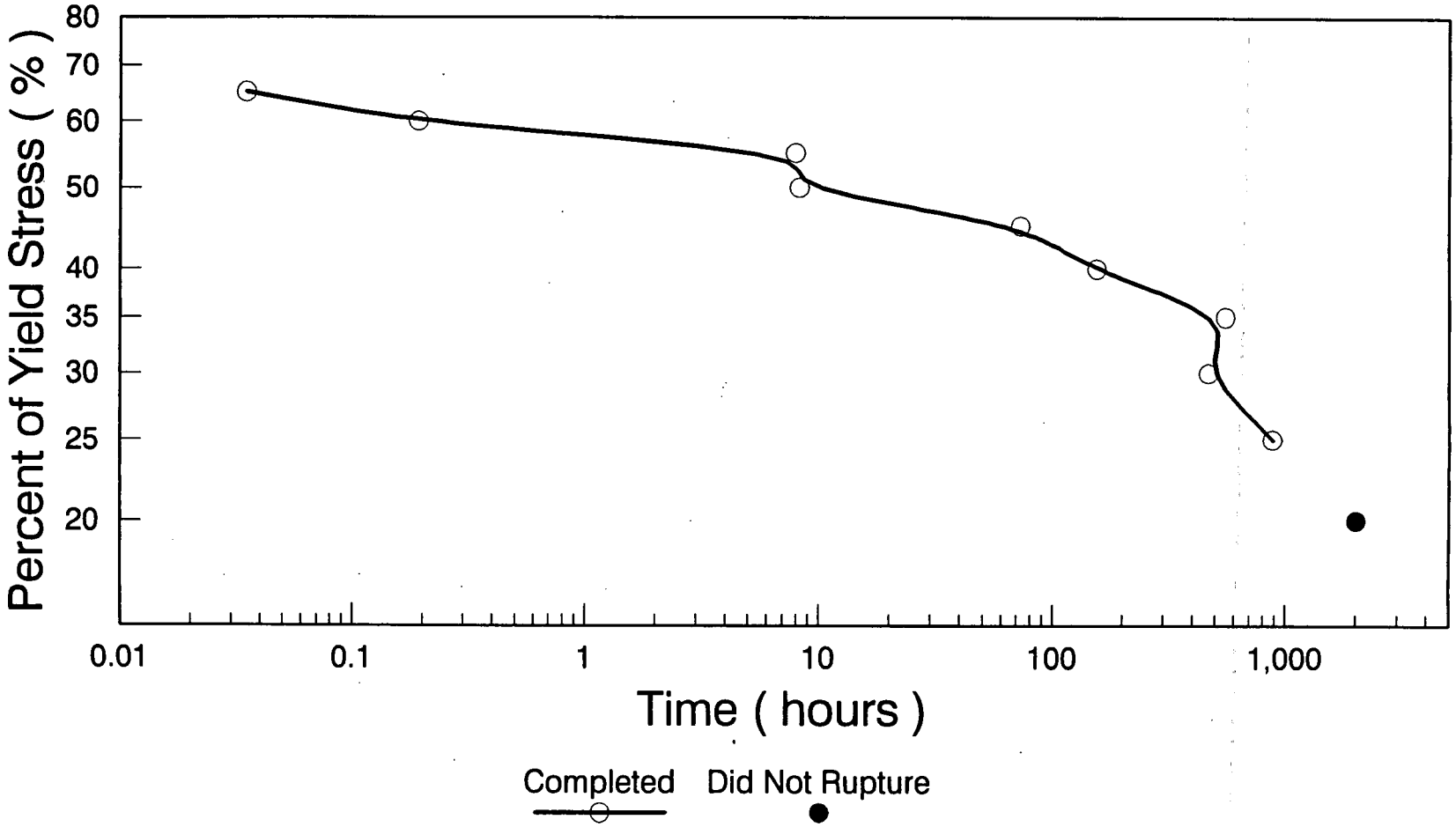



Yield Stress = 3086 psi

August 12, 1996

# NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

**Sample: 758 (SERROT)**




Yield Stress=2600 psi
August 12, 1996