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JUN 18 1997
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Mr. Thomas Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF FINAL ON-SITE DISPOSAL FACILITY LEACHATE/LINER COMPATIBILITY STUDY FINAL REPORT

This letter transmits the Final On-Site Disposal Facility (OSDF) Leachate/Liner Compatibility Study Final Report (Revision 0). Approval of this report was received from the U.S. Environmental Protection Agency (U.S. EPA) on September 27, 1996, and from the Ohio Environmental Protection Agency (OEPA) on May 23, 1997. This report incorporates all changes as a result of comments from the OEPA.

Please contact Rod Warner at (513) 648-3156 if there are any questions regarding this submittal.

Sincerely,

Johnny Reising

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LEACHATE / LINER COMPATIBILITY STUDY
FINAL REPORT

ON-SITE DISPOSAL FACILITY

REVISION 0
JUNE 1997

INFORMATION ONLY

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

prepared by

GeoSyntec Consultants
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under

Fluor Daniel Fernald
Subcontract 95PS005028

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LEACHATE/LINER COMPATIBILITY STUDY
FINAL REPORT

ON-SITE DISPOSAL FACILITY

Revision 0
June 1997

United States Department of Energy

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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

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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

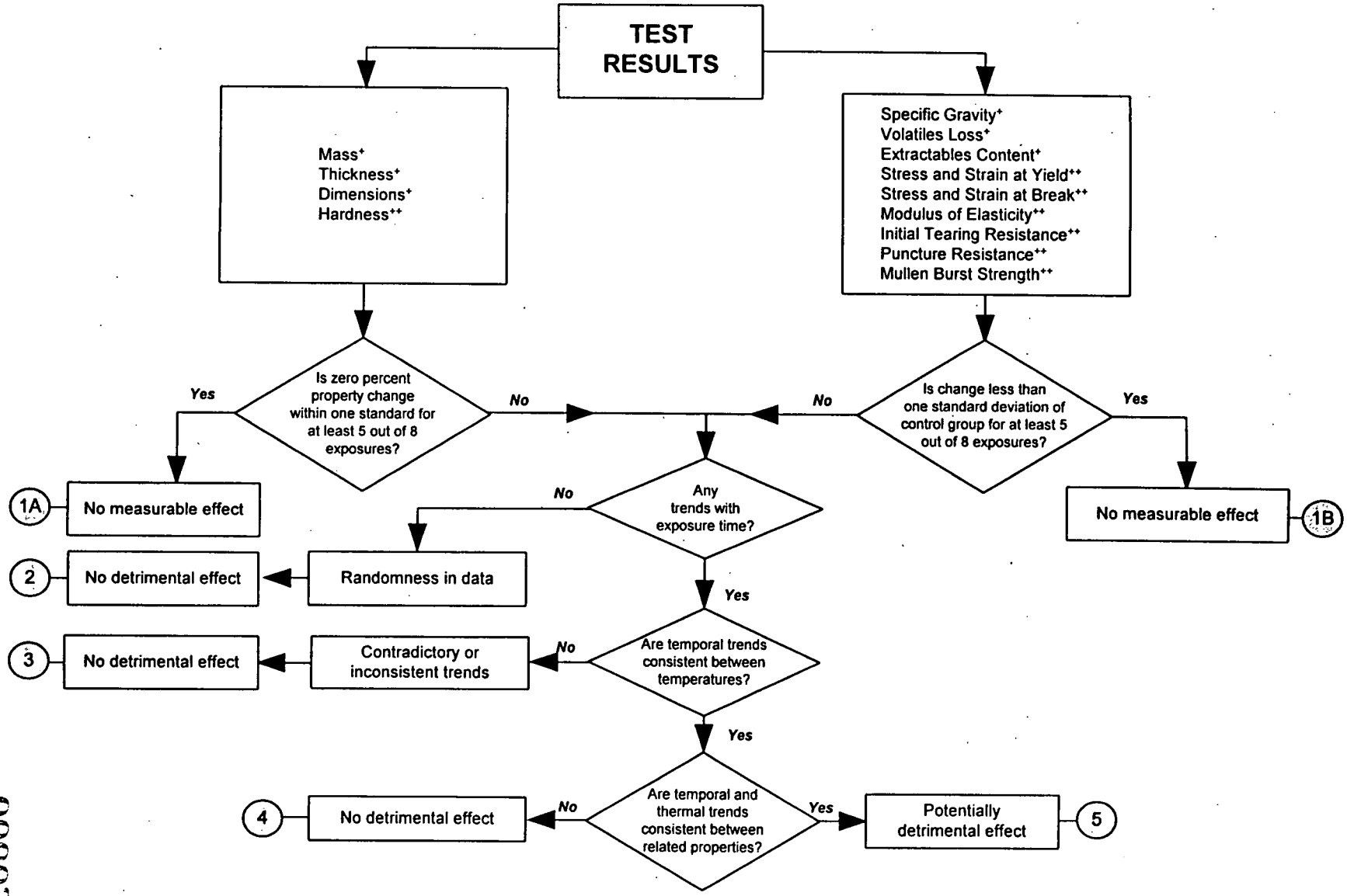

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FIGURE NO. 3-1
PROJECT NO. GE3900-07.4
DOCUMENT NO. F9630165.FIG
FILE NO. FIG_3-1.VSD

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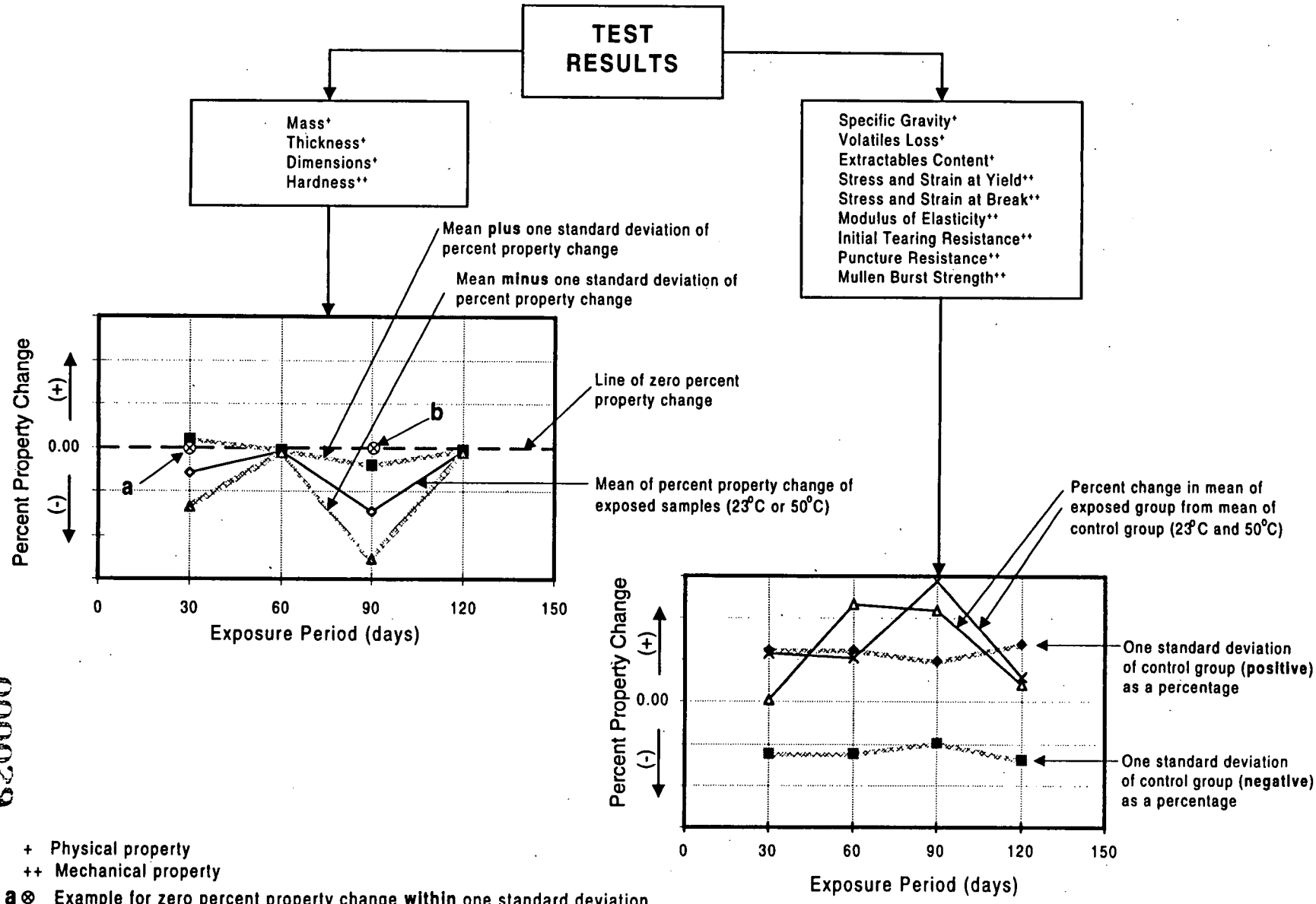
ILLUSTRATION OF COMPARISON WITH ONE STANDARD DEVIATION



\+ 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

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FIGURE NO. 3-2
PROJECT NO. GE3900-07.4
DOCUMENT NO. F9630165.FIG
FILE NO. FIG_3-2.VSD

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- *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

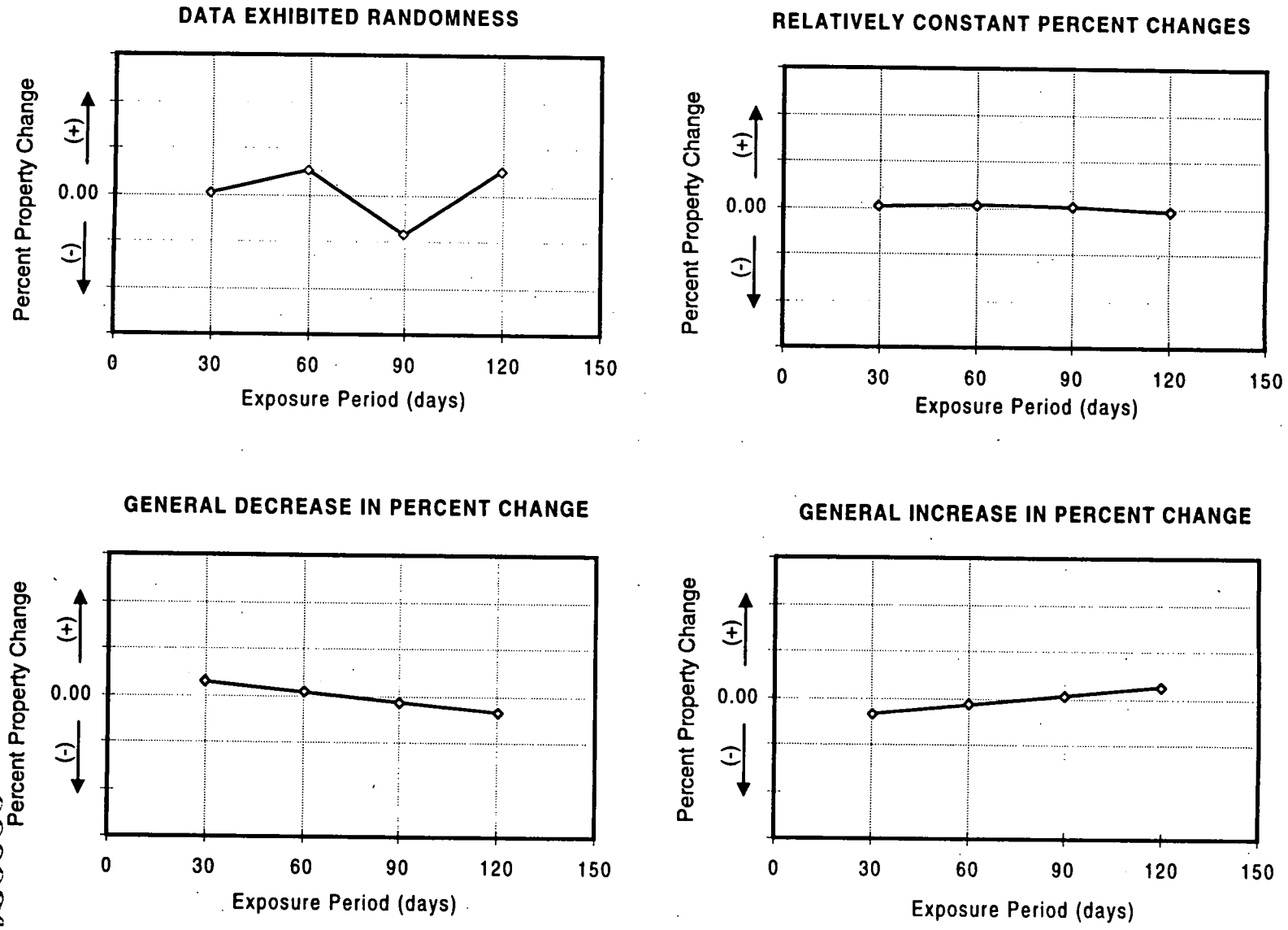

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FIGURE NO. 3-3
PROJECT NO. GE3900-07.4
DOCUMENT NO. F9630165.FIG
FILE NO. _3-3.VSD

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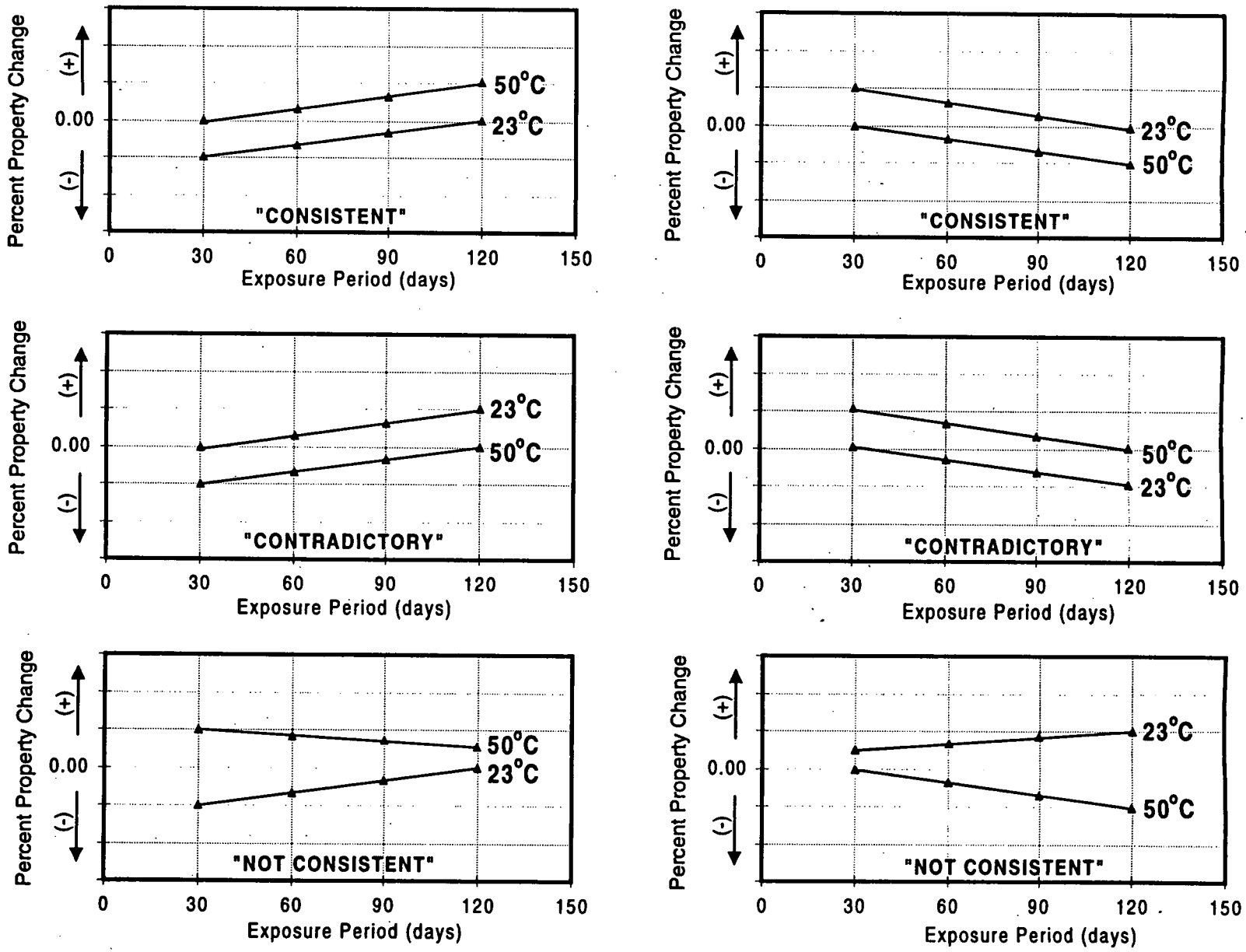
ILLUSTRATION OF CONSISTENCY BETWEEN TEMPORAL AND THERMAL TRENDS



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

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

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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

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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.

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APPENDIX A

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.

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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.L. Gq _____ 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)

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	IDLC
200212369	96-A3405	WATER	0.0001	URANIUM 238	pCi/L	240000	13000	110000	1300
200212369	96-A3405	WATER	0.0001	URANIUM 235/236	pCi/L	29000	4900	14000	2300
200212369	96-A3405	WATER	0.0001	URANIUM 234	pCi/L	220000	12000	100000	2500
200212369	96-A3405	WATER	0.001	TOTAL URANIUM	ug/L	580000		41000	29.3
200212369	96-A3405	WATER	1	TOTAL THORIUM	ug/L	0.47	0.24	0.29	0.91
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 226	pCi/L	5.3	4.1	4.2	6.8
200212369	96-A3405	WATER	0.5	RADIUM 228	pCi/L	0.07	0.25	0.25	0.46
200212369	96-A3405	WATER	1	PLUTONIUM 239/240	pCi/L	0.01	0.03	0.03	0.06
200212369	96-A3405	WATER	1	PLUTONIUM 238	pCi/L	0	0.04	0.04	0.07
200212369	96-A3405	WATER	0.5	NEPTUNIUM 237	pCi/L	0.14	0.1	0.11	0.14
200212369	96-A3405	WATER	0.001	GROSS BETA	pCi/L	330000	3700	71000	670
200212369	96-A3405	WATER	0.001	GROSS ALPHA	pCi/L	340000	4800	42000	193
200212369	96-A3405	WATER	0.5	CESIUM 137	pCi/L	4.3	1.6	1.7	2.2

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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 reproted
N/A = analyte not analyzed
RA = Data Re-assessment
RE = Data Re-analyzed

Comment Codes

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

BLANK CORRECTED

SDG: 7290

Accu-Labs® Research, Inc.

30-Apr-96

All units are per liter unless noted otherwise

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

UNCORRECTED RESULTS

30-Apr-96

All aliquots are per liter unless noted otherwise

FERMCO ID	LAB ID	MATRIX	ALIQUOT	ANALYTE	UNITS	RESULT	CU	TPU	IDLC
200212392	96-A3406	WATER	0.0001	URANIUM 238	pCi/L	210000	10000	82000	1200
200212392	96-A3406	WATER	0.0001	URANIUM 235/236	pCi/L	30000	4300	12000	1100
200212392	96-A3406	WATER	0.0001	URANIUM 234	pCi/L	160000	9200	65000	2200
200212392	96-A3406	WATER	0.001	TOTAL URANIUM	ug/L	585000		42000	29.3
200212392	96-A3406	WATER	1	TOTAL THORIUM	ug/L	0.56	0.28	0.36	0.34
200212392	96-A3406	WATER	1	THORIUM 232	pCi/L	0.06	0.03	0.04	0.04
200212392	96-A3406	WATER	1	THORIUM 230	pCi/L	0.67	0.08	0.29	0.02
200212392	96-A3406	WATER	1	THORIUM 228	pCi/L	0.24	0.05	0.11	0.04
200212392	96-A3406	WATER	1	TECHNETIUM 99	pCi/L	65000		3600	34000
200212392	96-A3406	WATER	1	STRONTIUM 90	pCi/L	0.05	0.2	0.2	0.34
200212392	96-A3406	WATER	0.5	RADIUM 228	pCi/L	4.9	5.9	5.9	9.9
200212392	96-A3406	WATER	0.5	RADIUM 226	pCi/L	0.19	0.26	0.26	0.46
200212392	96-A3406	WATER	1	PLUTONIUM 239/240	pCi/L	0.01	0.02	0.02	0.03
200212392	96-A3406	WATER	1	PLUTONIUM 238	pCi/L	0.02	0.03	0.03	0.05
200212392	96-A3406	WATER	0.5	NEPTUNIUM 237	pCi/L	-0.01	0.09	0.09	0.25
200212392	96-A3406	WATER	0.001	GROSS BETA	pCi/L	340000	3800	75000	660
200212392	96-A3406	WATER	0.001	GROSS ALPHA	pCi/L	320000	4700	36000	410
200212392	96-A3406	WATER	0.5	CESIUM 137	pCi/L	8.5	1.8	2.4	2.5

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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. Cos Date: 4-30-5

Definition of Qualifiers/Suffixes

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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)

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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	0.47	1.4	1.4	2.4
200212379	96-A3407	WATER	0.5	RADIUM 226	pCi/L	0.12	0.19	0.19	0.32
200212379	96-A3407	WATER	1	PLUTONIUM 239/240	pCi/L	0	0.01	0.01	0.02
200212379	96-A3407	WATER	1	PLUTONIUM 238	pCi/L	0.002	0.02	0.02	0.04
200212379	96-A3407	WATER	0.5	NEPTUNIUM 237	pCi/L	0.03	0.03	0.03	0.05
200212379	96-A3407	WATER	0.5	GROSS BETA	pCi/L	6.1	1	1.3	1.3
200212379	96-A3407	WATER	0.5	GROSS ALPHA	pCi/L	3.4	0.72	0.83	0.46
200212379	96-A3407	WATER	1	CESIUM 137	pCi/L	0	0.78	0.78	1.4

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

PROJECT NAME: PDZ

[redacted] BADGE NO.: 70653

SAMPLING TEAM LETTER: D

SAMPLE COLLECTION TEAM MEMBER NAMES: [redacted] 70650 N/A

SAMPLE LOCATION: CLASSIFIED PIT DRUMS S-39

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

FACTS SAMPLE ID NO. / FILTERED STATUS

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

SAMPLING EQUIPMENT LIST

NAME	MANUFACTURER / SERIAL NO.	NAME	TYPE
WATER LEVEL INDICATOR	N/A	BAILER	TEFLON
OTHER	N/A	SAMPLING HOSE	TYGON
OTHER	N/A	PUMP	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 ~~GALLONS~~

~~☐ No Packer~~ N/A — TOTAL DEPTH (ft) = WATER LEVEL (ft) = WATER COLUMN (ft) x (gal/ft) = 1 PURGE VOLUME (gal) x 3 = TOTAL PURGE VOLUME (gal)

WATER QUALITY DATA

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

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

ACTUAL PURGE VOLUME: (gal.) N/A

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

SAMPLE DEPTH (ft): N/A

COLLECTION DATA

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

WATER LEVEL (ft):

SCREEN LENGTH (ft):

MICRO-PURGE VOLUME: ☐ (gal.) ☐ (mL)

WATER QUALITY DATA

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

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

FORM F[illegible]808

INORGANIC/CONVENTIONAL DATA VALIDATION SUMMARY REPORT

Release # 1-10033 (2CCD3)
ASL B

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

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

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

Concurred by: [illegible] 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.

000063

827

FORM F[illegible]808

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.

000063

Validator: Jan Rhen (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.

228

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)	Lab Qual	Val Qual	DATE ANALYZED
9020A	TOX	5	611		J	02/09/96

3/2/96

 3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602005-13A	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	Result CONC (MG/L)	ASLB Val Qual	DATE ANALYZED	
9060	TOC	10	93	J	02/23/96	1:10 dil

3/24/96

000065

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602006-16A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212366	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-B Val Qual	DATE ANALYZED
420.2	PHENOLS	5	5.6	—	02/07/96

3/24/96

000066

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602005-17A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212366	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 Val. Qual	CONC (MG/L)	DATE ANALYZED
376.1	SULFIDES	1	U	ND	02/05/96

ASLB

P03 3/21/96 000067

J 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

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 (ASK/+ Vol. Gal)	(ASK Vol. Gal)	CONC (UG/L)	DATE ANALYZED
9020A	TOX	5	4	ND	02/09/96

3/21/96

000070

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	ASLB	CONC (MG/L)	DATE ANALYZED
9060	TOC	1	4	ND	02/23/96

3/24/96

000071

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

3/21/96

000072

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

000073

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602006-27A	REPORT DATE -	02/29/96
FERMCO SITE ID -	206212377	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 -	9602006-28A	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	UNITS	CONC	Results ASLB Vol 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

000075

3/2/96

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

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

MISC. INORGANICS - TABLE 40 PARAMETERS

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

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

000076

3/21/96

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602005-03A	REPORT DATE -	02/29/96
FERMCO SITE ID -	20021235	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

000077

3/21/96

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

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

MISC. INORGANICS - TABLE 40 PARAMETERS

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

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

3/4/96

000078

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 ASLB Validation	CONC (MG/L)	DATE ANALYZED
376.1	SULFIDES	1	U	ND	02/05/96

3/4/96

3/14/96

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602005-08A	REPORT DATE -	02/29/96
FERMCO SITE ID -	20021239D	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

000080 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 JDAC	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 -	9602005-28A	REPORT DATE -	02/29/96
FERMCO SITE ID -	200212378	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

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

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

3/21/96

000082

3/14/96

FERMCO QC ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602006-12A	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

000083

3/14/96

827

field dup of 212384

PERMCO TOTAL ANALYSIS
93PM-10033

TCT SAMPLE NUMBER -	9602005-12A	REPORT DATE --	02/29/96
PERMCO 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

000084

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

000085

3/14/96

827

field dup of 212390

FERMCO TOTAL ANALYSIS
93FM-10033

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

MISC. INORGANICS - TABLE 40 PARAMETERS

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

METHODS	PARAMETER	DETECTION LIMIT	CONC (MG/L)	DATE ANALYZED	
310.1	ALKALINITY	2	960	02/13/96	
300.0	SULFATE	2	121	02/02/96	1:20 dil
300.0	CHLORIDE	1	69.1	02/02/96	1:20 dil
340.2	FLUORIDE	0.25	2.98	02/09/96	1:5 dil
120.1	CONDUCTIVITY (uMHOS/cm)	-	3720	02/21/96	

3/4/96

000086

3/14/96

27
field dup of
212361

PERMCO TOTAL ANALYSIS
96PM-10033

TCT SAMPLE NUMBER -	9602005-02A	REPORT DATE -	02/29/96
PERMCO SITE ID -	200212364	MATRIX -	WATER
DATE RECEIVED -	02/01/96	RELEASE NUMBER -	10033
DATE SAMPLED -	01/30/96		

MISC. INORGANICS - TABLE 40 PARAMETERS

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

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

3/2/96

000087

3/14/96

field dup of 212362

FERMCO TOTAL ANALYSIS
93PM-10033

TCT SAMPLE NUMBER -	9602005-03A	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	1	3.68	02/23/96

3/21/96

000088

3/14/96

827

field dup of 212367

FERMCO TOTAL ANALYSIS
93FM-10033

TCT SAMPLE NUMBER -	9602006-08A	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	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	

000089

3/21/96

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.

000090

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.

228

FORM FS-[illegible]808

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.

0000091

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.

827

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. Qual.

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

Color Before: YELLOW Clarity Before: CLOUDY Texture:

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:

3/11/96

3/13/96

FORM I - IN

ENVIROFORMS/INORGANIC CLP

1

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

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

000093

pr 3/13/96

827

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

212387

Lab Name: TCT St. Louis Contract: 434286

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

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

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

% Solids: 0.0

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

ASLC Val. Qual.

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

Color Before: YELLOW Clarity Before: CLOUDY Texture:

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:

JPB 3/15/96

000094

JW 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	Prepa-ration Blank	C	M
Aluminum	75.0	U	75.0	U	75.0	U			108.600	B	P
Antimony	5.8	B	4.0	U	4.0	U			4.000	U	P
Arsenic	3.0	U	4.7	B	3.0	U			3.000	U	P
Barium	9.0	U	9.0	U	9.0	U			9.000	U	P
Beryllium	1.0	U	1.0	U	1.0	U			1.000	U	P
Cadmium	1.3	B	4.0	B	1.0	U			1.000	U	P
Calcium	40.0	U	40.0	U	40.0	U			97.900	B	P
Chromium	6.0	U	6.0	U	6.0	U			6.000	U	P
Cobalt	9.0	U	9.0	U	9.0	U			9.000	U	P
Copper	11.0	U	11.0	U	11.0	U			11.000	U	P
Iron	38.0	U	38.0	U	38.0	U			93.000	B	P
Lead	2.0	U	2.0	U	2.0	U			-2.140	B	P
Magnesium	82.0	U	82.0	U	82.0	U			82.000	U	P
Manganese	6.0	U	6.0	U	6.0	U			6.000	U	P
Mercury	0.1	B	0.1	B	0.1	B			0.100	U	CV
Nickel	19.0	U	19.0	U	19.0	U			19.000	U	P
Potassium	98.0	U	98.0	U					98.000	U	A
Selenium	5.0	U	5.0	U	5.0	U			5.000	U	P
Silver	1.0	U	1.0	U	1.0	U			1.000	U	P
Sodium	170.0	U	170.0	U	170.0	U			170.000	U	P
Thallium	5.0	U	5.0	U	5.0	U			5.000	U	P
Vanadium	2.2	B	2.0	U	2.0	U			2.000	U	P
Zinc	13.0	U	13.0	U	13.0	U			13.000	U	P
Cyanide											

2/15/96

FORM III - IN

2/13/96

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

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

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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:

3/12/96

3/12/96

FORM I - IN

field dup of 212364

827

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

000099

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

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

Concurred by: Date: 3/27/96

QC Check of Subcontractor Deliverable by: Date:

Qualifier Codes Entered by: Date:

Qualifier Codes Approved by: Date:

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

ORGANIC DATA VALIDATION SUMMARY REPORT

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

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

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

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

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

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

Qualifier Codes Entered by: Date:

Qualifier Codes Approved by: Date:

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

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212360

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

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

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

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

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

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

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

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

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	A&C
74-87-3	Chloromethane	10	U	U
74-83-9	Bromomethane	10	U	U
75-01-4	Vinyl chloride	10	U	U
75-00-3	Chloroethane	10	U	U
75-09-2	Methylene Chloride	3	BJ	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	E
124-48-1	Dibromochloromethane	10	U	U
79-00-5	1,1,2-Trichloroethane	10	U	U
71-43-2	Benzene	10	U	U
10061-02-6	trans-1,3-Dichloropropene	10	U	U
75-25-2	Bromoform	10	U	U
108-[illegible]	4-Methyl-2-pentanone	10	U	U
591-[illegible]	2-Hexanone	10	U	U
127-[illegible]	Tetrachloroethene	90		
79-[illegible]	1,1,2,2-Tetrachloroethane	10	U	U
108-[illegible]	Toluene	10	U	U
108-90-7	Chlorobenzene	10	U	U
100-41-4	Ethylbenzene	10	U	U
100-42-5	Styrene	10	U	U

3/27/96

000102 3/27/96 AM

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212360

Lab Name: TCF-ST. LOUIS Contract: 434286

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

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

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

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

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

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

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

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

FORM I VOA-2 3/90 Rev

3/16/96

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	21.93	13	J
2.				
3.				
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FORM I VOA-TIC 3/90 Rev

3/14/96

0001043/14/96 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	Z
74-83-9	Bromomethane	50	U	
75-01-4	Vinyl chloride	50	U	
75-00-3	Chloroethane	50	U	
75-09-2	Methylene Chloride	50	U	
67-64-1	Acetone	43	BJ	
75-15-0	Carbon Disulfide	50	U	
75-35-4	1,1-Dichloroethene	50	U	
75-34-3	1,1-Dichloroethane	50	U	
156-60-5	trans-1,2-Dichloroethene	50	U	
156-59-2	cis-1,2-Dichloroethene	50	U	
67-66-3	Chloroform	50	U	
107-06-2	1,2-Dichloroethane	50	U	
78-93-3	2-Butanone	50	U	
71-55-6	1,1,1-Trichloroethane	50	U	
56-23-5	Carbon Tetrachloride	50	U	
108-05-4	Vinyl Acetate	50	U	
75-27-4	Bromodichloromethane	50	U	
78-87-5	1,2-Dichloropropane	50	U	
10061-01-5	cis-1,3-Dichloropropene	50	U	Z
79-01-6	Trichloroethene	510		Z 3/20/4 AT
124-48-1	Dibromochloromethane	50	U	Z
79-00-5	1,1,2-Trichloroethane	50	U	Z
71-43-2	Benzene	50	U	
10061-02-6	trans-1,3-Dichloropropene	50	U	
75-25-2	Bromoform	50	U	
108-10-1	4-Methyl-2-pentanone	50	U	
591-78-6	2-Hexanone	50	U	
127-18-4	Tetrachloroethene	66		
79-34-5	1,1,2,2-Tetrachloroethane	50	U	
108-88-3	Toluene	50	U	
108-90-7	Chlorobenzene	50	U	
100-41-4	Ethylbenzene	50	U	
100-42-5	Styrene	50	U	Z

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 3/21/96

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

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212370

Lab Name: TCT-ST. LOUIS Contract: 434286

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

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

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

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

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

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

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

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASLC
74-87-3	Chloromethane	10	U	U
74-83-9	Bromomethane	10	U	
75-01-4	Vinyl chloride	10	U	
75-00-3	Chloroethane	10	U	U
75-09-2	Methylene Chloride	2	BJ	10 U
67-64-1	Acetone	32	B	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	
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

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3/18/96

3/14/96 KA

827

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

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000108 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.				
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DGB 3/16/96

3/14/96 AA

827

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	
124-48-1	Dibromochloromethane	10	U	U
79-00-5	1,1,2-Trichloroethane	10	U	U
71-43-2	Benzene	10	U	U
10061-02-6	trans-1,3-Dichloropropene	10	U	U
75-25-2	Bromoform	10	U	U
108-10-1	4-Methyl-2-pentanone	10	U	U
591-[illegible]	2-Hexanone	10	U	U
127-[illegible]	Tetrachloroethene	75		
79-3[illegible]	1,1,2,2-Tetrachloroethane	2	J	U
108-[illegible]	Toluene	10	U	U
108-90-7	Chlorobenzene	10	U	U
100-41-4	Ethylbenzene	10	U	U
100-42-5	Styrene	10	U	U

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000110

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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

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1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212383

Lab Name: TCT-ST. LOUIS Contract: 434286

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

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

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

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

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

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

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

Number TICs found: 0

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

ASLC

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
2.				
3.				
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30.				

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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

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3/21/96

 3/14/96 AT

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

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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.				
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0001153 3/19/96

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	10 U
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	J
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	
591-78-6	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	U

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3/16/96

3/19/96 AA

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Trip Blank
212439

Lab Name: TCT-ST. LOUIS Contract: 434286

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

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

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

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

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

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

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

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

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1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Trip Blank
212439

Lab Name: TCF-ST. LOUIS Contract: 434286

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

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

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

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

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

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

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

Number TICs found: 3

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

ASLC

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	1120214	UNDECANE	24.89	8	JN
2.		Unknown	26.08	6	J
3.	112403	DODECANE	27.39	10	JN
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
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000118 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-[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	U

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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	ASLC 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	U
126-73-8	Tributylphosphate	6	J	J
534-52-1	4,6-Dinitro-2-methylphenol	50	U	U
86-30-6	N-Nitrosodiphenylamine	20	U	
101-55-3	4-Bromophenyl-phenylether	20	U	
118-74-1	Hexachlorobenzene	20	U	U
87-86-5	Pentachlorophenol	50	U	UJ
85-01-8	Phenanthrene	20	U	U
120-12-7	Anthracene	20	U	
86-74-8	Carbazole	20	U	
84-74-2	Di-n-butylphthalate	20	U	
206-44-0	Fluoranthene	20	U	
129-00-0	Pyrene	20	U	
85-68-7	Butylbenzylphthalate	20	U	
91-[illegible]	3,3'-Dichlorobenzidine	20	U	
56-[illegible]	Benzo(a)anthracene	20	U	
218-[illegible]	Chrysene	20	U	U
11[illegible]	bis(2-Ethylhexyl)phthalate	5	J	20U
117-[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

3/27/96 KA

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.	2665676	Acetic acid, (triphenylphosp	30.97	15	J N
20.					
21.					
22.					
23.					
24.					
25.					
26.					
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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[redacted]	2-Methylnaphthalene	20	U
77[redacted]	Hexachlorocyclopentadiene	20	U
88[redacted]	2,4,6-Trichlorophenol	20	U
95[redacted]	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

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RTA

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212373

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

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

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

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

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

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

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

Injection Volume: 1.0 (uL) Dilution Factor: 1

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

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

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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.				
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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

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3/20/96

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212386

Lab Name: TCL-ST. LOUIS Contract: 434286

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

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

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

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

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

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

Injection Volume: 1.0 (uL) Dilution Factor: 1

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

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

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Field Duplicate
212386

Lab Name: TCT-ST.LOUIS Contract: 434286

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

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

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

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

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

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

Injection Volume: 1.0 (uL) Dilution Factor: 1

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

Number TICs found: 22

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

ASLC

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	75854	2-Butanol, 2-methyl-	4.74	17	JB N
2.	563804	3-Methyl-2-butanone	5.12	15	JB N
3.	1569502	3-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	JB N
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

JN R

MW 3-11-96

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213383

7A

VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: TCT-ST. LOUIS Contract: 434286

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

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

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

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

GC Column: DB624 ID: 0.53 (mm)

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

All other compounds must meet a minimum RRF of 0.010.

FORM VII VOA 3/90

3/18/96

3/19/96 ATK

000128

157

7A-1
VOLATILE CONTINUING CALIBRATION CHECK

Lab Name: TCT-ST. LOUIS Contract: 434286

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

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

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

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

GC Column: DB624 ID: 0.53 (mm)

Surrogate

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

All other compounds must meet a minimum RRF of 0.010.

FORM VII VOA-2 3/90

3/8/96

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	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
1330-20-7	Xylene (total)	50	U

ASLC

FORM I VOA-2 3/90 Rev

3/15/96

000131 3/14/96 KR

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
Lab 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.				
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MW 3.1.96

FORM I VOA-TIC 3/90 Rev

3/15/96

3/14/96 MA

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	
56-23-5	Carbon Tetrachloride	10	U	U
108-05-4	Vinyl Acetate	10	U	
75-27-4	Bromodichloromethane	10	U	
78-87-5	1,2-Dichloropropane	10	U	
10061-01-5	cis-1,3-Dichloropropene	10	U	
79-01-6	Trichloroethene	10	U	
124-48-1	Dibromochloromethane	10	U	
79-00-5	1,1,2-Trichloroethane	10	U	
71-43-2	Benzene	10	U	
10061-02-6	trans-1,3-Dichloropropene	10	U	
75-25-2	Bromoform	10	U	
108-10-1	4-Methyl-2-pentanone	10	U	
591-78-6	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	U

FORM I VOA 3/90 Rev

3/16/96

3/14/96 KA

827

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

000134

827

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.				
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FORM I VOA-TIC 3/90 Rev

3/18/96

3/14/96

000135

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

VBLK3682

Lab Name: TCT-ST. LOUIS Contract: 434286

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

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

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

Level: (low/med) LOW Date Received:

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

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

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

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

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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

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1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

VBLK3682

Lab Name: TCT-ST. LOUIS Contract: 434286

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

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

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

Level: (low/med) LOW Date Received:

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

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

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

Number TICs found: 2

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

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	22.04	140	JB
2.	Unknown	29.14	8	JB
3.				
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FORM I VOA-TIC 3/90 Rev

3/18/96

3/14/96 KK

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

VBLK3683

Lab Name: TCT-ST. LOUIS Contract: 434286

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

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

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

Level: (low/med) LOW Date Received:

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

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

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

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

FORM I VOA 3/90 Rev

3/18/96

3/14/96

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.				
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3/18/96

3/14/96

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212360

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

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

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

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

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

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

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

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

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q	ASL C
74-87-3	Chloromethane	10	U	
74-83-9	Bromomethane	10	U	
75-01-4	Vinyl chloride	10	U	
75-00-3	Chloroethane	10	U	
75-09-2	Methylene Chloride	3	BJ	10U
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
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-[illegible]-2	Bromoform	10	U	
10[illegible]	4-Methyl-2-pentanone	10	U	
5[illegible]	2-Hexanone	10	U	
12[illegible]	Tetrachloroethene	90		
79-[illegible]	1,1,2,2-Tetrachloroethane	10	U	
108-[illegible]-3	Toluene	10	U	
108-90-7	Chlorobenzene	10	U	
100-41-4	Ethylbenzene	10	U	
100-42-5	Styrene	10	U	

3/14/96 RM

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212360

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: 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

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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
2.				
3.				
4.				
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R

FORM I VOA-TIC 3/90 Rev

3/16/96

3/14/96 AA 1S

827

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	
75-25-2	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

5/24/96 R

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000145

3/14/96 RK

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

3/15/96

3/14/96 KK

827

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

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3/14/96 KA

000147

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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

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3/18/96

000148 3/14/96 AA

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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.				
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DB 3/18/96

000149

3/14/96 AA

1A
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	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	J
67-64-1	Acetone	12		U
75-15-0	Carbon Disulfide	10	U	U
75-35-4	1,1-Dichloroethene	5	J	U
75-34-3	1,1-Dichloroethane	1	J	U
156-60-5	trans-1,2-Dichloroethene	10	U	U
156-59-2	cis-1,2-Dichloroethene	3	J	U
67-66-3	Chloroform	10	U	U
107-06-2	1,2-Dichloroethane	2	J	U
78-93-3	2-Butanone	10	U	U
71-55-6	1,1,1-Trichloroethane	7	J	U
56-23-5	Carbon Tetrachloride	10	U	U
108-05-4	Vinyl Acetate	10	U	U
75-27-4	Bromodichloromethane	10	U	U
78-87-5	1,2-Dichloropropane	10	U	U
10061-01-5	cis-1,3-Dichloropropene	10	U	U
79-01-6	Trichloroethene	550	E	J
124-48-1	Dibromochloromethane	10	U	U
79-00-5	1,1,2-Trichloroethane	10	U	U
71-43-2	Benzene	10	U	U
10061-02-6	trans-1,3-Dichloropropene	10	U	U
75-25-2	Bromoform	10	U	U
108-[illegible]	4-Methyl-2-pentanone	10	U	U
591-[illegible]	2-Hexanone	10	U	U
127-[illegible]	Tetrachloroethene	75		U
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

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000150 3/14/96 KA

1A-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212383

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: 02005-01A

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

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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.				
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30.				

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212383 DL

Lab Name: TCT-ST. LOUIS Contract: 434286

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

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

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

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

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

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

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

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q ASL C
74-87-3	Chloromethane	50	U
74-83-9	Bromomethane	50	U
75-01-4	Vinyl chloride	50	U
75-00-3	Chloroethane	50	U
75-09-2	Methylene Chloride	8	BJ
67-64-1	Acetone	50	U
75-15-0	Carbon Disulfide	50	U
75-35-4	1,1-Dichloroethene	5	J
75-34-3	1,1-Dichloroethane	50	U
156-60-5	trans-1,2-Dichloroethene	50	U
156-59-2	cis-1,2-Dichloroethene	50	U
67-66-3	Chloroform	50	U
107-06-2	1,2-Dichloroethane	50	U
78-93-3	2-Butanone	50	U
71-55-6	1,1,1-Trichloroethane	5	J
56-23-5	Carbon Tetrachloride	50	U
108-05-4	Vinyl Acetate	50	U
75-27-4	Bromodichloromethane	50	U
78-87-5	1,2-Dichloropropane	50	U
10061-01-5	cis-1,3-Dichloropropene	50	U
79-01-6	Trichloroethene	530	
124-48-1	Dibromochloromethane	50	U
79-00-5	1,1,2-Trichloroethane	50	U
71-43-2	Benzene	50	U
10061-02-6	trans-1,3-Dichloropropene	50	U
75-25-2	Bromoform	50	U
108-10-1	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

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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

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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.				
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212386

Lab Name: TCR-ST. LOUIS Contract: 434286

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

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

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

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

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

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

Injection Volume: 1.0 (uL) Dilution Factor: 1

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

ASLC

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

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3/27/96

3/27/90

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	R
56[illegible]	Benzo(a)anthracene	20	U	U
21[illegible]	Chrysene	20	U	U
1[illegible]	Bis(2-Ethylhexyl)phthalate	5	J	20U
1[illegible]	Di-n-octylphthalate	20	U	U
2[illegible]	Benzo(b)fluoranthene	20	U	
2[illegible]	Benzo(k)fluoranthene	20	U	
50-32-8	Benzo(a)pyrene	20	U	
193-39-5	Indeno(1,2,3-cd)pyrene	20	U	
53-70-3	Dibenzo(a,h)anthracene	20	U	
191-24-2	Benzo(g,h,i)perylene	20	U	U

3/27/96

3/21/96

827

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-Dini[illegible]ene	*	.387	.387	.383	.372	.343	.374	5.0*
3-Nitroa[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

3/21/96

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.					

AW 3-11-96

FORM I SV-TIC 3/90 Rev

3/27/96

3/27/96

827

212373
212363

7C

SEMIVOLATILE CONTINUING CALIBRATION CHECK

Lab Name: TCT-ST.LOUIS Contract: 434286

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

Instrument ID: 59701D Calibration Date: 03/01/96 Time: 10:38

Lab File ID: >D5312 Init. Calib. Date(s): 02/29/96 03/01/96

Init. Calib. Times: 22:36 02:24

COMPOUND	RRF	RRF050	MIN RRF	%D	MAX %D
Diethylphthalate	1.433	1.522		6.2	
4-Chlorophenyl-phenyl ether	.631	.697	.400	10.5	25.0
Fluorene	1.160	1.292	.900	11.4	25.0
4-Nitroaniline	.156	.132		15.4	
Tributylphosphate	4.160	4.441		6.8	
4,6-Dinitro-2-methylphenol	.111	.116		4.5	
N-Nitrosodiphenylamine	.479	.475		.9	
4-Bromophenyl-phenylether	.234	.236	.100	1.1	25.0
Hexachlorobenzene	.280	.276	.100	1.5	25.0
* Pentachlorophenol	.102	.075	.050	26.0	25.0
Phenanthrene	1.028	1.030	.700	.2	25.0
Anthracene	.957	.990	.700	3.5	25.0
Carbazole	.537	.555		3.3	
Di-n-butylphthalate	1.434	1.452		1.3	
Fluoranthene	1.083	1.076	.600	.7	25.0
Pyrene	1.954	1.922	.600	1.6	25.0
Butylbenzylphthalate	1.130	1.124		.6	
3,3'-Dichlorobenzidine	.138	.143		3.4	
Benzo(a)anthracene	1.357	1.352	.800	.4	25.0
Chrysene	1.209	1.395	.700	15.3	25.0
bis(2-Ethylhexyl)phthalate	1.393	1.382		.8	
Di-n-octylphthalate	3.034	2.362		22.2	
* Benzo(b)fluoranthene	1.664	1.199	.700	28.0	25.0
Benzo(k)fluoranthene	1.226	1.146	.700	6.6	25.0
Benzo(a)pyrene	1.167	1.123	.700	3.7	25.0
Indeno(1,2,3-cd)pyrene	.844	.746	.500	11.6	25.0
Dibenzo(a,h)anthracene	.610	.656	.400	7.5	25.0
Benzo(g,h,i)perylene	.766	.606	.500	20.9	25.0
Nitrobenzene-d5	.409	.375	.200	8.3	25.0
2-Fluorobiphenyl	1.242	1.348	.700	8.5	25.0
Terphenyl-d14	1.168	1.046	.500	10.4	25.0
Phenol-d5	1.323	1.403	.800	6.0	25.0
2-Fluorophenol	1.102	1.166	.600	5.8	25.0
2,4,6-Tribromophenol	.188	.198		5.0	
2-Chlorophenol-d4	1.263	1.356	.800	7.3	25.0
1,2-Dichlorobenzene-d4	.890	.962	.400	8.1	25.0

All other compounds must meet a minimum RRF of 0.010.

FORM VII SV-2 3/90

DJB 3/24/96

000160 3/21/96 AM

212356

6B

SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: TCT-ST.LOUIS Contract: 434286

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

Instrument ID: 59701D Calibration Date(s): 03/04/96

Calibration Times: 14:09 20:17

LAB FILE ID: RRF020= >D5354 RRF050= >D5349
RRF080= >D5351 RRF120= >D5352 RRF160= >D5353

COMPOUND		RRF020	RRF050	RRF080	RRF120	RRF160	$\overline{RRF}$	RSD
Phenol	*	1.717	1.633	1.730	1.764	1.756	1.720	3.0*
bis(2-Chloroethyl)Ether	*	1.537	1.357	1.421	1.417	1.314	1.409	6.0*
2-Chlorophenol	*	1.334	1.358	1.414	1.400	1.387	1.379	2.4*
1,3-Dichlorobenzene	*	1.529	1.587	1.590	1.527	1.487	1.544	2.8*
1,4-Dichlorobenzene	*	1.581	1.647	1.633	1.600	1.565	1.605	2.1*
1,2-Dichlorobenzene	*	1.485	1.524	1.505	1.436	1.347	1.460	4.9*
2-Methylphenol	*	1.189	1.193	1.197	1.157	1.110	1.169	3.1*
bis(2-Chloroisopropyl)ether		1.962	1.891	1.943	1.896	2.231	1.985	7.1
4-Methylphenol	*	1.190	1.237	1.287	1.286	1.269	1.254	3.3*
N-Nitroso-di-n-propylamine	*	1.079	1.042	1.083	1.087	1.067	1.072	1.7*
Hexachloroethane	*	.669	.675	.673	.673	.652	.668	1.4*
Nitrobenzene	*	.468	.440	.467	.463	.450	.457	2.7*
Isophorone	*	.849	.844	.853	.850	.839	.847	.7*
2-Nitrophenol	*	.279	.244	.241	.251	.245	.252	6.2*
2,4-Dimethylphenol	*	.385	.389	.384	.399	.388	.389	1.5*
bis(2-Chloroethoxy)methane	*	.533	.526	.538	.547	.558	.540	2.3*
2,4-Dichlorophenol	*	.355	.374	.367	.373	.376	.369	2.3*
1,2,4-Trichlorobenzene	*	.428	.452	.440	.440	.436	.439	2.0*
Naphthalene	*	1.197	1.173	1.214	1.221	1.188	1.199	1.6*
4-Chloroaniline		.443	.514	.564	.590	.590	.540	11.6
Hexachlorobutadiene		.294	.310	.304	.302	.291	.300	2.5
4-Chloro-3-methylphenol	*	.347	.361	.367	.371	.358	.361	2.5*
2-Methylnaphthalene	*	.729	.765	.762	.758	.750	.753	1.9*
Hexachlorocyclopentadiene		.463	.486	.523	.530	.494	.499	5.5
2,4,6-Trichlorophenol	*	.466	.497	.515	.549	.558	.517	7.3*
2,4,5-Trichlorophenol	*	.505	.517	.531	.482	.480	.503	4.4*
2-Chloronaphthalene	*	1.268	1.248	1.268	1.276	1.256	1.263	.9*
2-Nitroaniline		.415	.388	.440	.446	.439	.426	5.7
Dimethylphthalate		1.546	1.509	1.584	1.552	1.543	1.547	1.7
Acenaphthylene	*	1.900	1.818	1.729	1.829	1.869	1.829	3.5*
2,6-Dinitrotoluene	*	.348	.364	.383	.354	.349	.360	4.0*
3-Nitroaniline		.100	.151	.225	.324	.354	.231	47.1
Acenaphthene	*	1.212	1.230	1.229	1.209	1.150	1.206	2.7*
2,4-Dinitrophenol		.150	.204	.226	.248	.257	.217	19.6
4-Nitrophenol		.153	.173	.175	.183	.180	.173	6.7
Dibenzofuran	*	1.800	1.789	1.828	1.819	1.791	1.805	1.0*

* Compounds with required minimum RRF and maximum %RSD values.
All other compounds must meet a minimum RRF of 0.010.

FORM VI SV-1 3/90

3/27/96

3/27/96

827

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
Ni[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
Ph[illegible]	1.657	1.645	.800	.7	25.0
2-Fluorophenol	1.317	1.291	.600	2.0	25.0
2,4,6-Tribromophenol	.300	.288		4.0	
2-Chlorophenol-d4	1.383	1.410	.800	1.9	25.0
1,2-Dichlorobenzene-d4	.986	1.011	.400	2.5	25.0

All other compounds must meet a minimum RRF of 0.010.

FORM VII SV-2 3/90

3/27/96

000162 3/21/96

8C

SEMIVOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: TCT-ST.LOUIS Contract: 434286

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

Lab File ID (Standard): >D5312 Date Analyzed: 03/01/96

Instrument ID: 59701D Time Analyzed: 10:38

		IS4(PHN) AREA #	RT #	IS5(CHR) AREA #	RT #	IS6(PER) AREA #	RT #
	12 HOUR STD	184166	23.63	103526	30.73	80704	34.96
	UPPER LIMIT	368332	24.13	207052	31.23	161408	35.46
	LOWER LIMIT	92083	23.13	51763	30.23	40352	34.46
	EPA SAMPLE NO.						
1	212373	138943	23.63	74160	30.74	45449	34.96
2	212363	111970	23.64	47791 *	30.75	20157 *	34.99
3	212363 MS	150821	23.64	60609	30.75	29705 *	34.97
4	212363 MSD	172940	23.65	70750	30.76	35567 *	34.98
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

IS4 ([illegible]) = D10 PHENANTHRENE
IS5 ([illegible]) = D12 CHRYSENE
IS6 ([illegible]) = D12 PERYLENE

AREA UPPER LIMIT = +100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = +.50 minutes of internal standard RT
RT LOWER LIMIT = -.50 minutes of internal standard RT

Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.

page __ of __.

FORM VIII SV-2

3/90 Rev

3/27/96

3/21/96 AK

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

212363 MS

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: >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	

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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
218-01-9	Chrysene	20	U
117-81-7	bis(2-Ethylhexyl)phthalate	4	J
117-84-0	Di-n-octylphthalate	20	U
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

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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	

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000166

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

212363 MSD

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: 2005-14A

Sample wt/vol: 1000 (g/ml) ML Lab File ID: >D5316

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

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

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

Injection Volume: 1.0 (uL) Dilution Factor: 1

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

CAS NO.	COMPOUND	(ug/L or ug/Kg) ug/L	Q
51-28-5	2,4-Dinitrophenol	50	U
100-02-7	4-Nitrophenol	59	
132-64-9	Dibenzofuran	20	U
121-14-2	2,4-Dinitrotoluene	36	
84-66-2	Diethylphthalate	20	U
7005-72-3	4-Chlorophenyl-phenyl ether	20	U
86-73-7	Fluorene	20	U
100-01-6	4-Nitroaniline	50	U
126-73-8	Tributylphosphate	5	J
534-52-1	4,6-Dinitro-2-methylphenol	50	U
86-30-6	N-Nitrosodiphenylamine	20	U
101-55-3	4-Bromophenyl-phenylether	20	U
118-74-1	Hexachlorobenzene	20	U
87-86-5	Pentachlorophenol	110	
85-01-8	Phenanthrene	20	U
120-12-7	Anthracene	20	U
86-74-8	Carbazole	20	U
84-74-2	Di-n-butylphthalate	20	U
206-44-0	Fluoranthene	20	U
129-00-0	Pyrene	55	
85-68-7	Butylbenzylphthalate	20	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)anthracene	20	U
218-01-9	Chrysene	20	U
117-[illegible]	bis(2-Ethylhexyl)phthalate	5	J
117-[illegible]	Di-n-octylphthalate	20	U
205-[illegible]	Benzo(b)fluoranthene	20	U
207-[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

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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	ASLC
108-95-2	Phenol	20	U	
111-44-4	bis(2-Chloroethyl)Ether	20	U	U
95-57-8	2-Chlorophenol	20	U	
541-73-1	1,3-Dichlorobenzene	20	U	
106-46-7	1,4-Dichlorobenzene	20	U	
95-50-1	1,2-Dichlorobenzene	20	U	
95-48-7	2-Methylphenol	20	U	
108-60-1	bis(2-Chloroisopropyl)ether	20	U	
106-44-5	4-Methylphenol	20	U	
621-64-7	N-Nitroso-di-n-propylamine	20	U	
67-72-1	Hexachloroethane	20	U	
98-95-3	Nitrobenzene	20	U	
78-59-1	Isophorone	20	U	
88-75-5	2-Nitrophenol	20	U	
105-67-9	2,4-Dimethylphenol	20	U	
111-91-1	bis(2-Chloroethoxy)methane	20	U	
120-83-2	2,4-Dichlorophenol	20	U	
120-82-1	1,2,4-Trichlorobenzene	20	U	
91-20-3	Naphthalene	20	U	
106-47-8	4-Chloroaniline	20	U	
87-68-3	Hexachlorobutadiene	20	U	
59-50-7	4-Chloro-3-methylphenol	20	U	
91-57-6	2-Methylnaphthalene	20	U	
77-47-4	Hexachlorocyclopentadiene	20	U	
88-06-2	2,4,6-Trichlorophenol	20	U	
95-95-4	2,4,5-Trichlorophenol	50	U	
91-58-7	2-Chloronaphthalene	20	U	
88-74-4	2-Nitroaniline	50	U	
131-11-3	Dimethylphthalate	20	U	
208-96-8	Acenaphthylene	20	U	
606-20-2	2,6-Dinitrotoluene	20	U	
99-09-2	3-Nitroaniline	50	U	
83-32-9	Acenaphthene	20	U	U

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1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Duplicate
212363

Lab Name: ST. LOUIS Contract: 434286

Lab Code: TCL 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	J
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	UJ
87-86-5	Pentachlorophenol	50	U	UJ
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	UJ
129-00-0	Pyrene	20	U	UJ
[illegible]	Butylbenzylphthalate	20	U	
[illegible]	3,3'-Dichlorobenzidine	20	U	
[illegible]	Benzo(a)anthracene	20	U	
[illegible]	Chrysene	20	U	UJ
[illegible]	bis(2-Ethylhexyl)phthalate	5	J	R OUJ
[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 KT

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.					

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3/21/96 RTT

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field Blank
212373

Lab Name: TCT-ST. LOUIS Contract: 434286

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

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

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

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

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

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

Injection Volume: 1.0 (uL) Dilution Factor: 1

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

ASLC

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

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1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Field blank 1C
212373

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

Lab Code: TCW 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	
85-68-7	Butylbenzylphthalate	20	U	
[redacted]	3,3'-Dichlorobenzidine	20	U	
[redacted]	Benzo(a)anthracene	20	U	
[redacted]	Chrysene	20	U	U
[redacted]	bis(2-Ethylhexyl)phthalate	5	J	U
[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.				
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29.				
30.				

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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

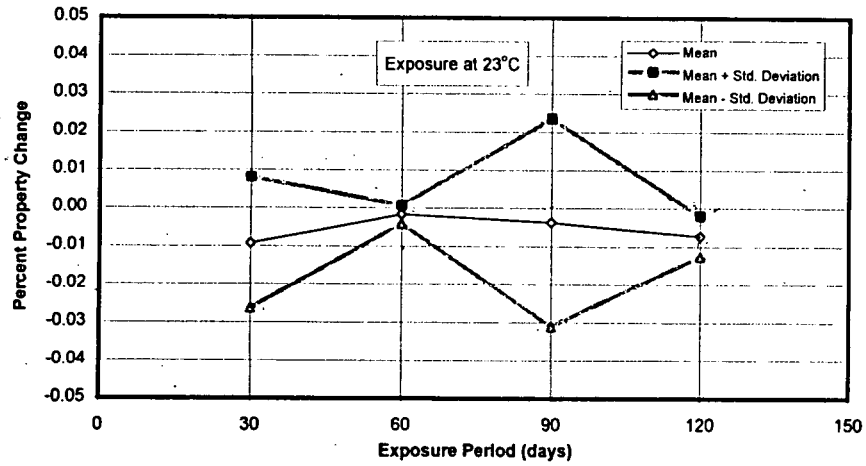
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

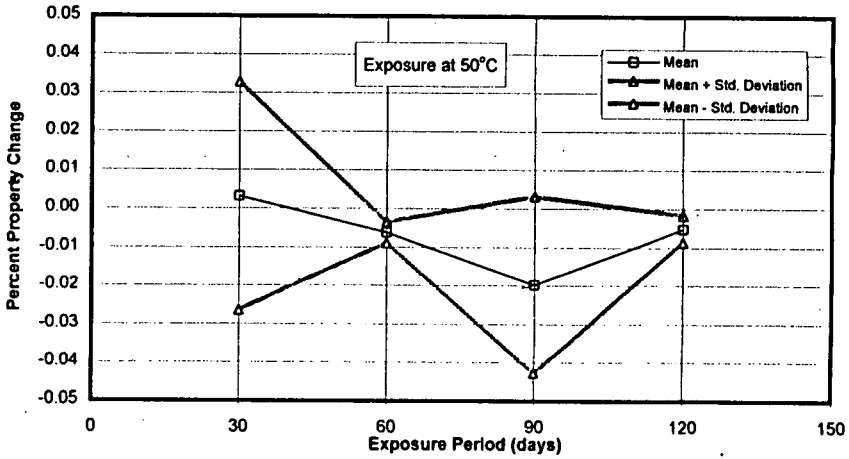
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: GSE-SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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





GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

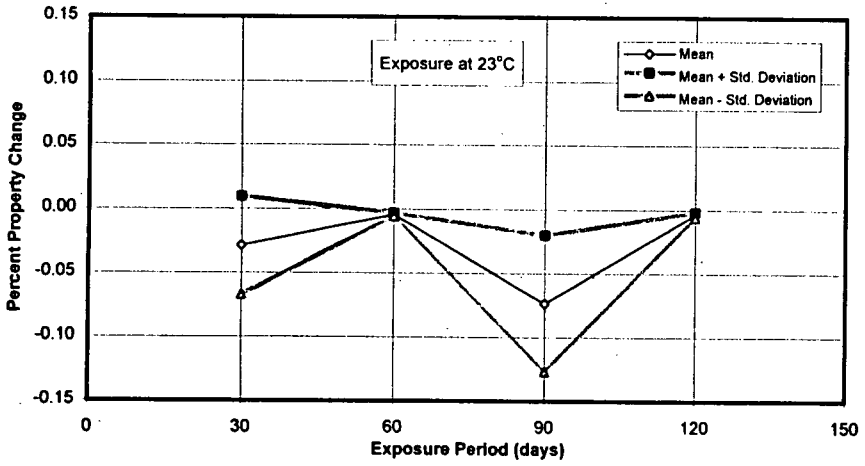
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

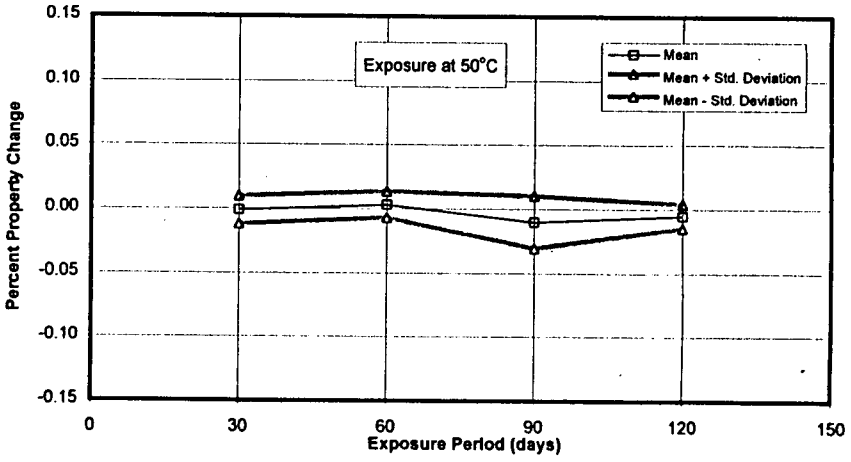
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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	68.478	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





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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

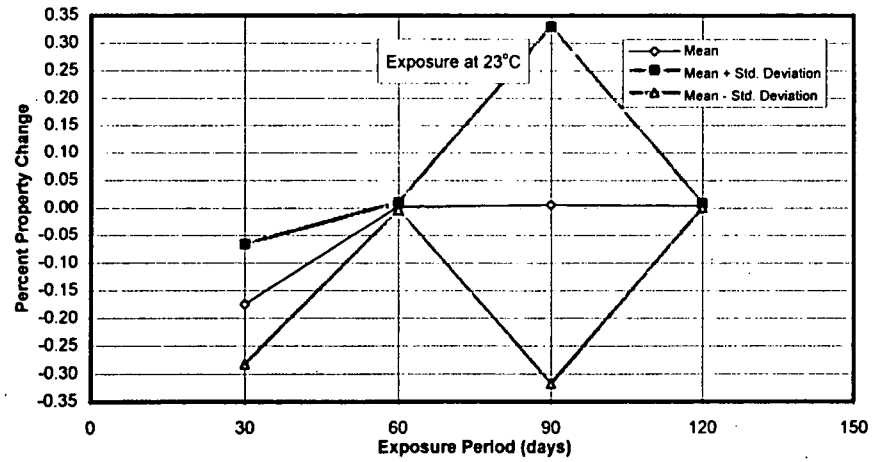
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

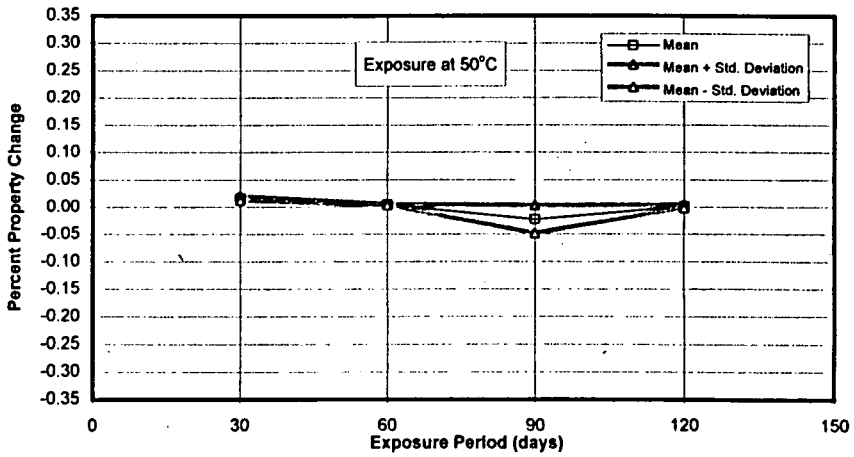
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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	73.128	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

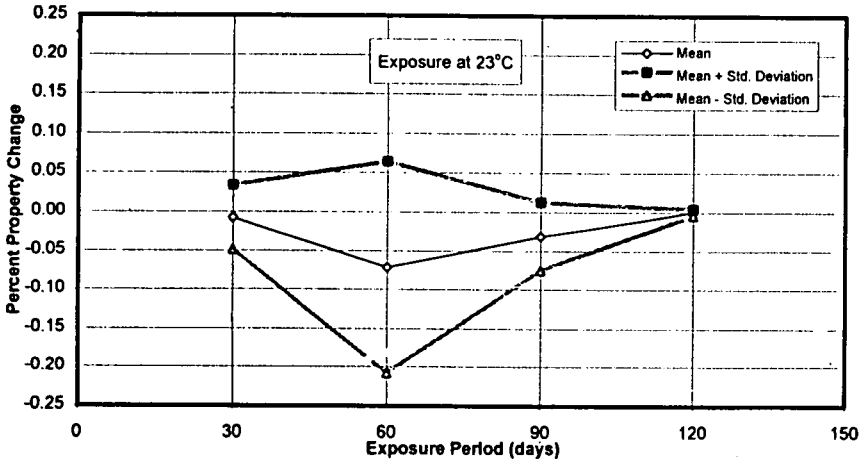
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

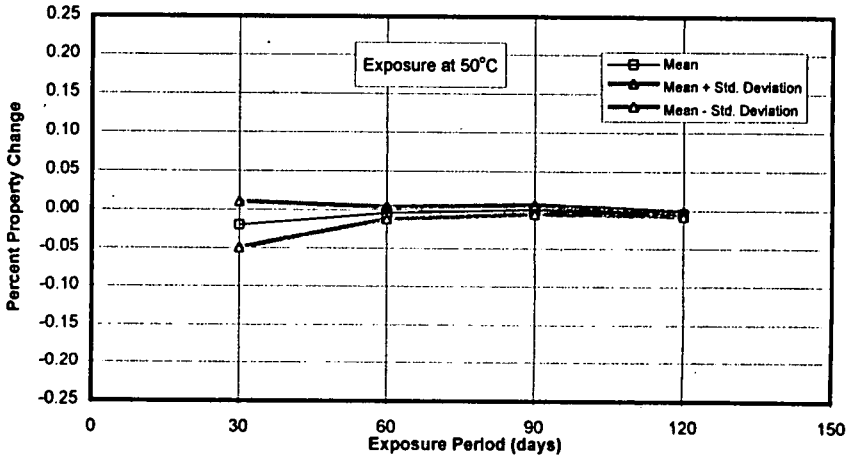
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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			0.138			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





GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

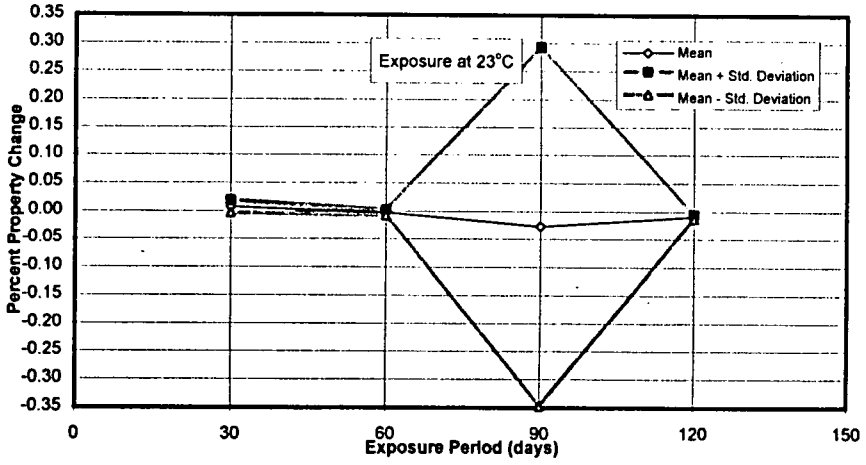
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

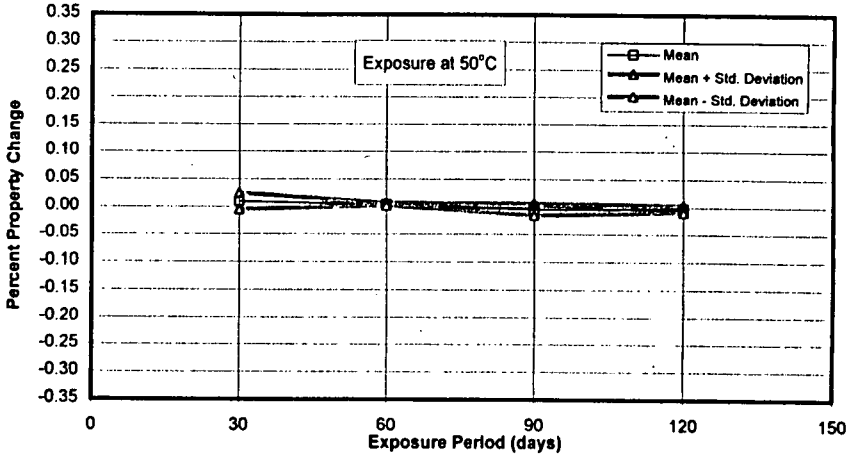
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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





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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

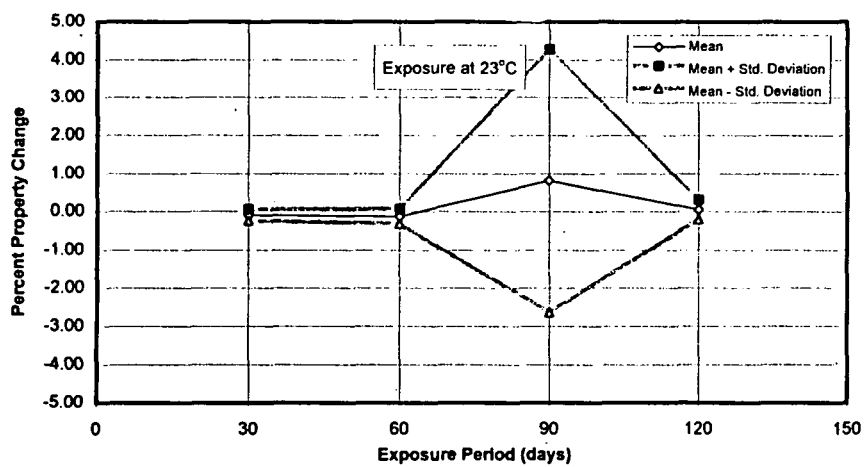
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

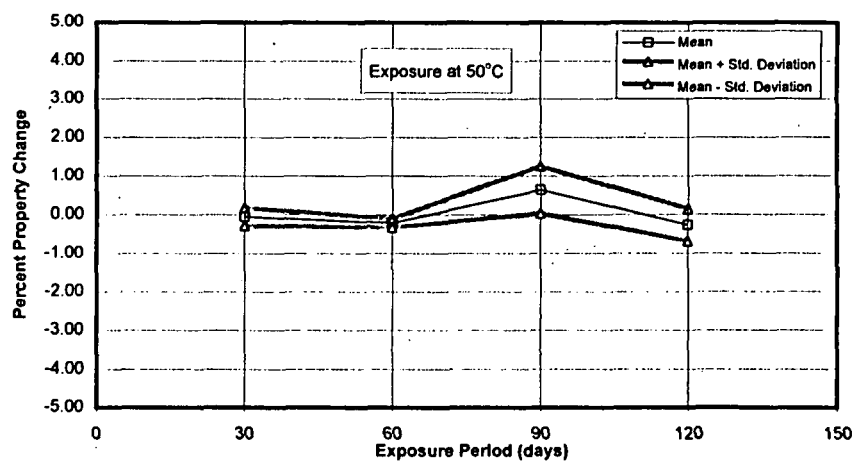
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: GSE-SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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

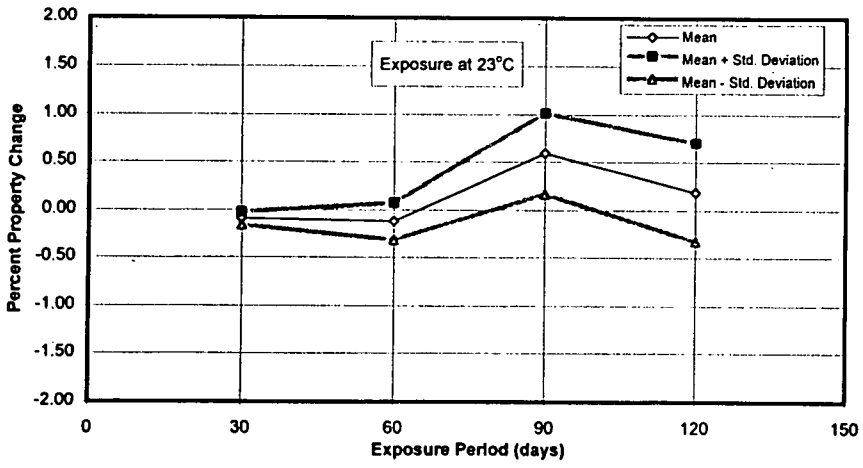
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

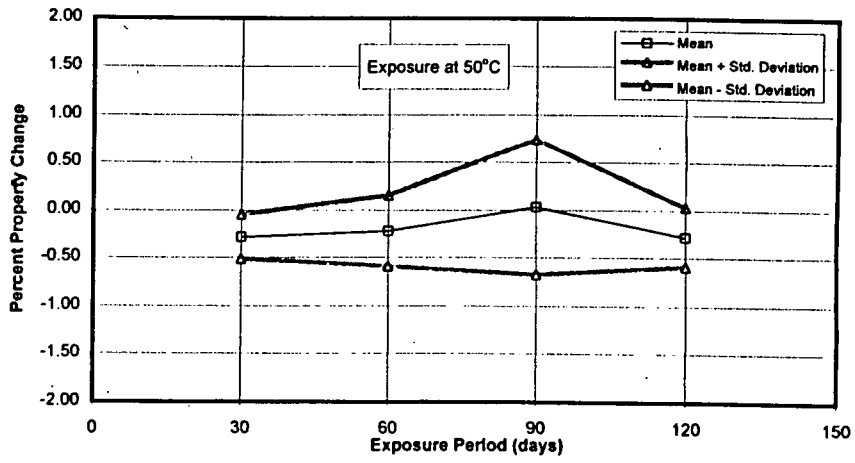
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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	-0.389
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

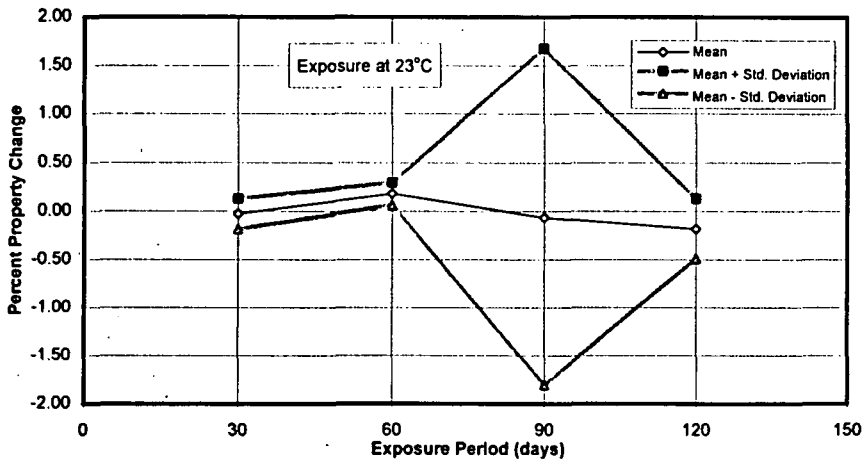
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

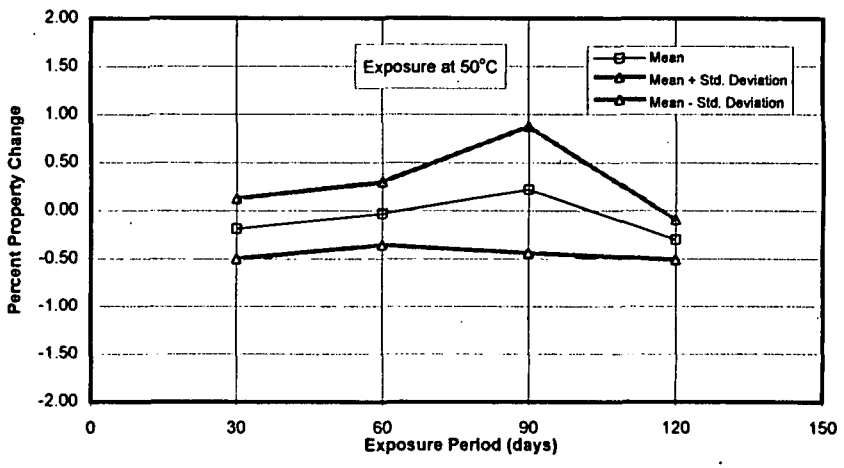
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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





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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

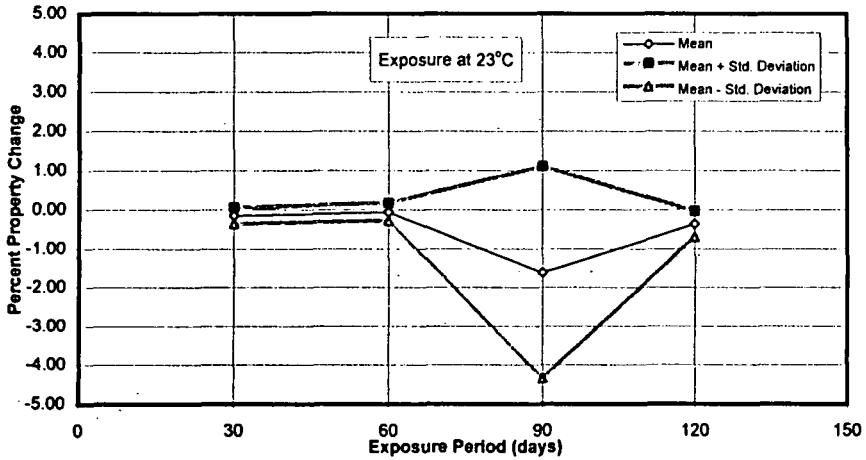
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

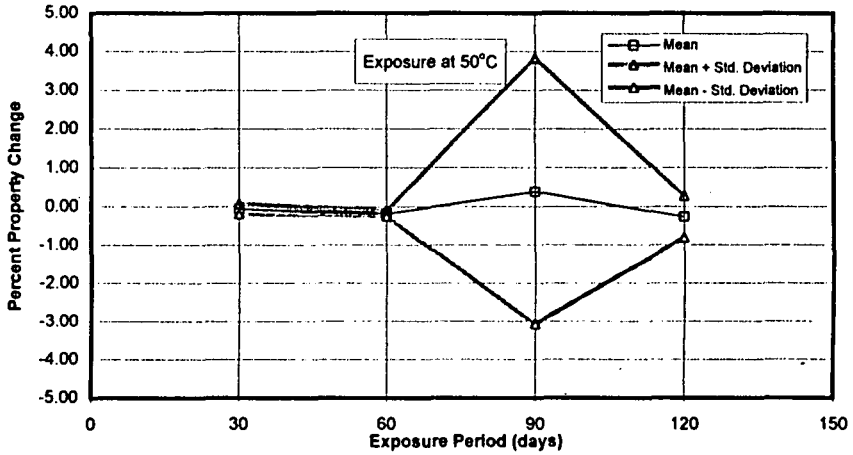
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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

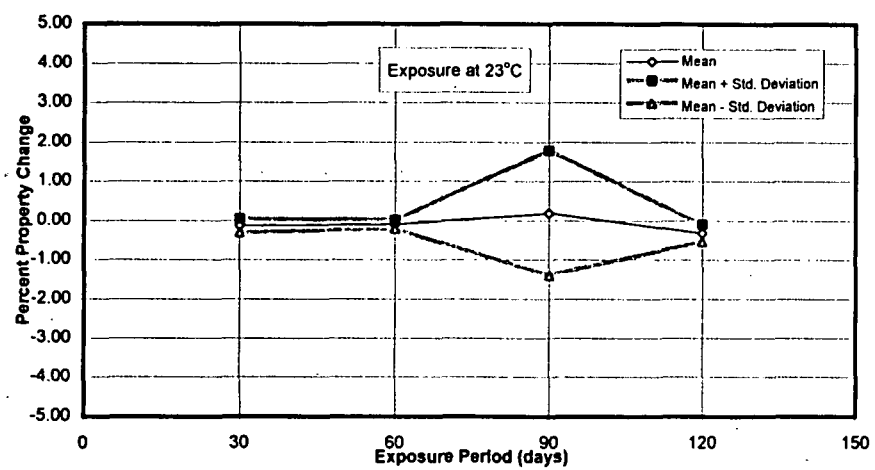
CLIENT: *FERMCO*
METHOD: *EPA 9090*
DATE TESTED: *6/14/96*

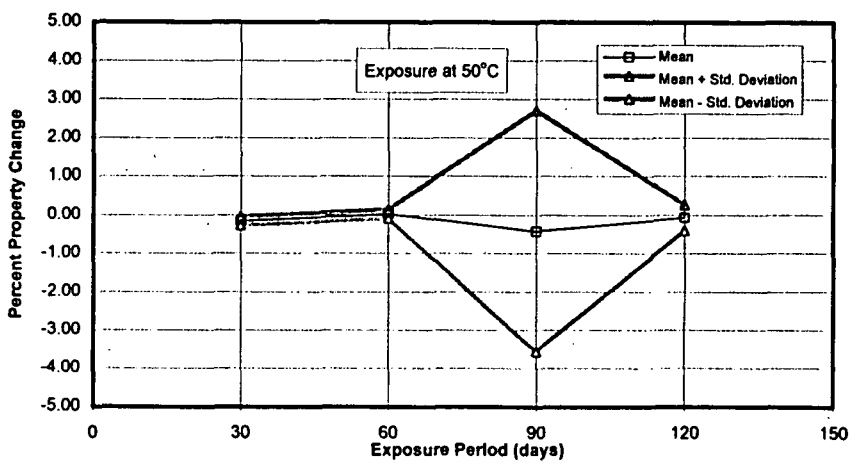
GEOSYNTEC JOB NO.: *GE3900*
MATERIAL TYPE: *SERROT*
CHARACTERISTICS: *80 mil HDPE Geomembrane*
IMMERSION MEDIUM: *Perched Ground Water*

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





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

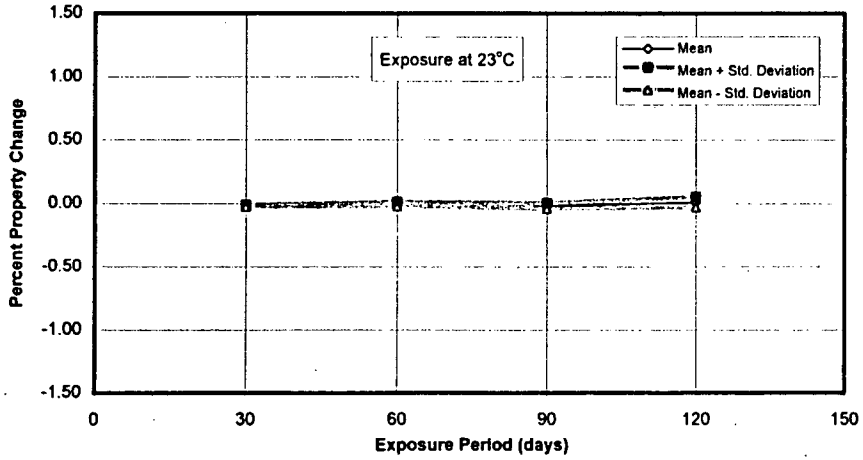
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

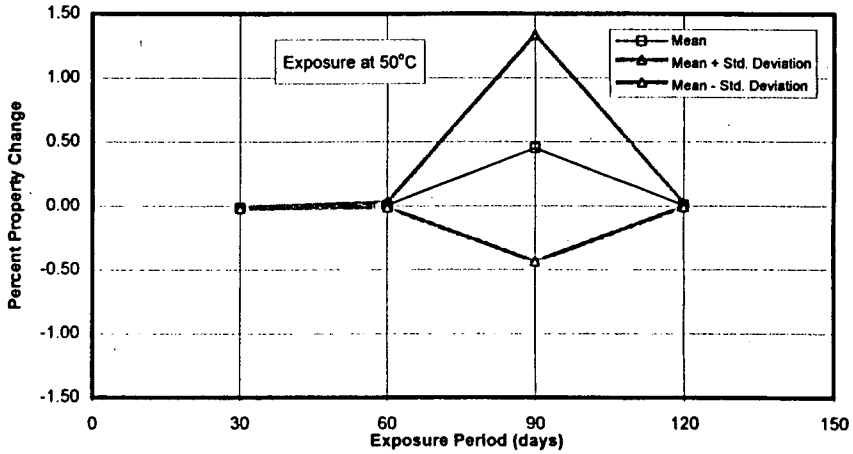
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: GSE-SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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			0.018			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





GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

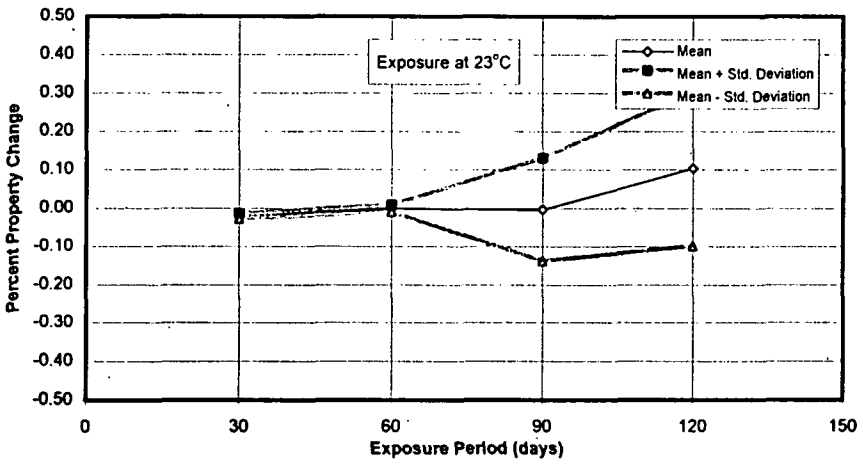
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

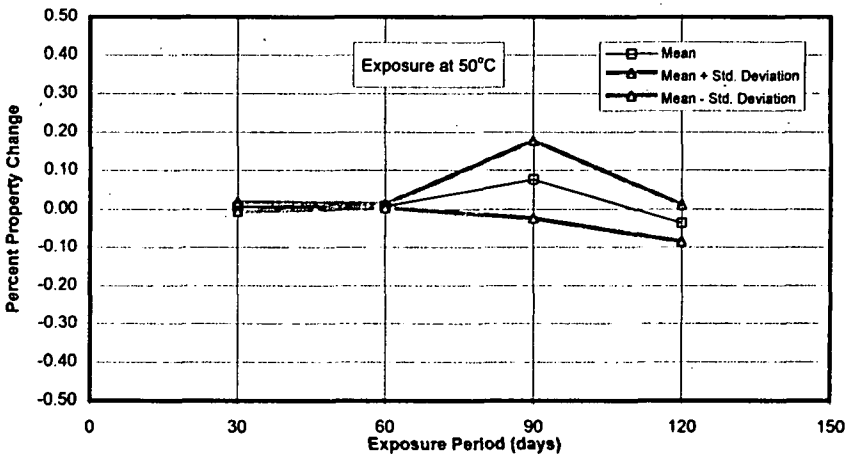
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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

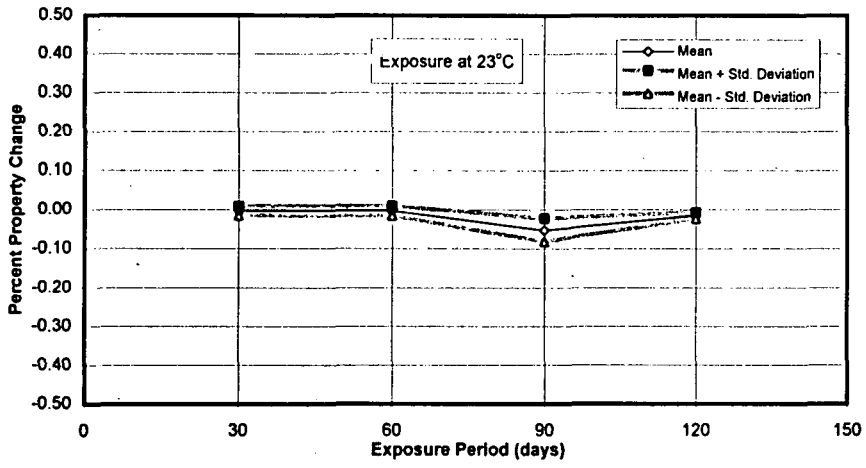
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

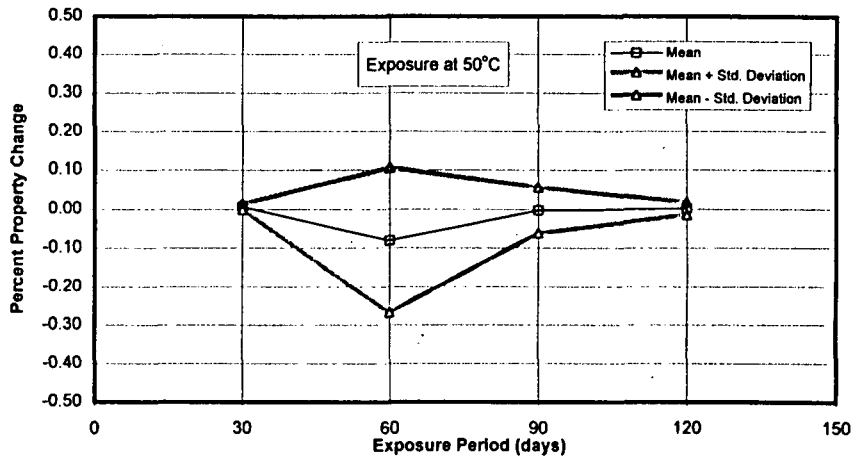
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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			0.016
Is Zero Percent Property Change within One Std. Deviation?			Yes			Yes			Yes			Yes





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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

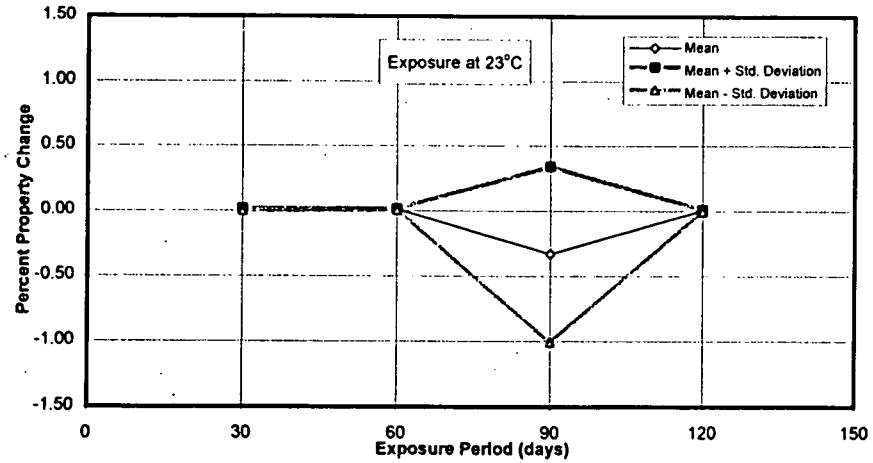
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

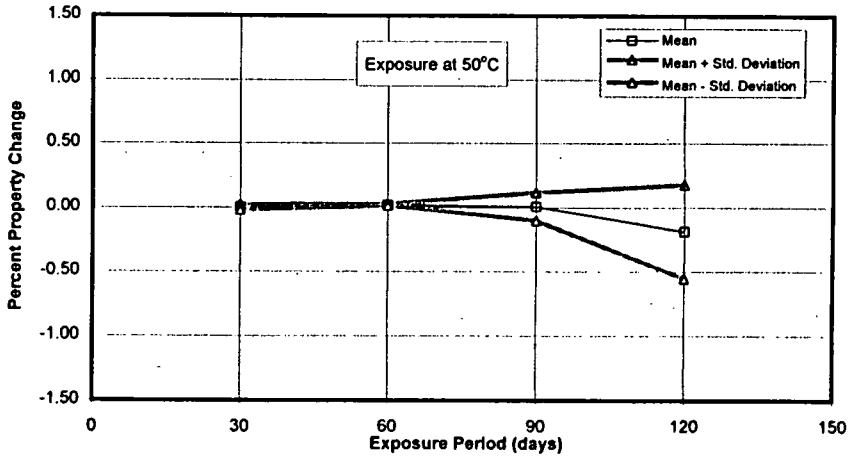
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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	268.760	268.780	0.007
	267.350	267.390	0.015	266.270	266.310	0.015	268.770	269.000	0.086	268.760	268.740	-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	265.640	265.600	-0.015
	266.990	266.980	-0.004	268.100	268.140	0.015	268.670	268.690	0.007	268.120	268.150	-0.735
	265.380	265.310	-0.026	267.420	267.480	0.022	268.670	268.350	-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

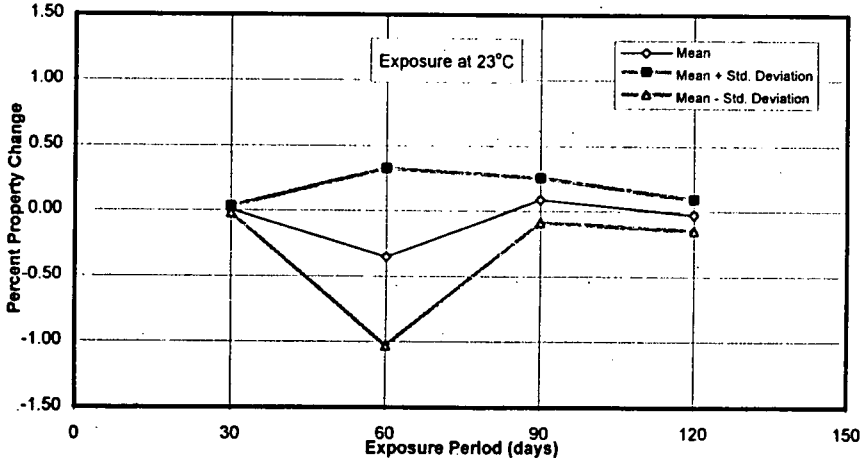
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

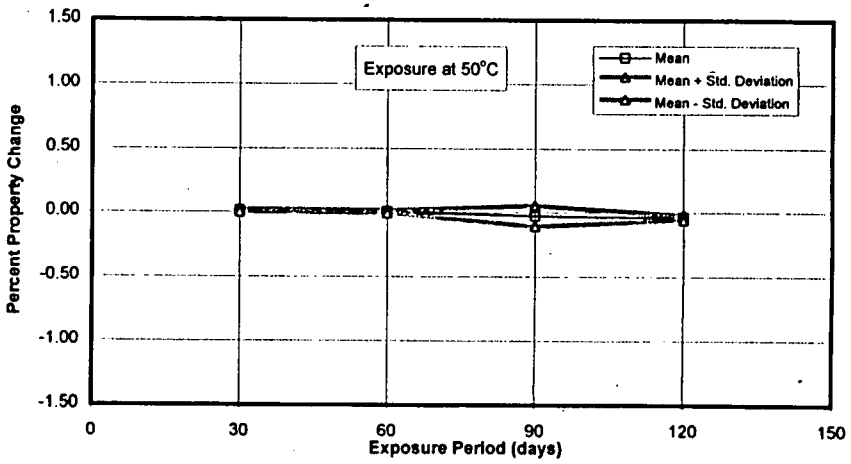
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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





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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

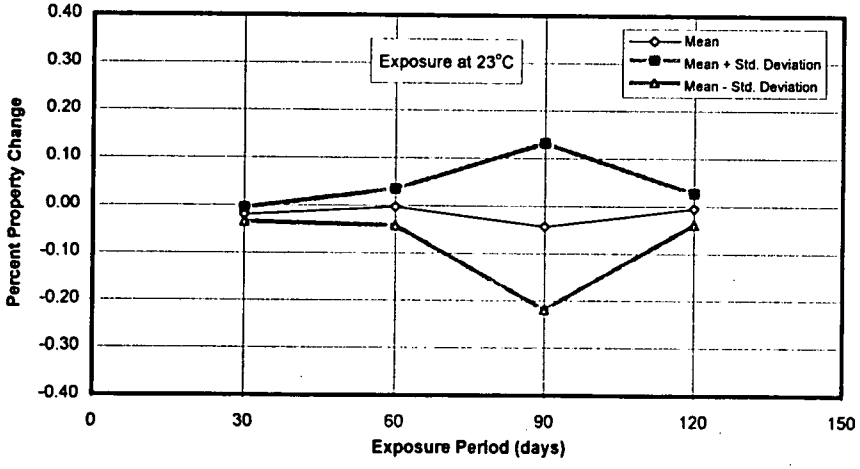
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

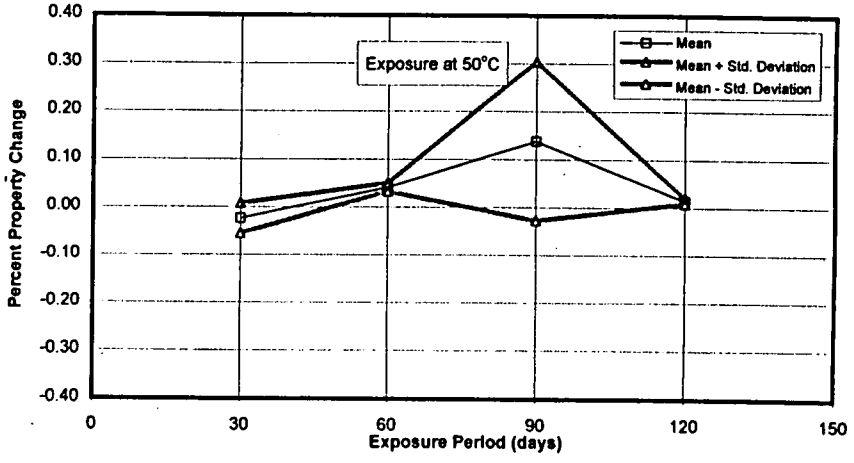
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: GSE-SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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





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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

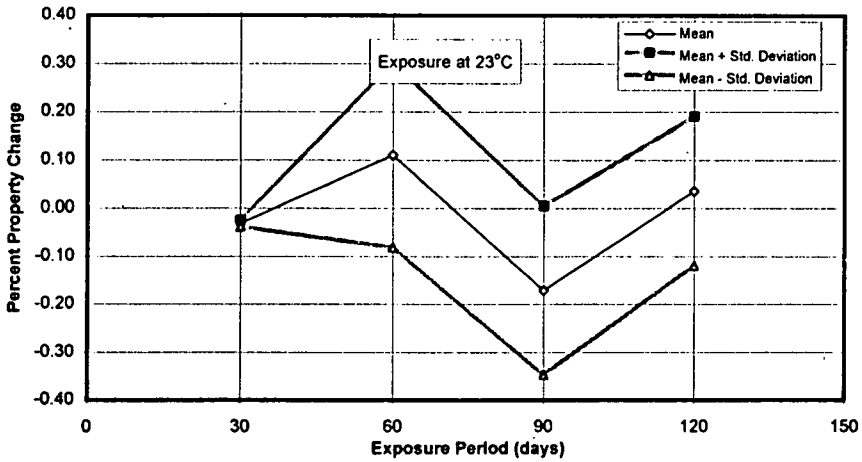
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

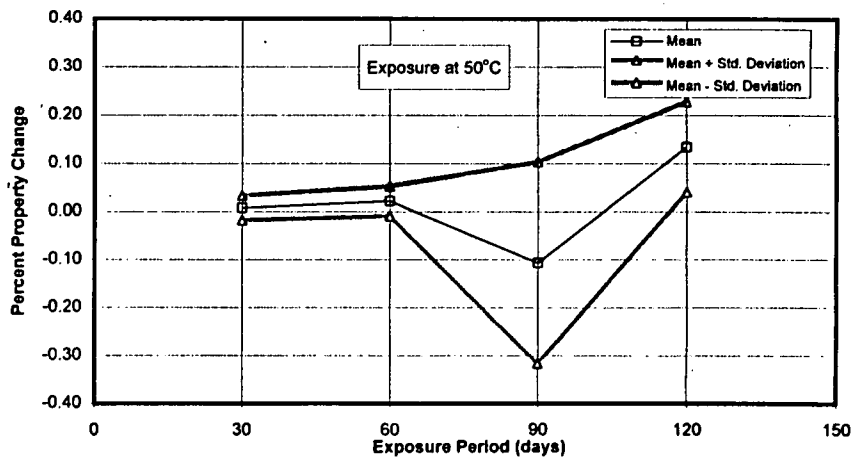
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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	0.398	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			-0.108			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





GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

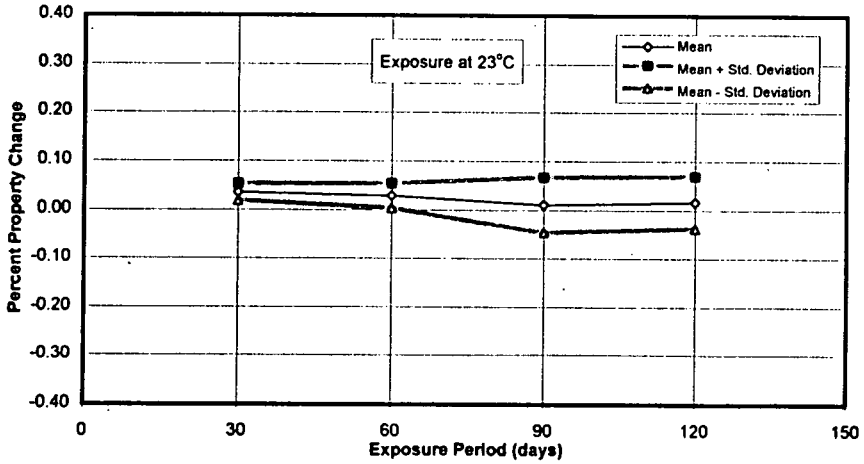
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

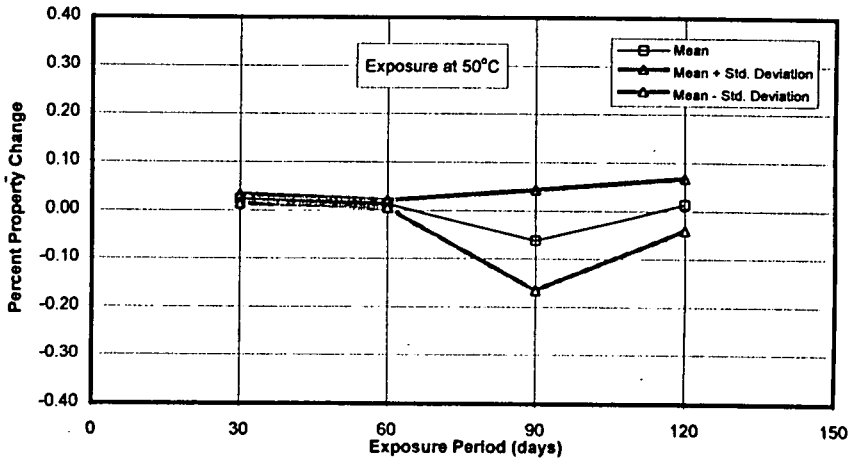
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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





GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

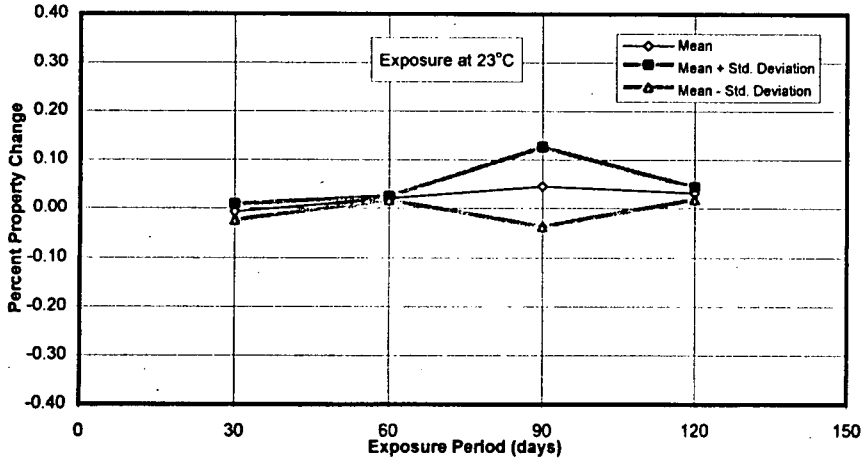
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

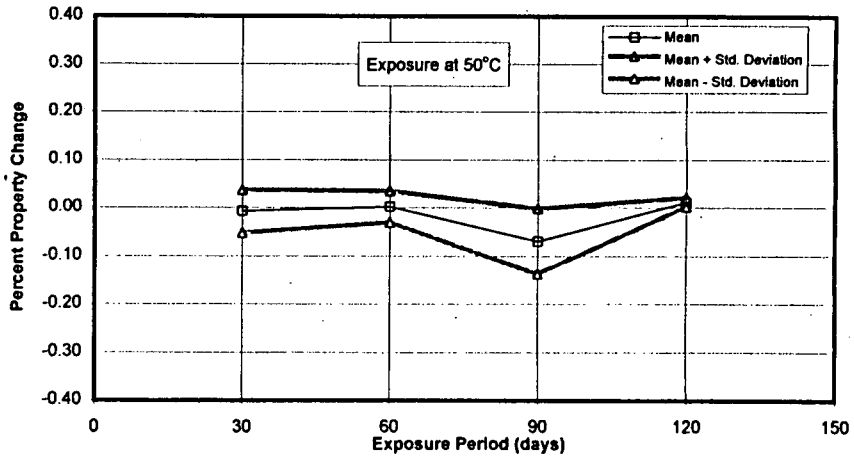
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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





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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

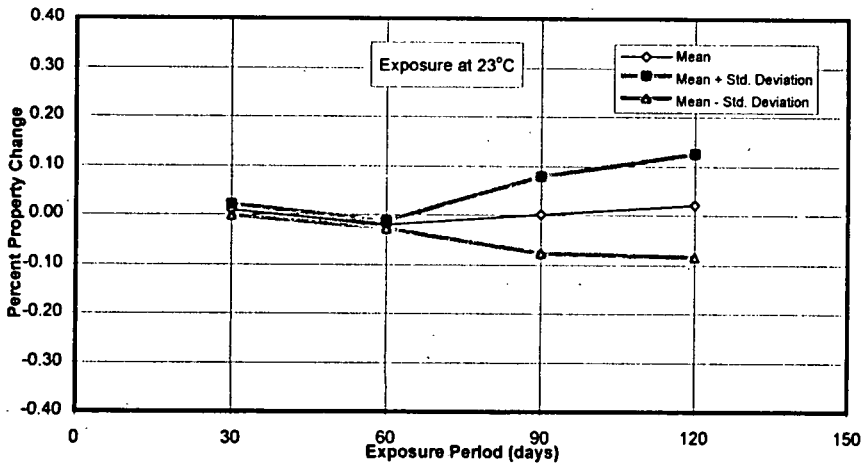
CLIENT: FERMCO
METHOD: EPA 9090
DATE TESTED: 6/14/96

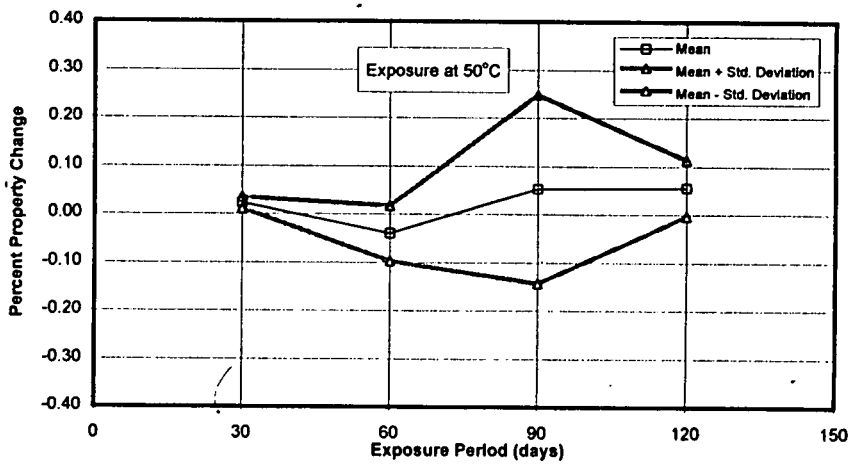
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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			0.196			0.059
Is Zero Percent Property Change within One Std. Deviation?			No			Yes			Yes			Yes





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2.4 SPECIFIC GRAVITY

2.4 Specific Gravity

Rationale for Test

Specific gravity is the ratio of the density of a material to the density of water. In USEPA 9090 tests, specific gravity is measured to provide an indication of the amount of swelling or shrinkage a geomembrane has undergone as the result of absorption of leachate constituents or extraction of geomembrane constituents. The specific gravity of the geomembrane was measured using a direct measurement of mass and an indirect measurement of volume (liquid displacement).

Results and Discussion

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

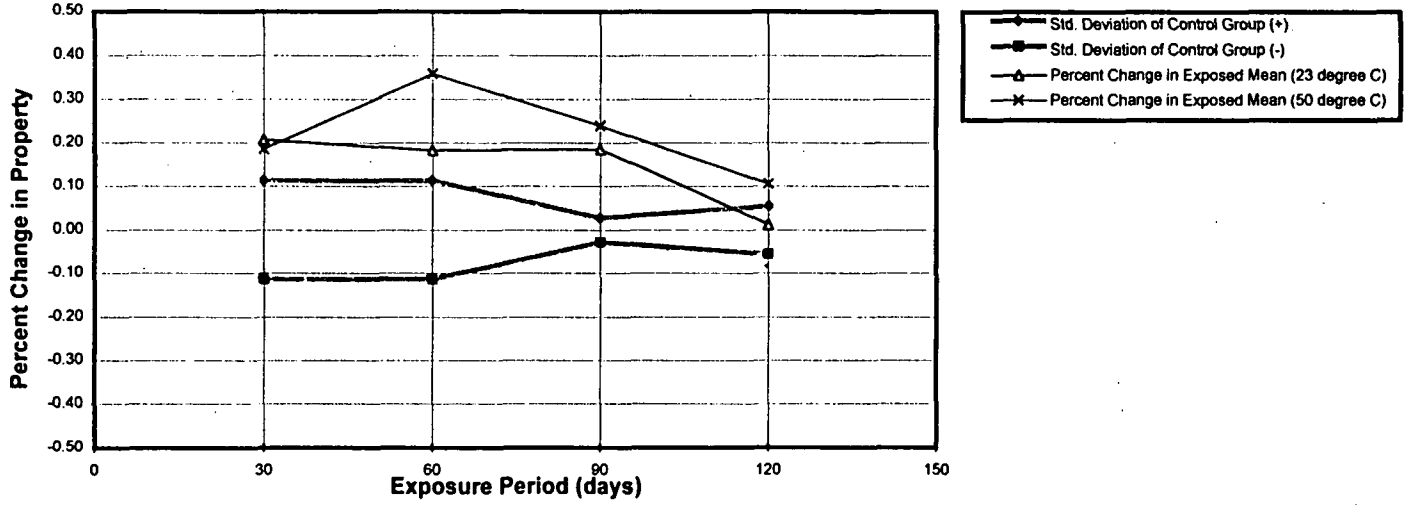
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

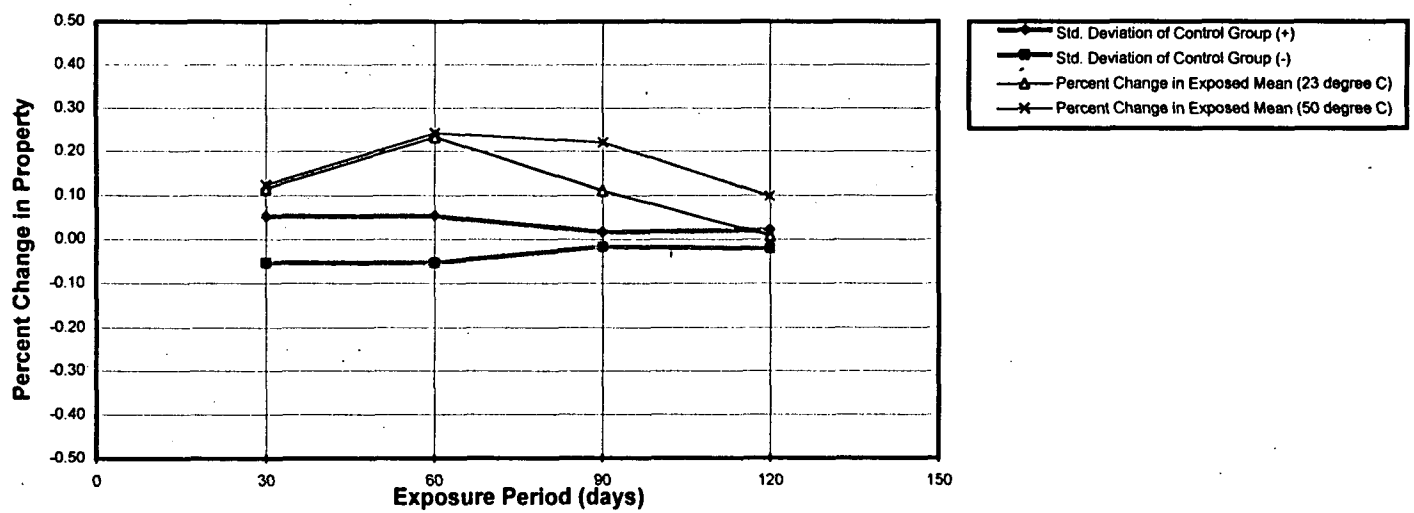
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

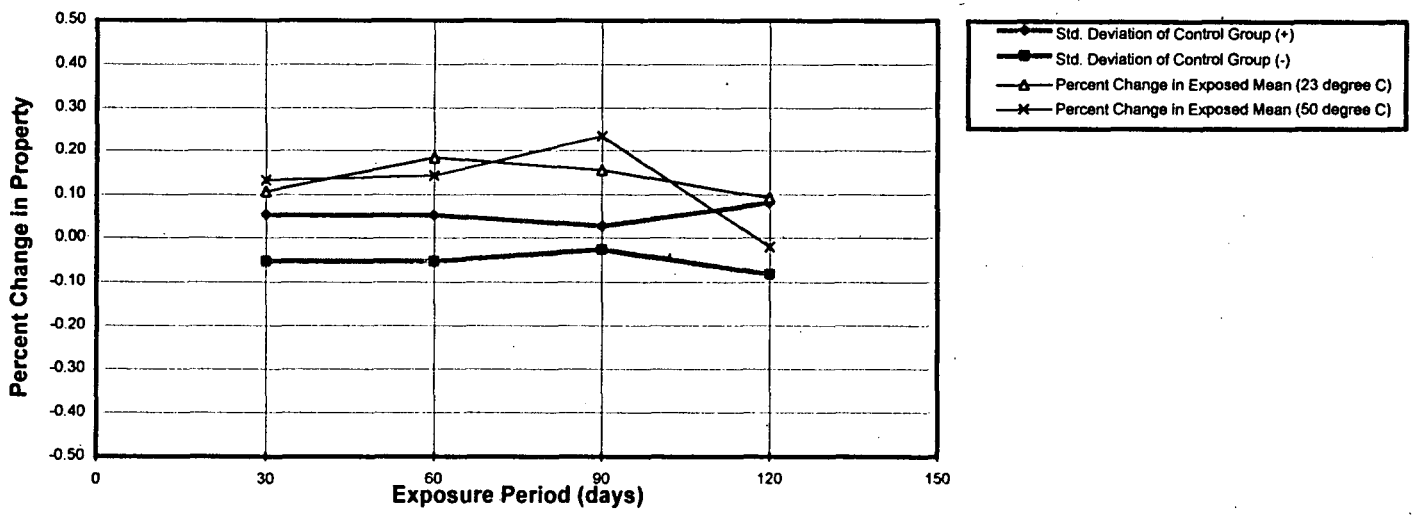
CHEMICAL COMPATIBILITY TEST RESULTS

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



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Materials Testing Laboratory

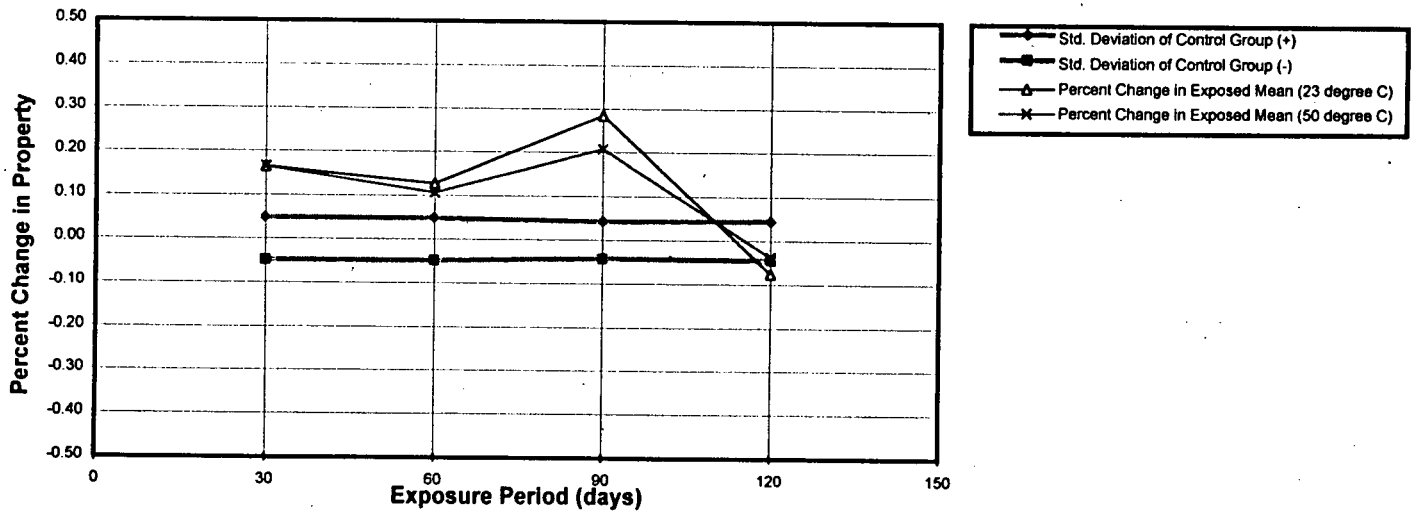
CHEMICAL COMPATIBILITY TEST RESULTS

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

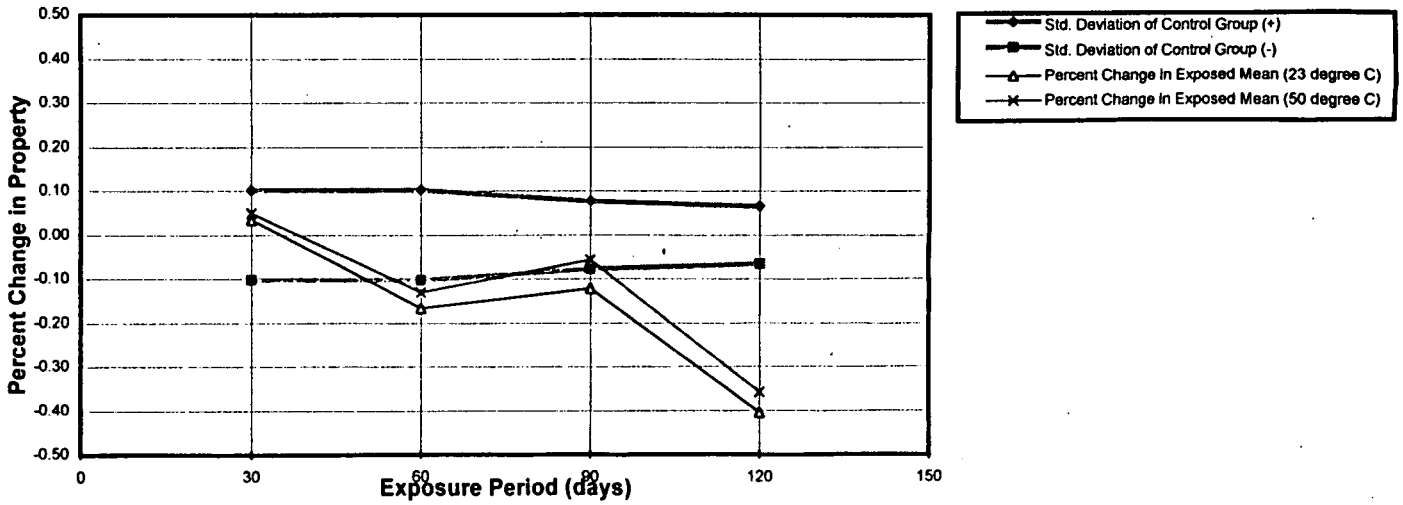
CHEMICAL COMPATIBILITY TEST RESULTS

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 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.

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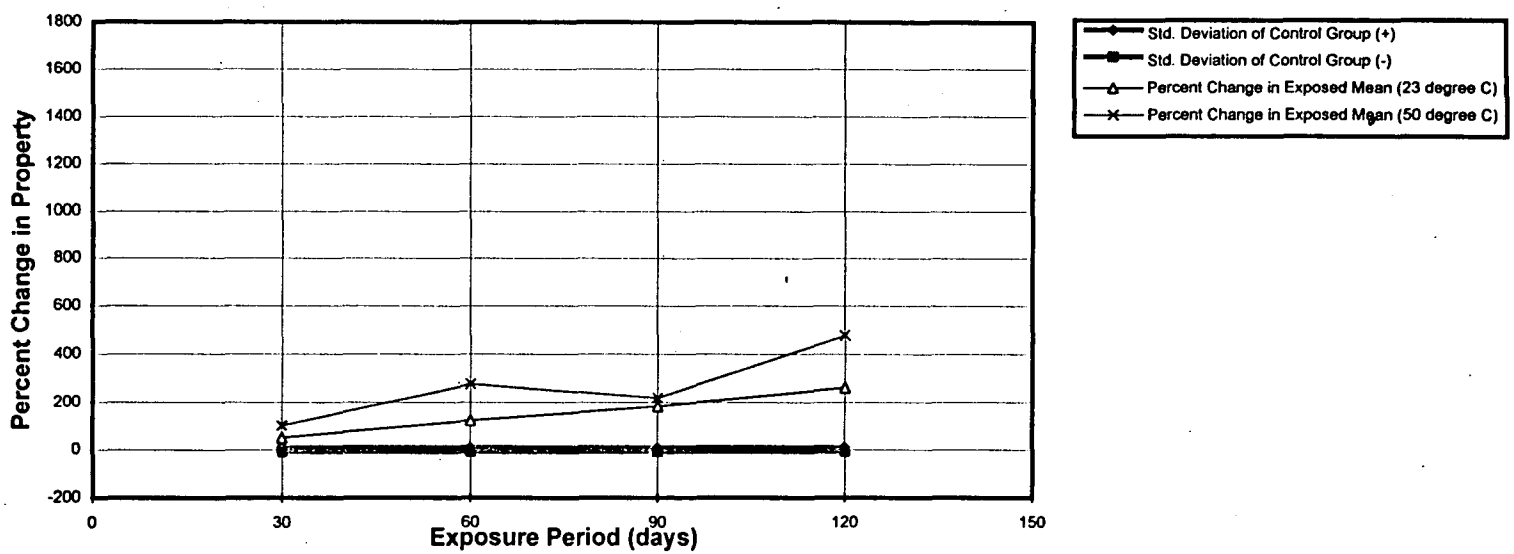
CHEMICAL COMPATIBILITY TEST RESULTS

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	0.0800	0.1010	0.1230	0.2080	0.1930	0.2000	0.2100	0.3260
	0.0589	0.0880	0.1250	0.1260	0.2110	0.1230	0.1560	0.1940	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



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GEOSYNTEC CONSULTANTS

Materials Testing Laboratory

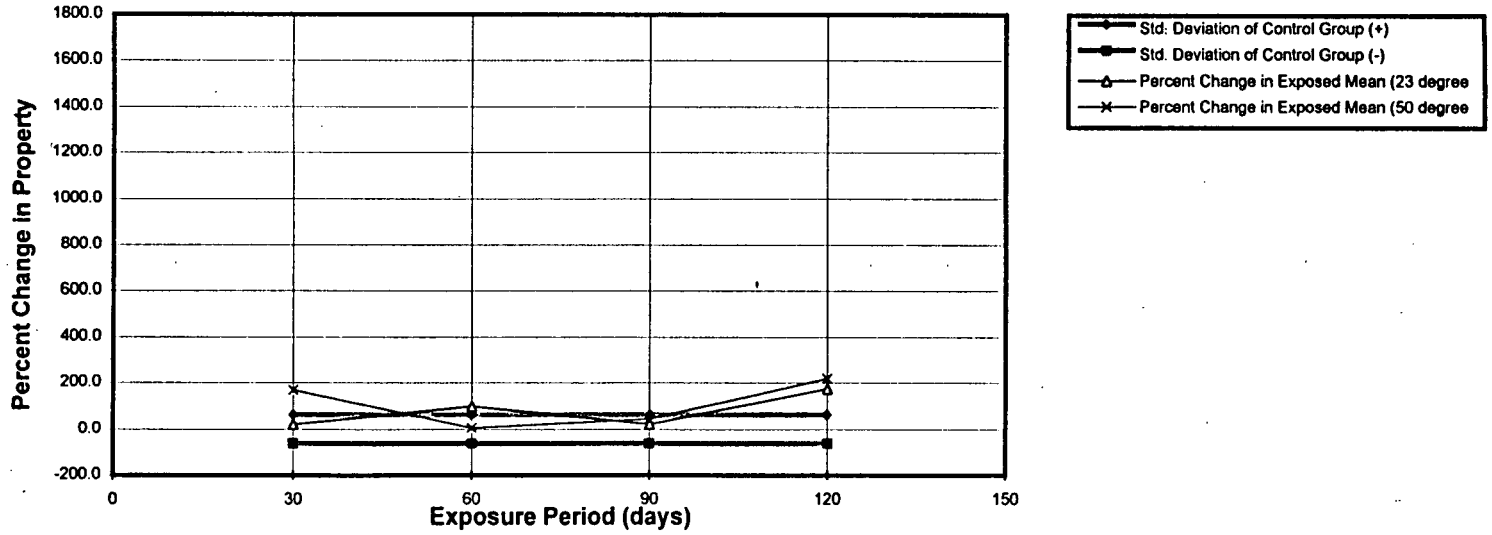
CHEMICAL COMPATIBILITY TEST RESULTS

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 0.0814	0.0760 0.0610	0.1840 0.1210	0.1140 0.1110	0.0590 0.0610	0.0580 0.0820	0.0720 0.0920	0.1230 0.1870	0.1900 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



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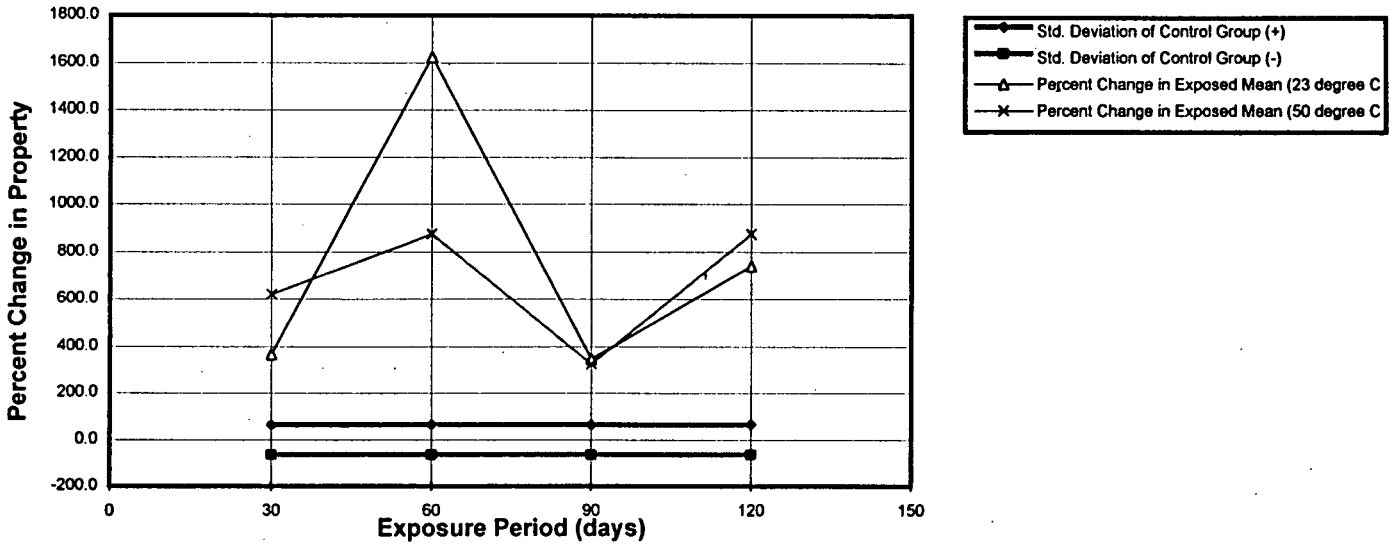
CHEMICAL COMPATIBILITY TEST RESULTS

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 0.0260	0.0910 0.0760	0.1380 0.1200	0.3120 0.3050	0.1770 0.1720	0.0880 0.0720	0.0830 0.0690	0.1450 0.1560	0.1750 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



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Materials Testing Laboratory

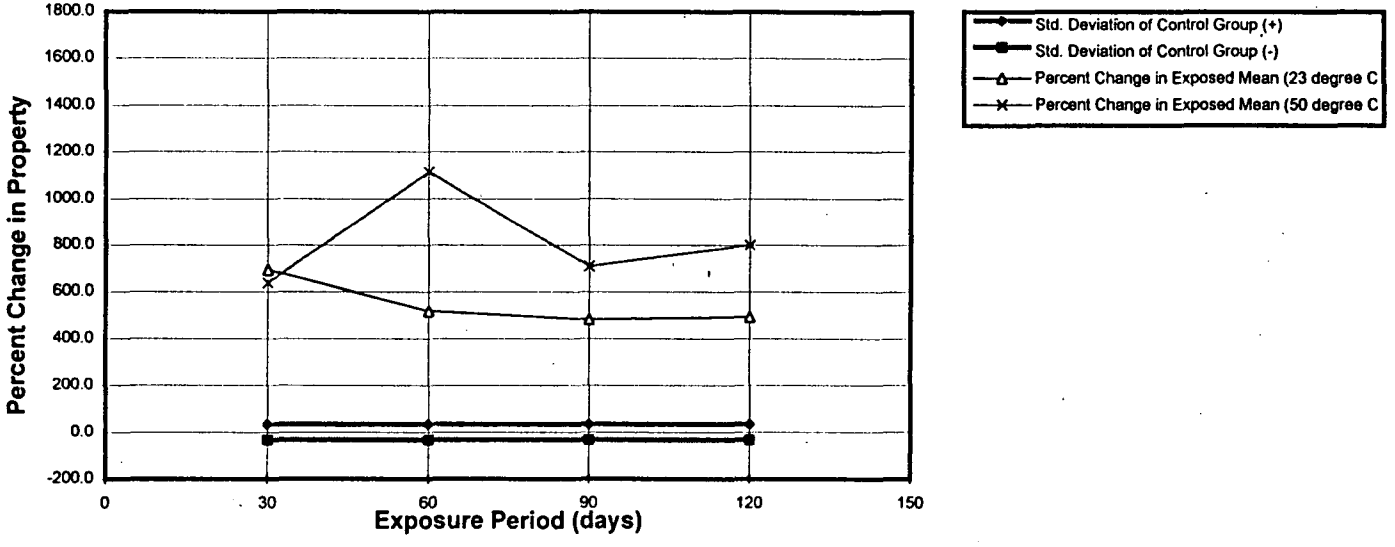
CHEMICAL COMPATIBILITY TEST RESULTS

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 0.0211	0.1390 0.1310	0.1230 0.1280	0.1010 0.1090	0.2030 0.2100	0.0990 0.0990	0.1360 0.1390	0.0970 0.1050	0.1610 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



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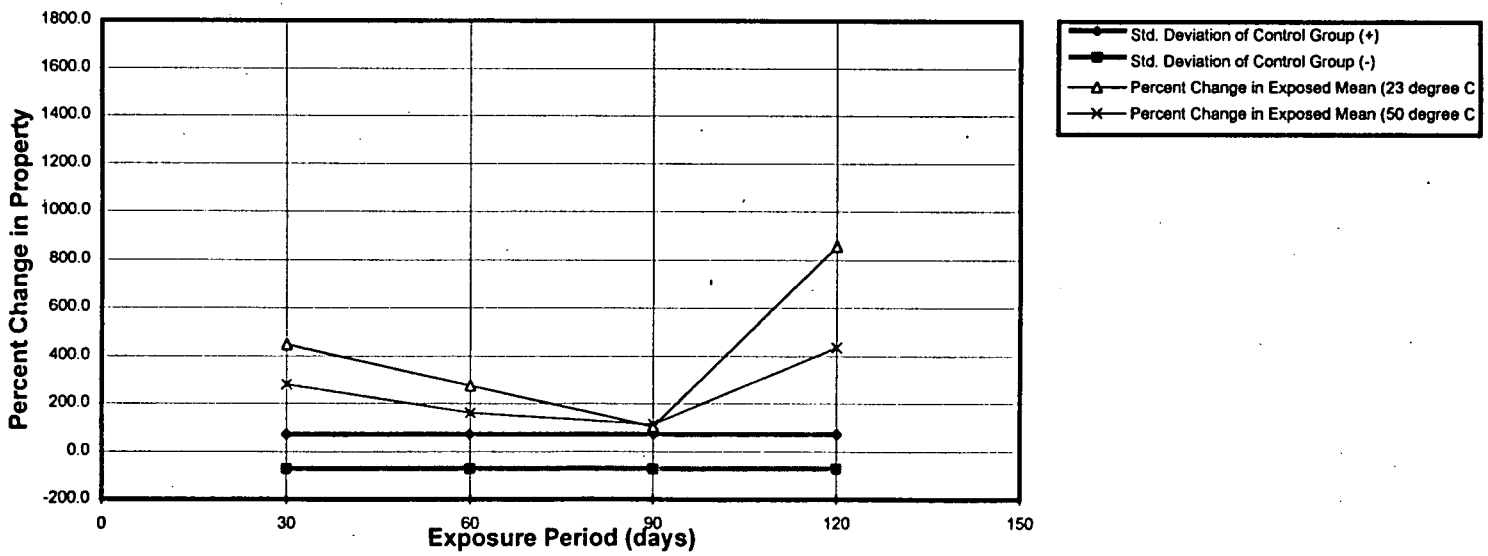
CHEMICAL COMPATIBILITY TEST RESULTS

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 0.0500	0.1830 0.1800	0.1030 0.1490	0.1230 0.1250	0.0810 0.0920	0.0730 0.0620	0.0880 0.0540	0.2990 0.3350	0.2410 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



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2.6 EXTRACTABLES CONTENT

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.

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Materials Testing Laboratory

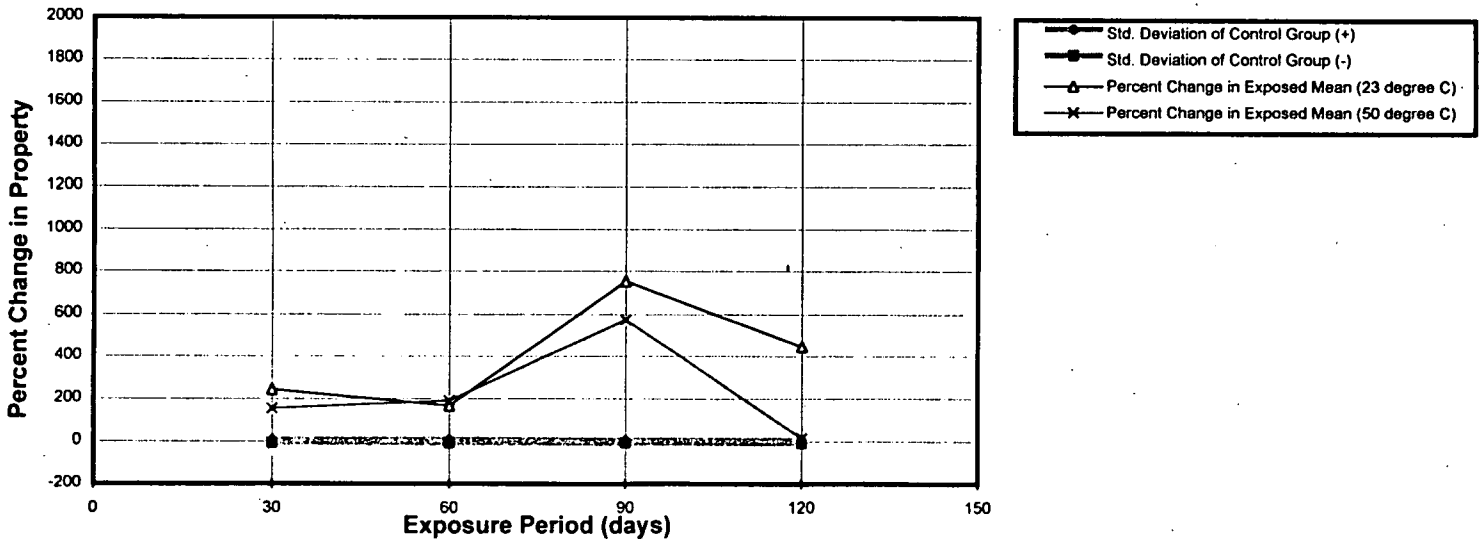
CHEMICAL COMPATIBILITY TEST RESULTS

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 0.0390	0.1310 0.1240	0.1050 0.0840	0.1020 0.0960	0.1120 0.1030	0.2150 0.4180	0.1290 0.3700	0.2630 0.1420	0.0110 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



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Materials Testing Laboratory

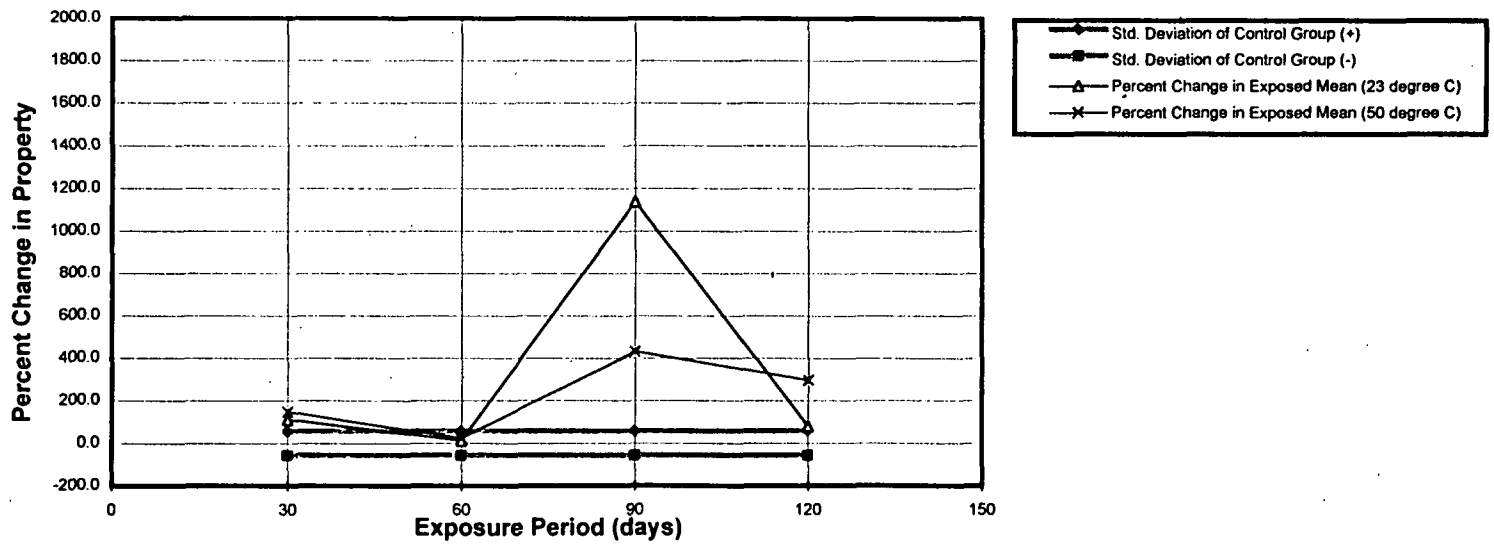
CHEMICAL COMPATIBILITY TEST RESULTS

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 0.0970	0.1480 0.1450	0.1840 0.1600	0.0750 0.0810	0.0820 0.0890	0.7680 0.9430	0.3500 0.3850	0.1330 0.1160	0.3090 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



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Materials Testing Laboratory

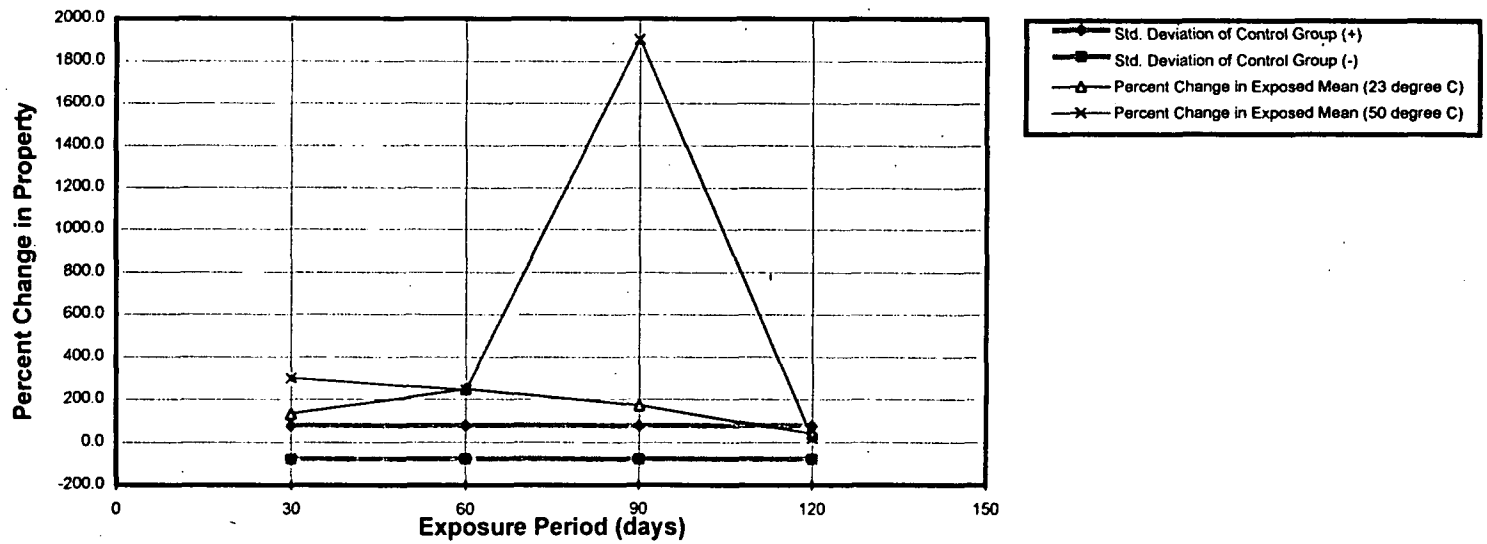
CHEMICAL COMPATIBILITY TEST RESULTS

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 0.0360	0.1830 0.1880	0.3320 0.3110	0.2850 0.2760	0.2910 0.2630	0.1690 0.2670	0.2670 2.9400	0.1080 0.1180	0.0630 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



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GEOSYNTEC CONSULTANTS

Materials Testing Laboratory

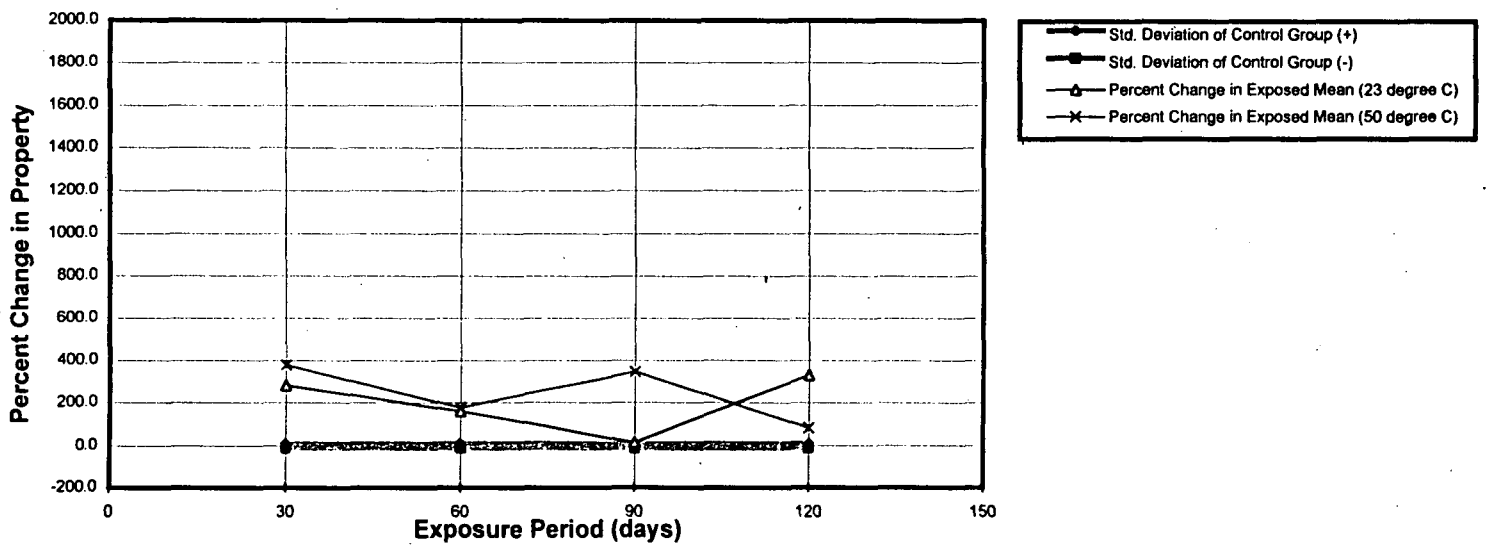
CHEMICAL COMPATIBILITY TEST RESULTS

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 0.0610	0.2350 0.2700	0.3420 0.2890	0.1750 0.1690	0.1790 0.1870	0.0610 0.0930	0.1640 0.4250	0.2560 0.3130	0.2090 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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

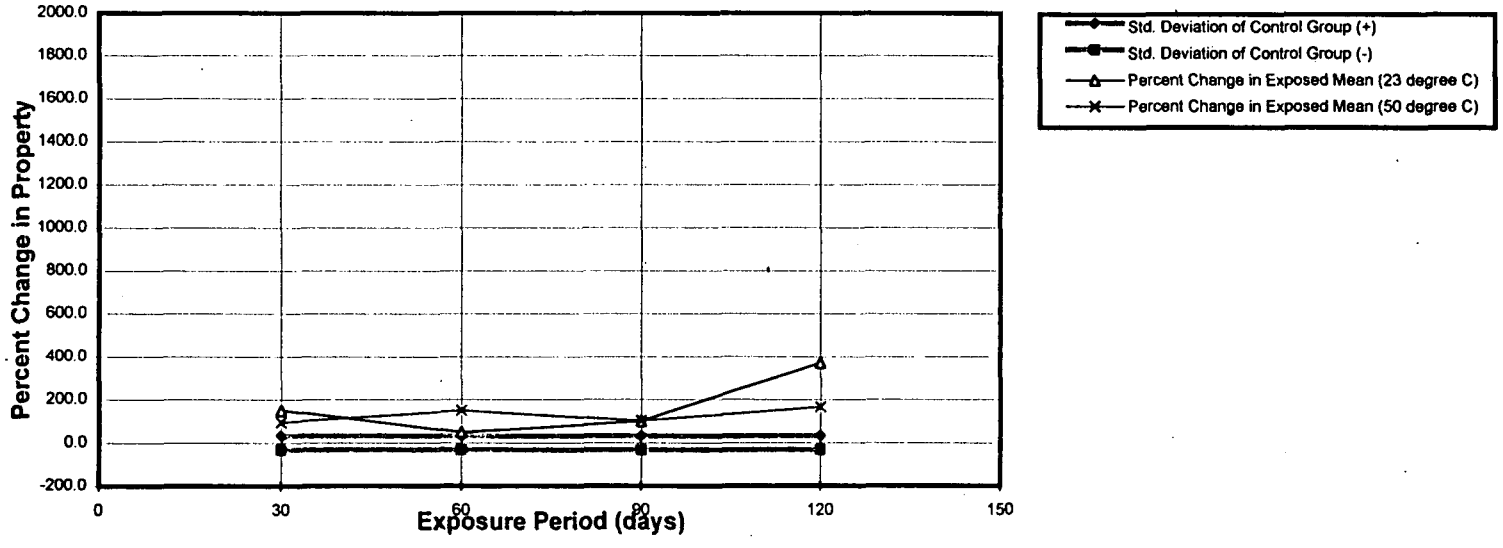
CHEMICAL COMPATIBILITY TEST RESULTS

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 0.0820	0.1710 0.1640	0.1370 0.1230	0.1030 0.0980	0.1620 0.1710	0.1310 0.1380	0.1370 0.1350	0.2990 0.3350	0.2410 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



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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.

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.

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

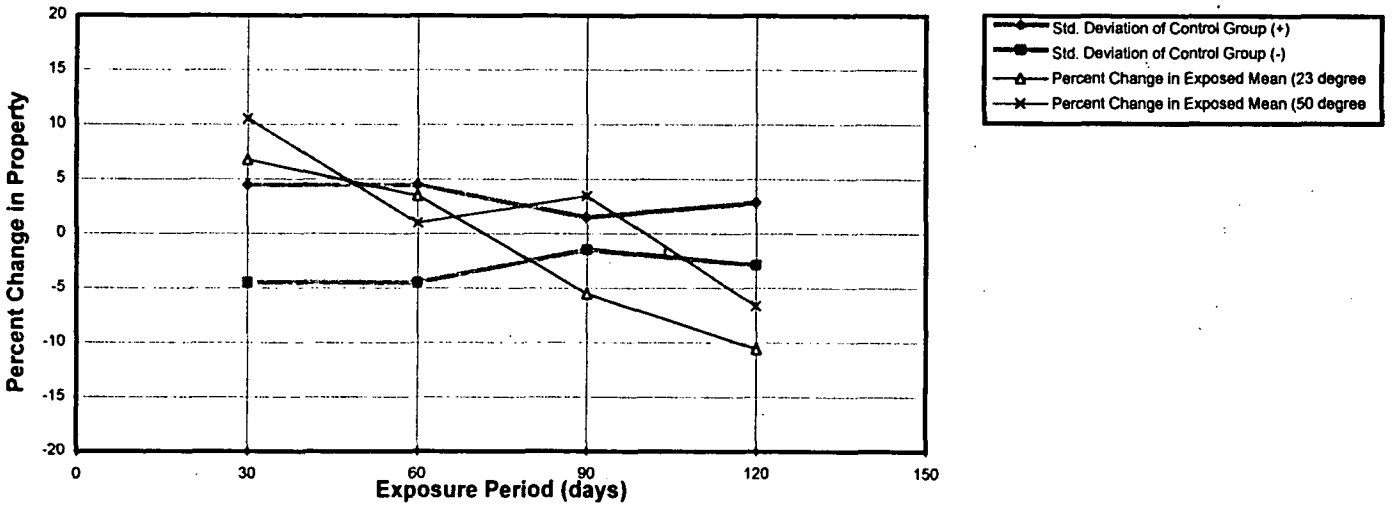
CHEMICAL COMPATIBILITY TEST RESULTS

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	2482.5	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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

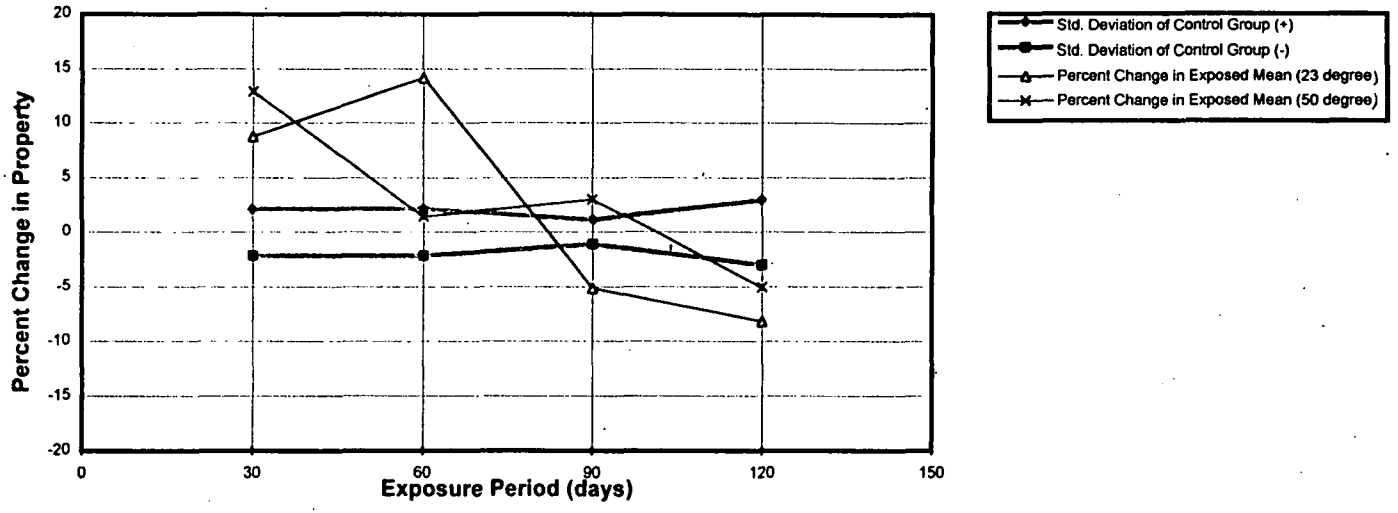
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

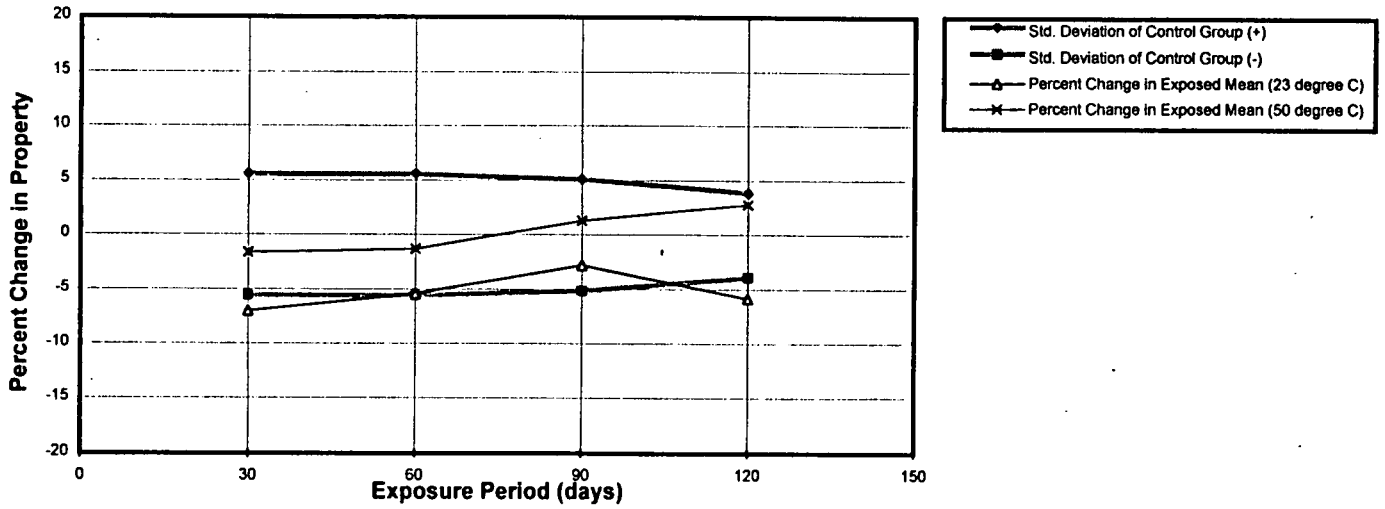
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

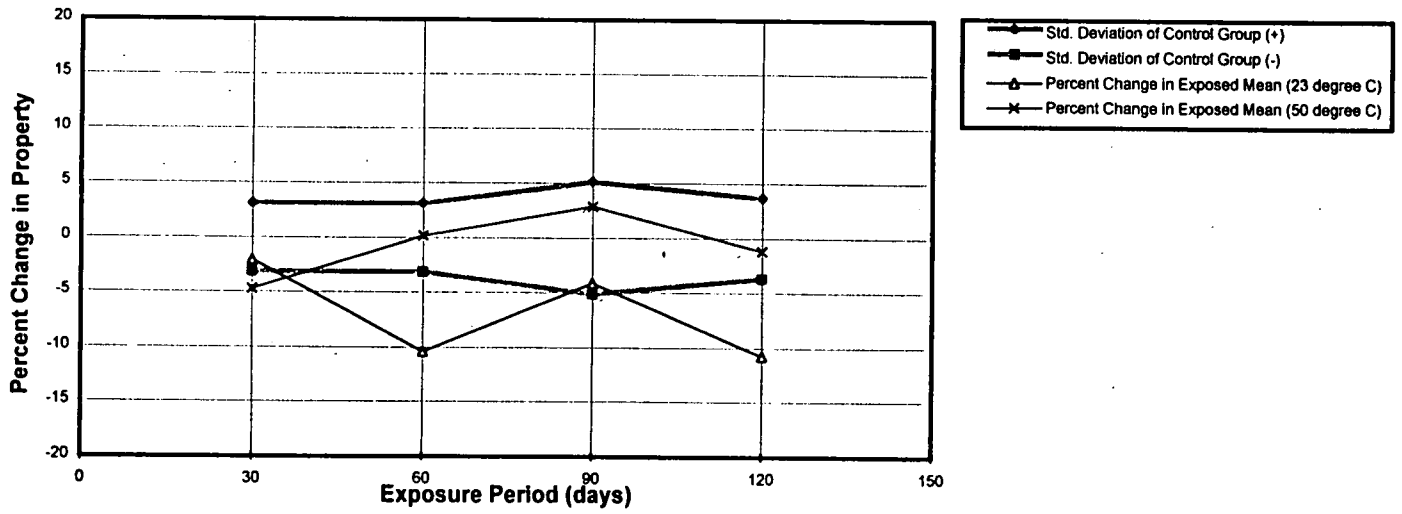
CHEMICAL COMPATIBILITY TEST RESULTS

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



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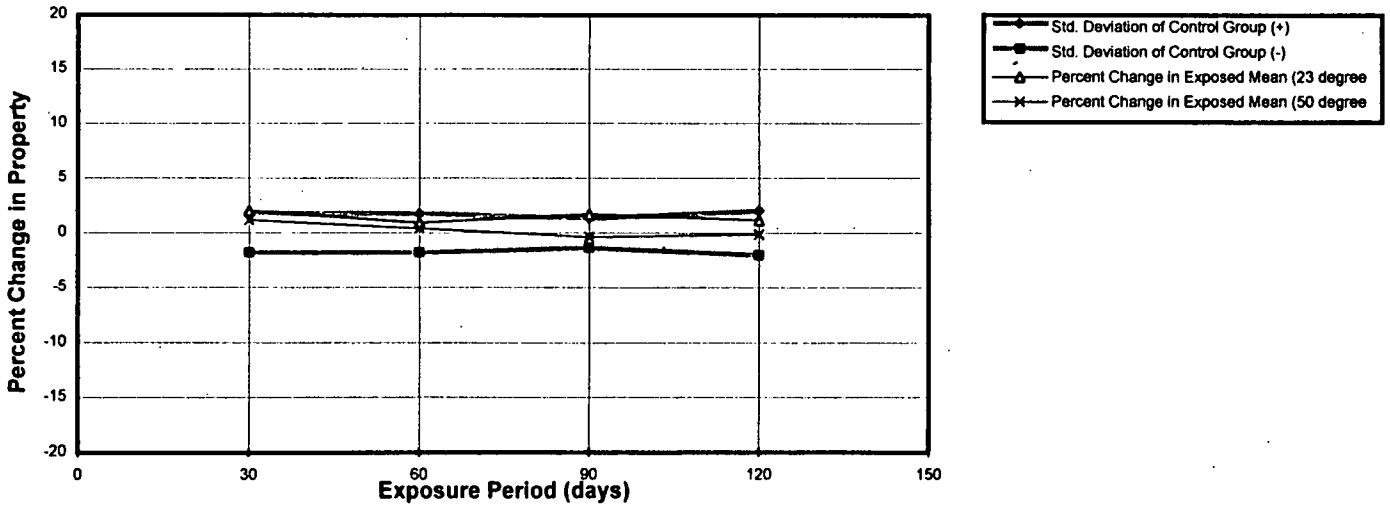
CHEMICAL COMPATIBILITY TEST RESULTS

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	2487.5
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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

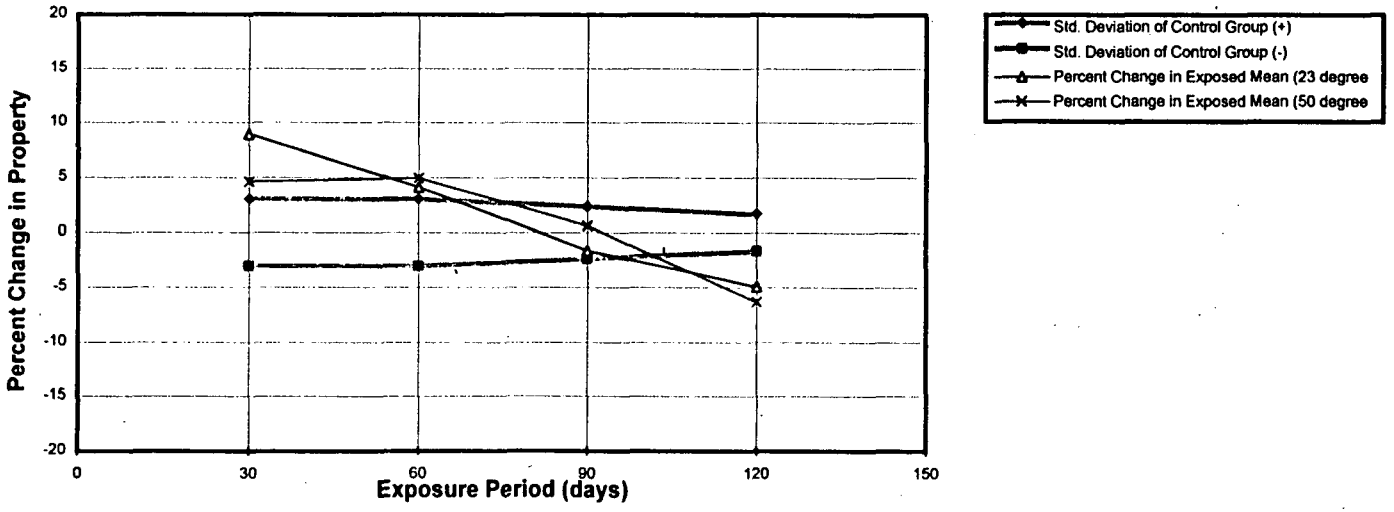
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

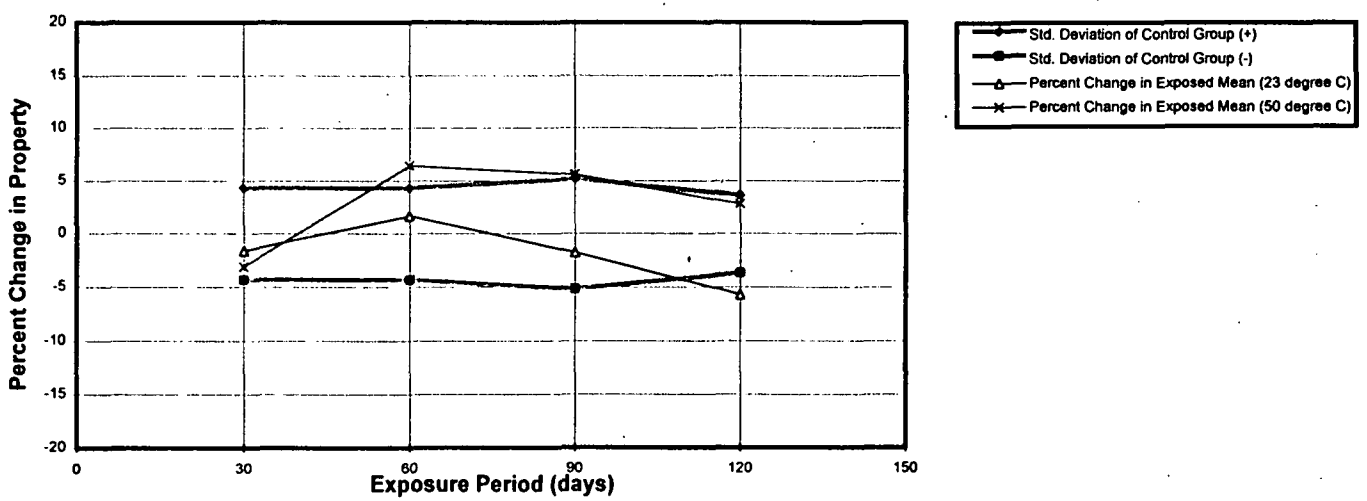
CHEMICAL COMPATIBILITY TEST RESULTS

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	23.8	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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

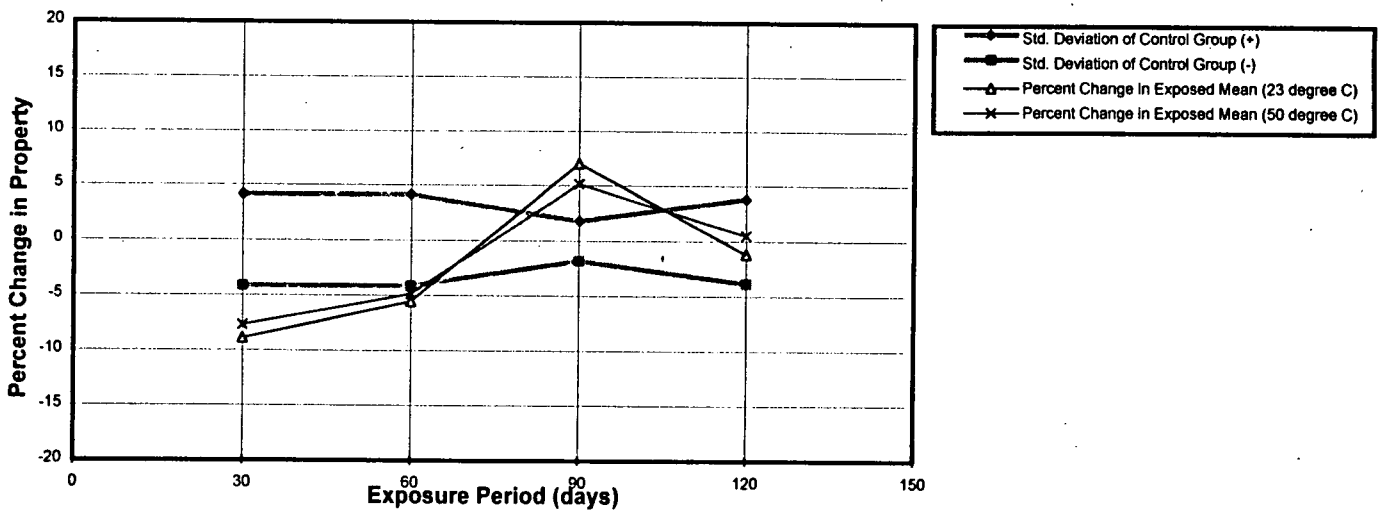
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

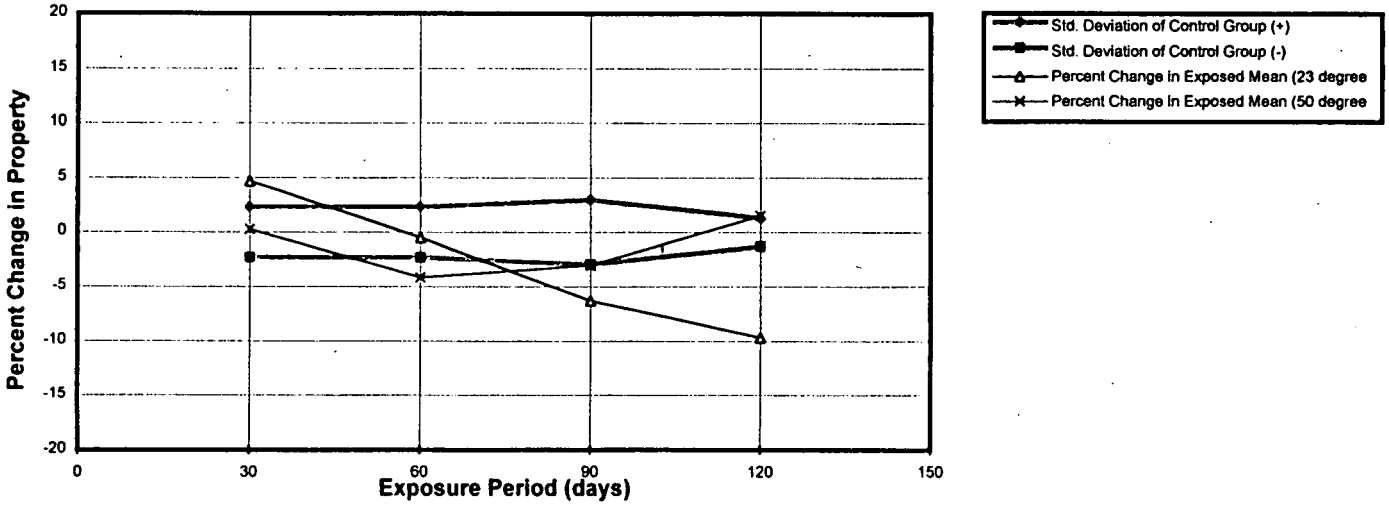
CHEMICAL COMPATIBILITY TEST RESULTS

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	2482.5	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



GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

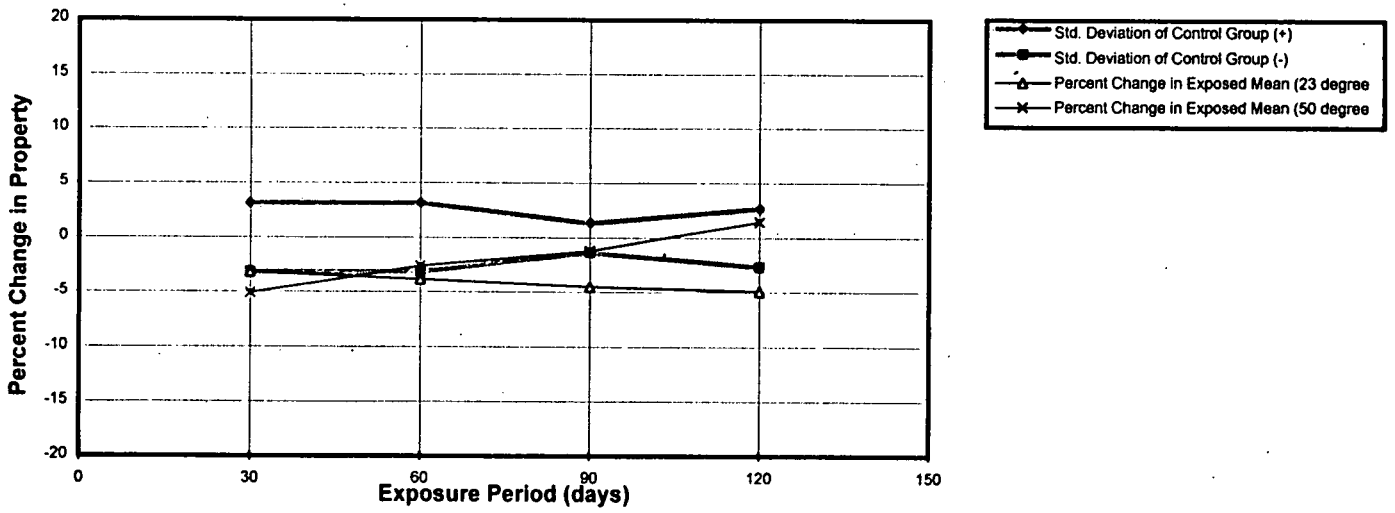
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

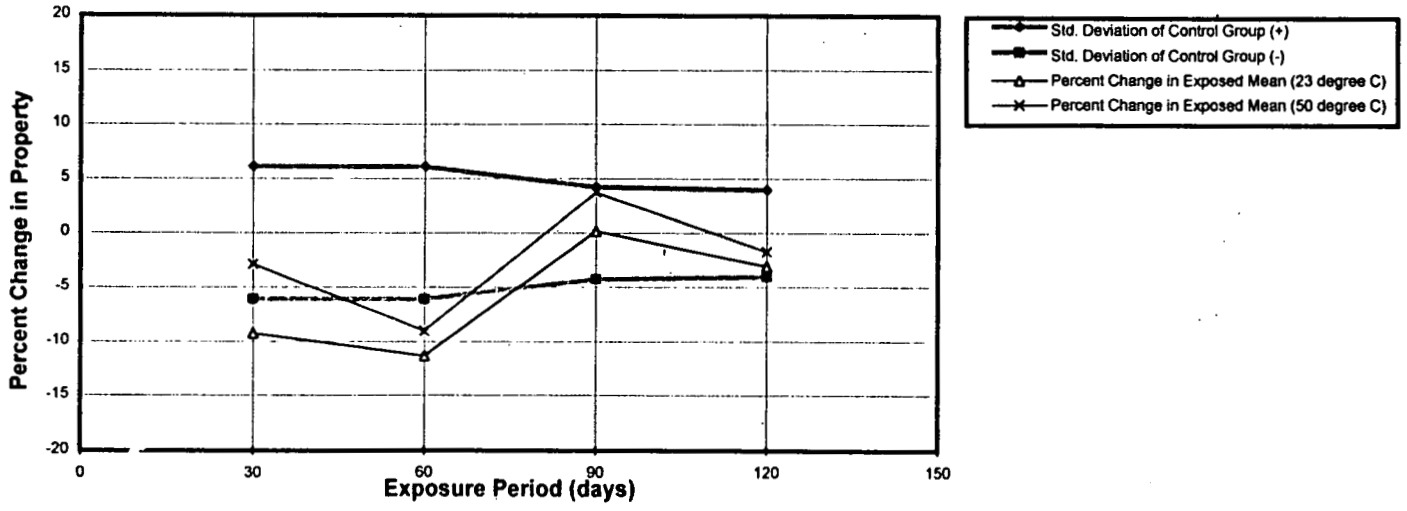
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

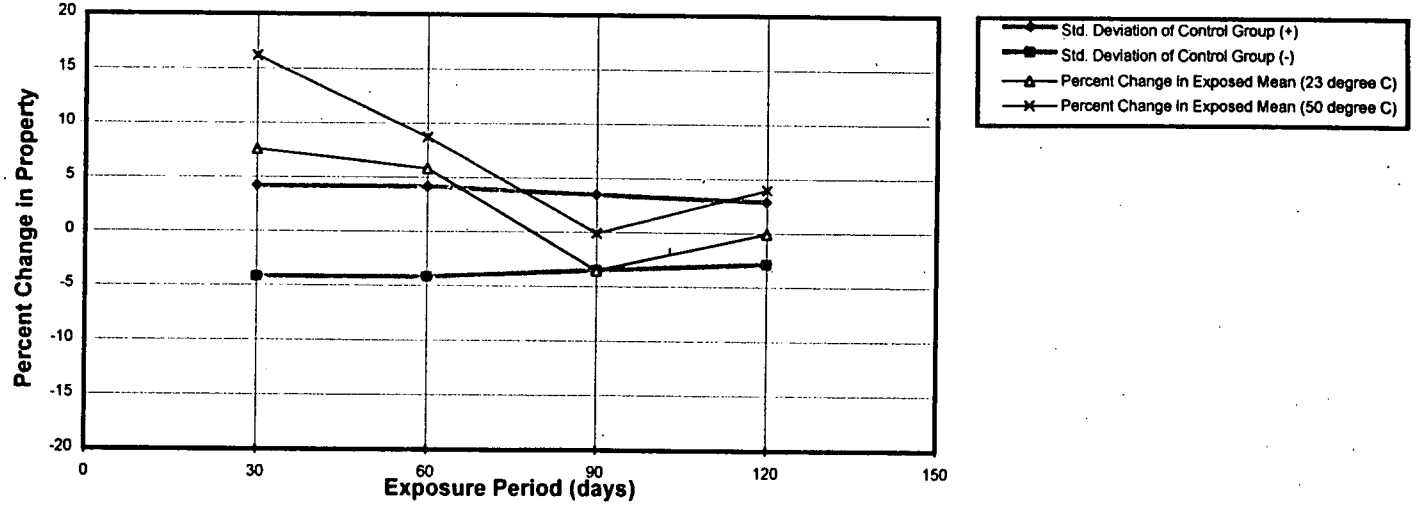
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

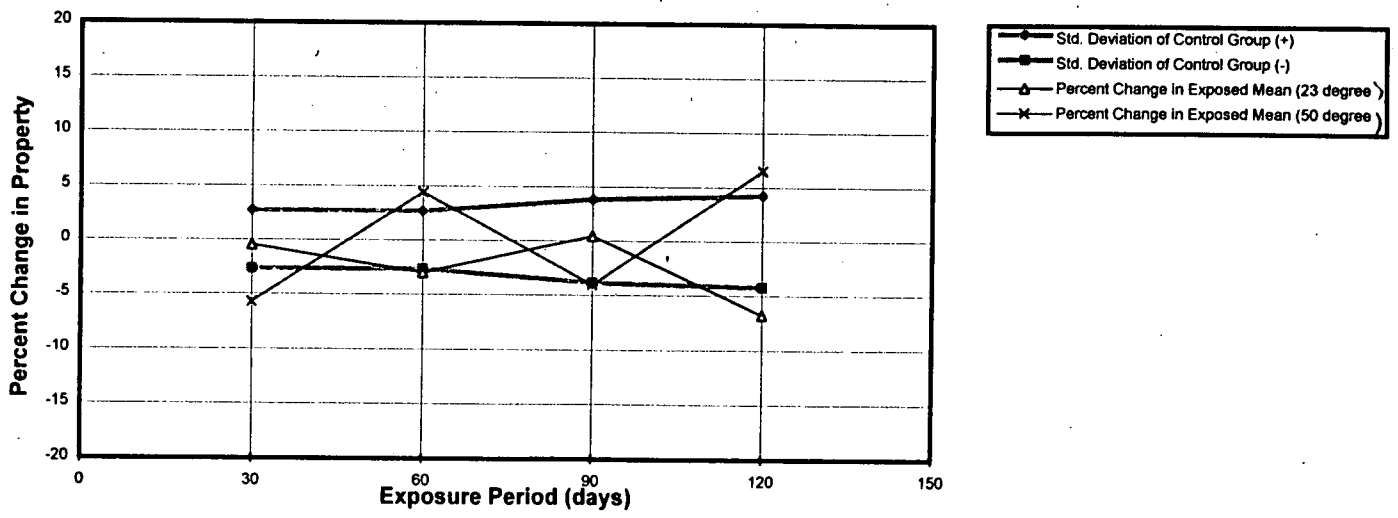
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

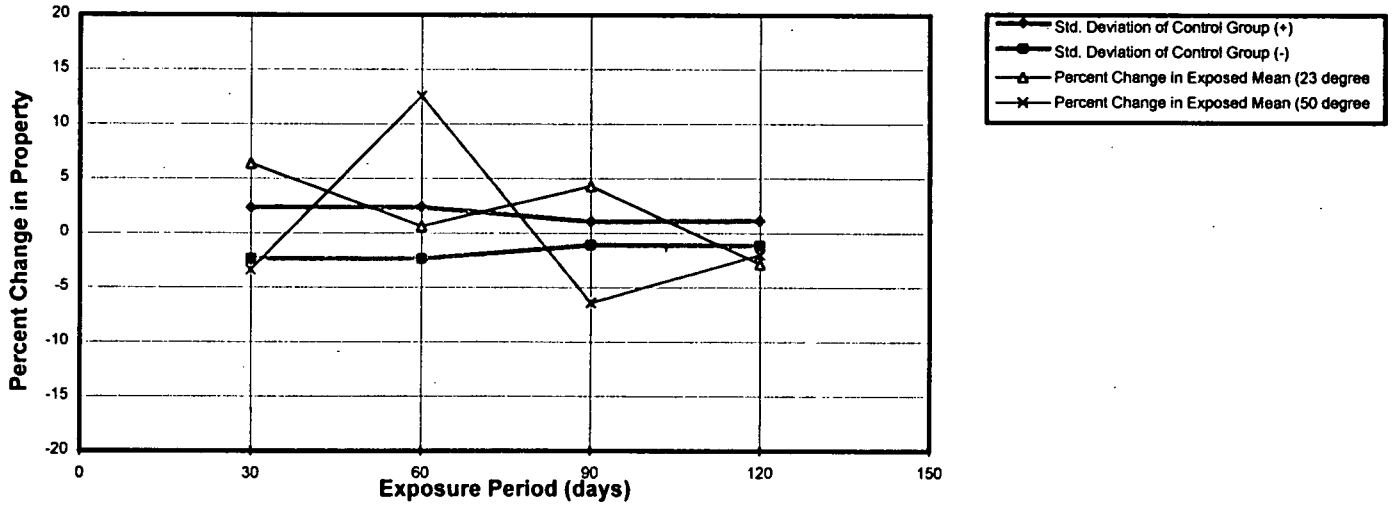
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

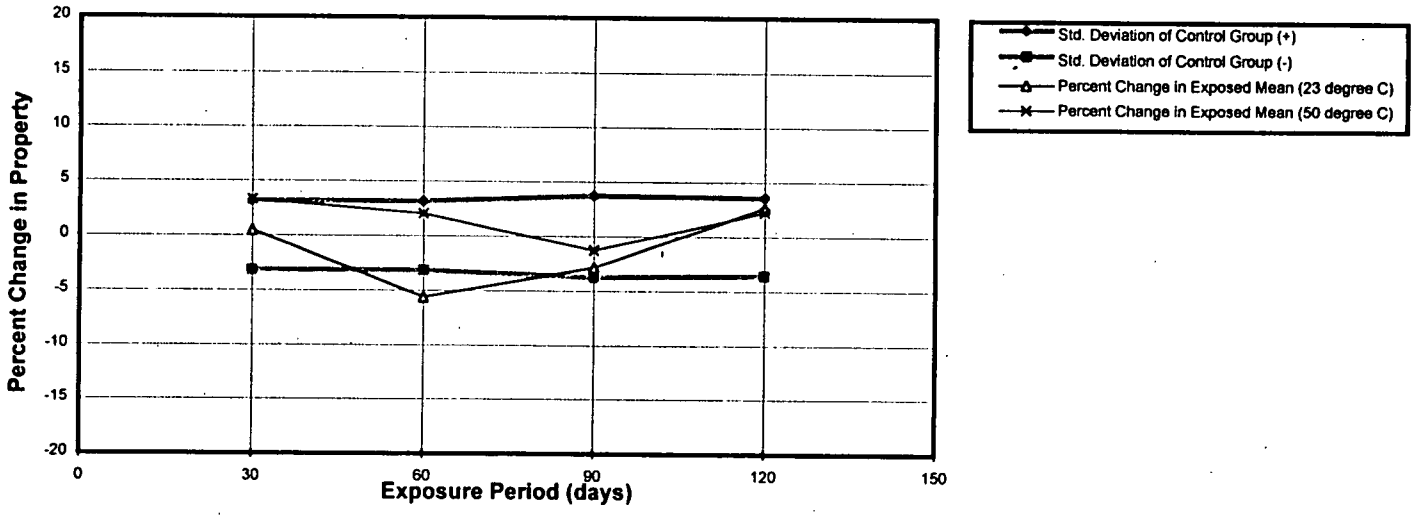
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

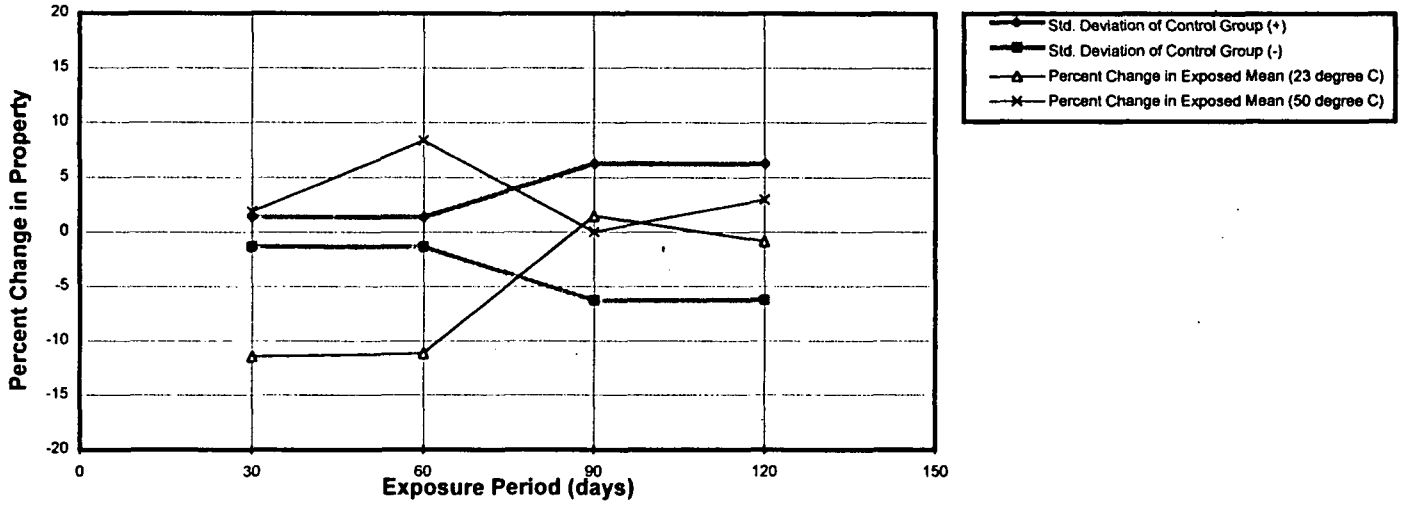
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

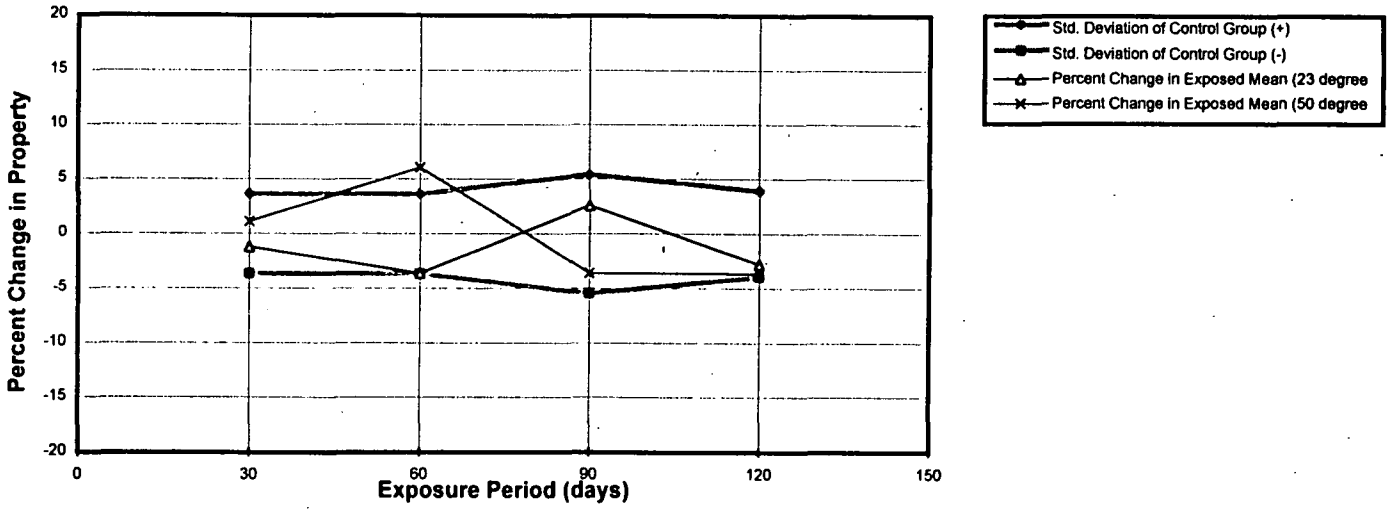
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

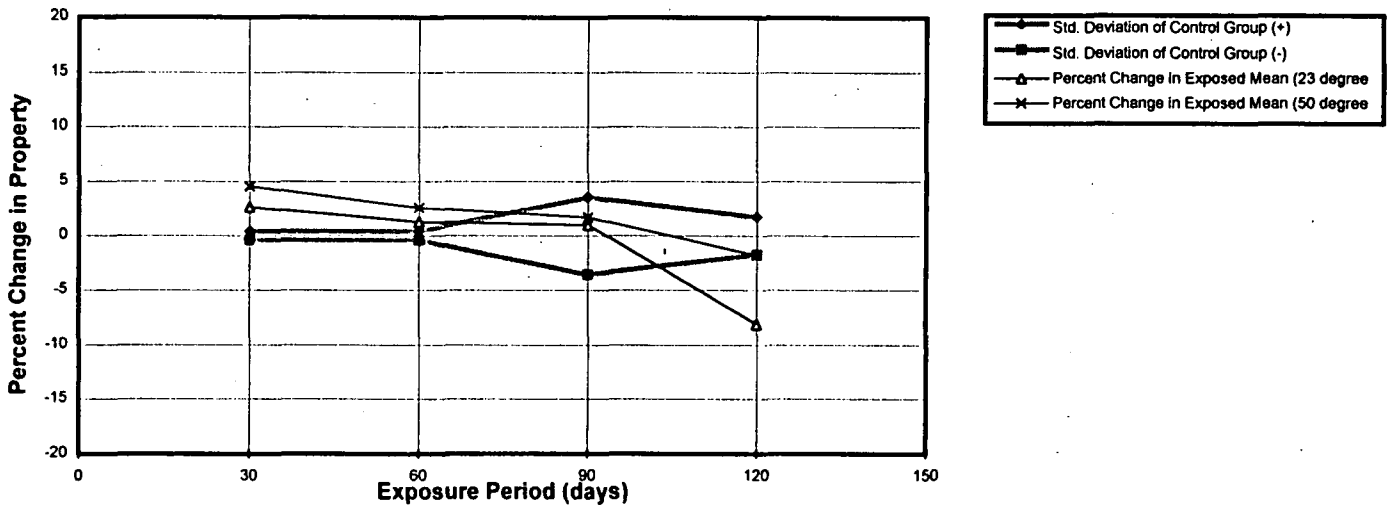
CHEMICAL COMPATIBILITY TEST RESULTS

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	2787.5		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



GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

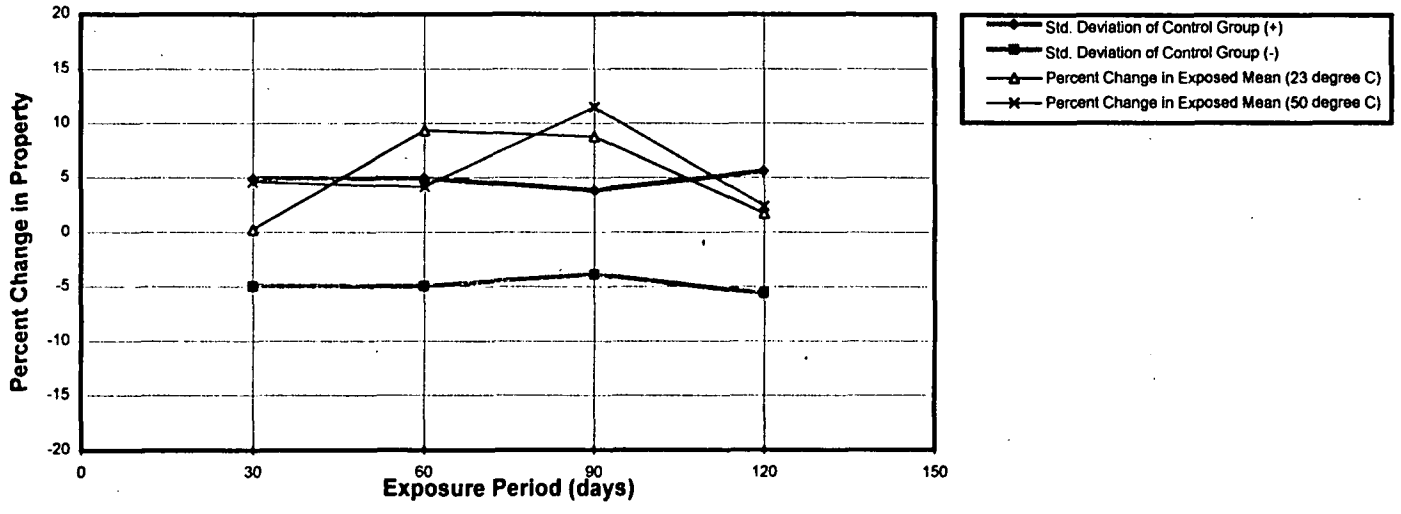
CHEMICAL COMPATIBILITY TEST RESULTS

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



GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

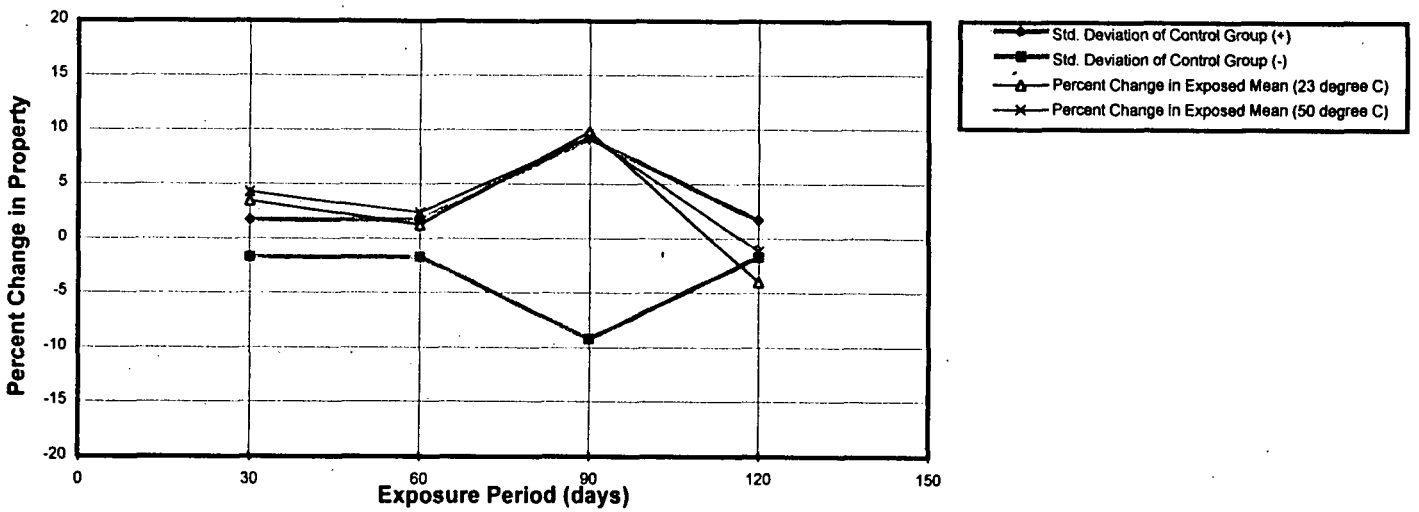
CHEMICAL COMPATIBILITY TEST RESULTS

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



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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

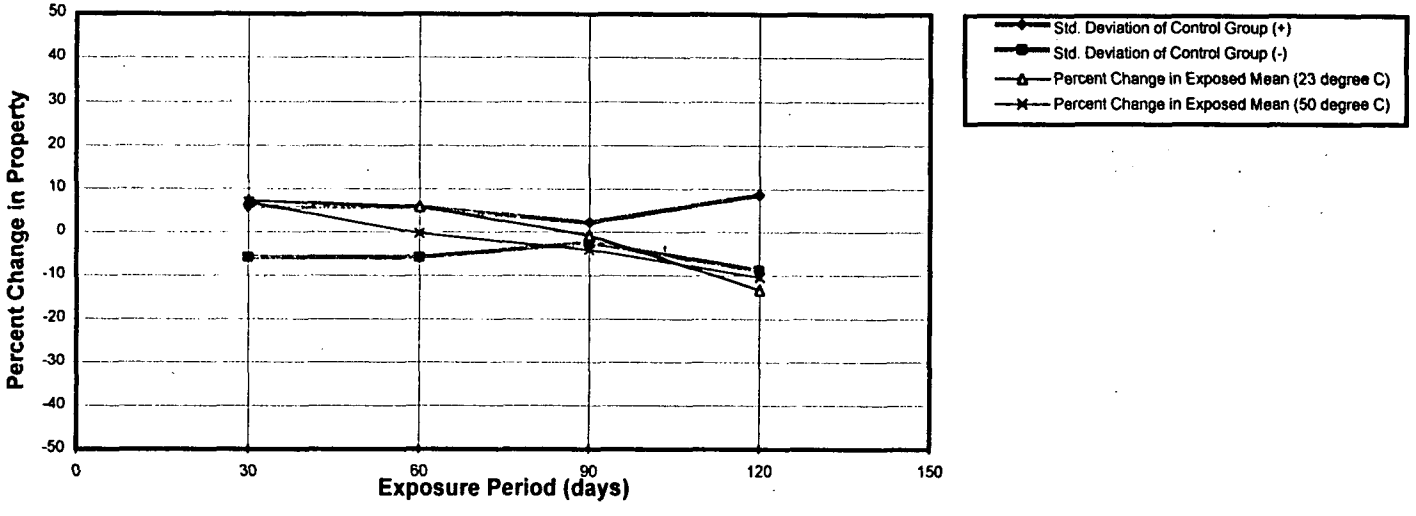
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

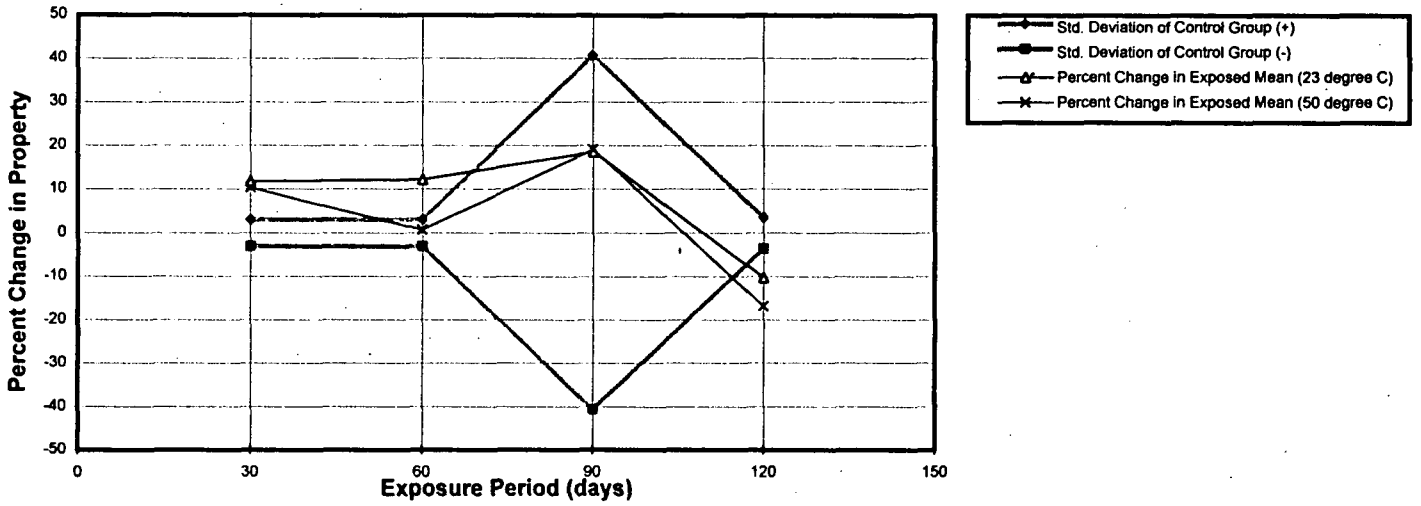
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

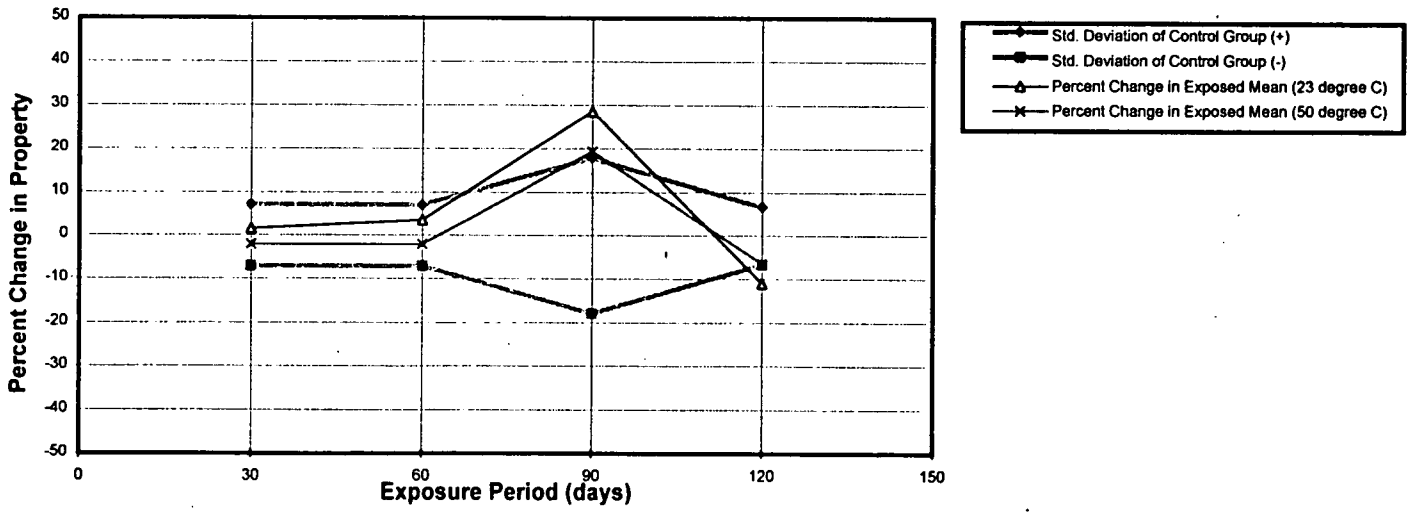
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

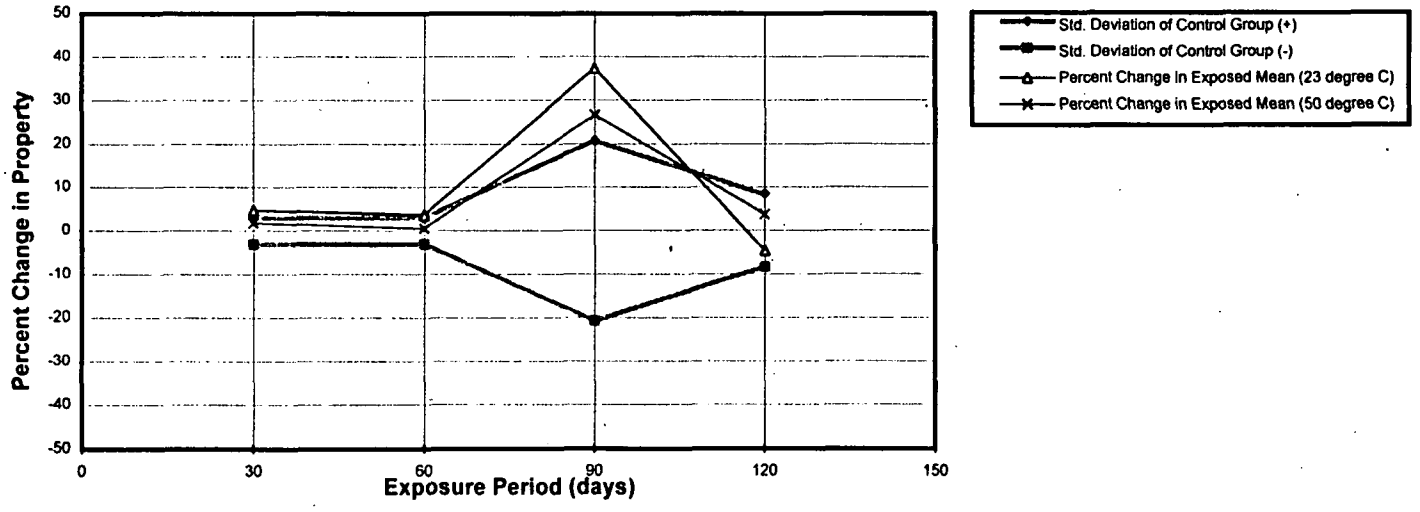
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

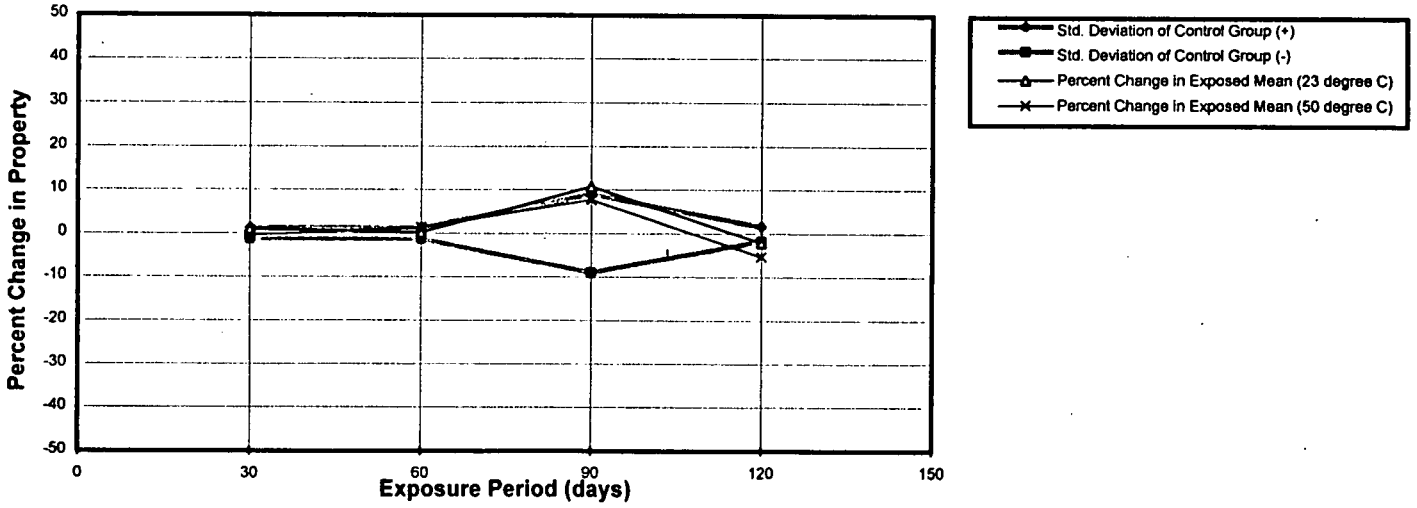
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

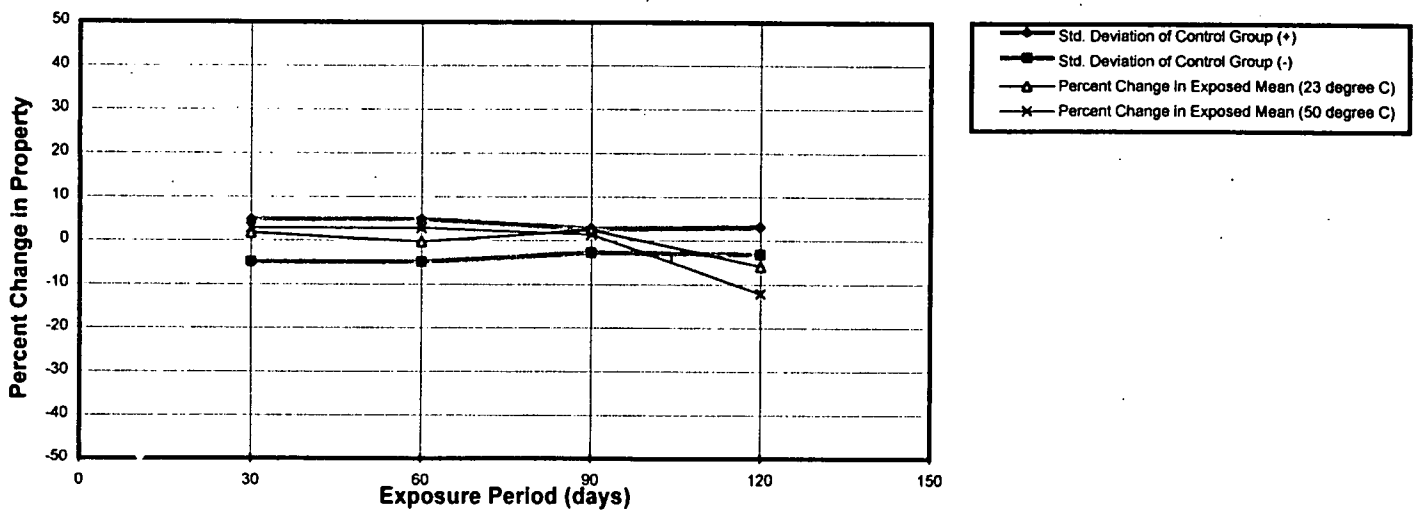
CHEMICAL COMPATIBILITY TEST RESULTS

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	4687.5	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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

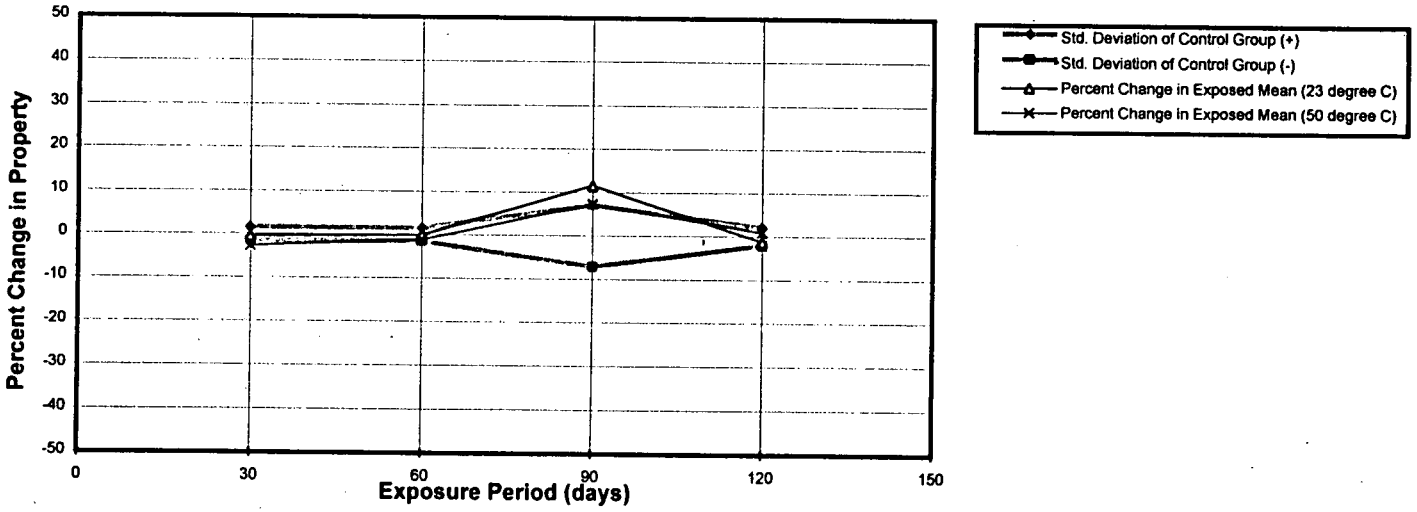
CHEMICAL COMPATIBILITY TEST RESULTS

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



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Materials Testing Laboratory

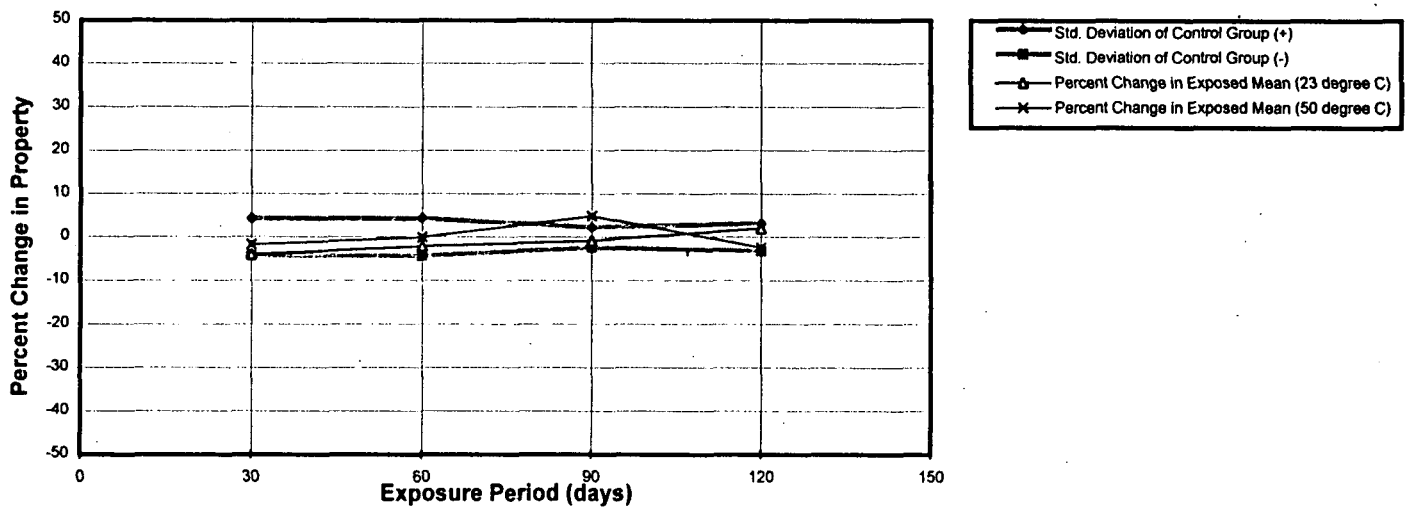
CHEMICAL COMPATIBILITY TEST RESULTS

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		1428.8	1367.8
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



GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

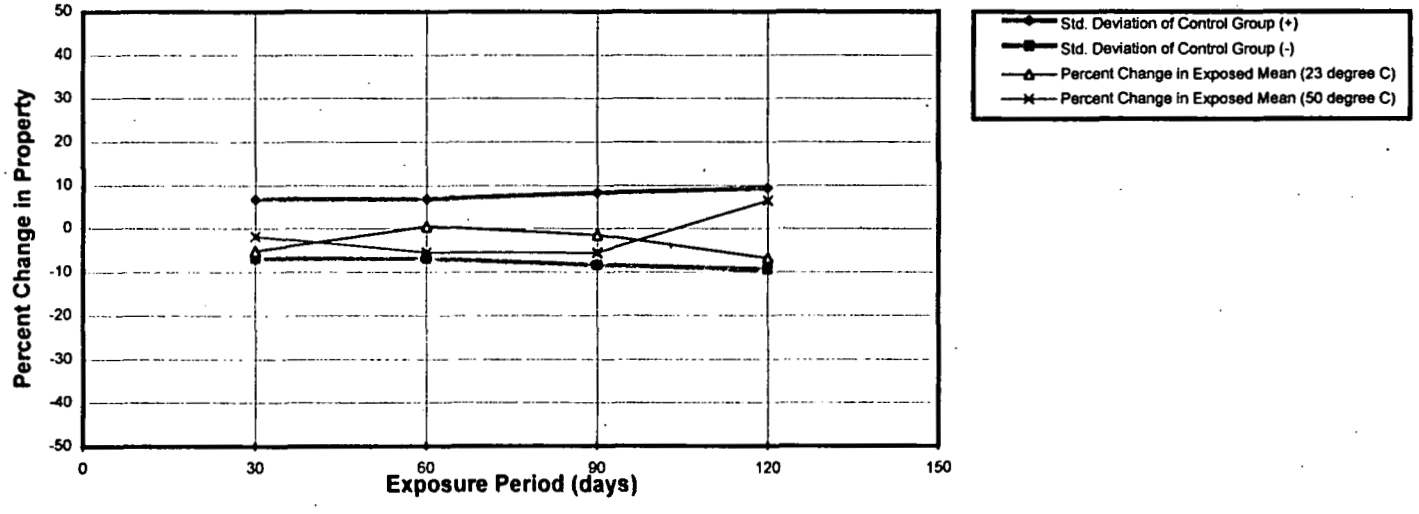
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

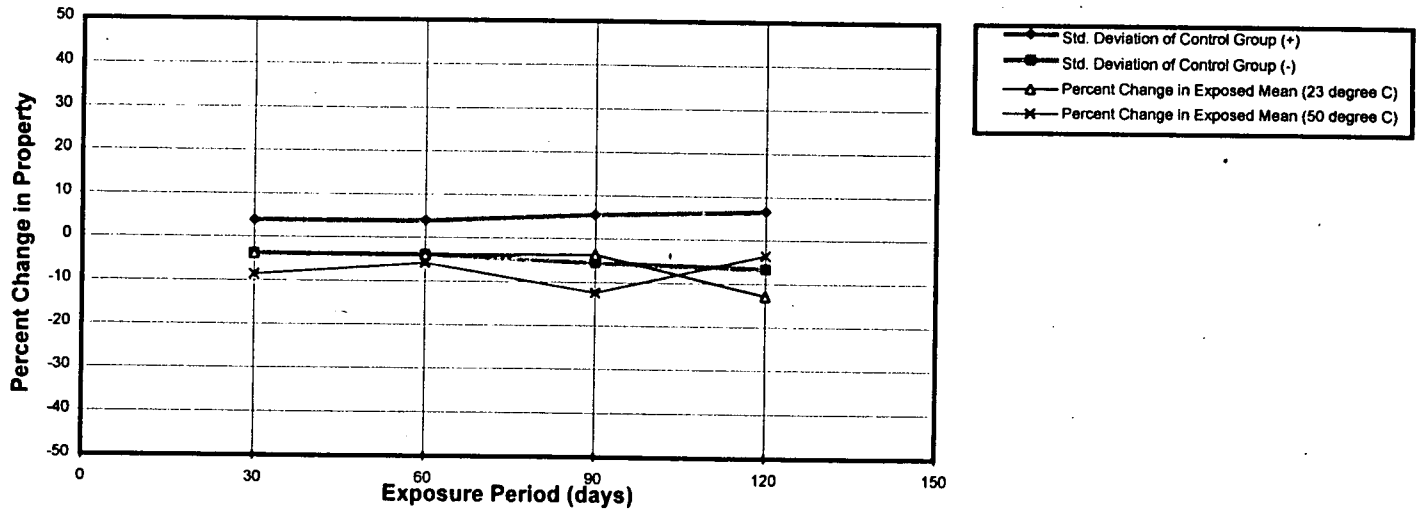
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

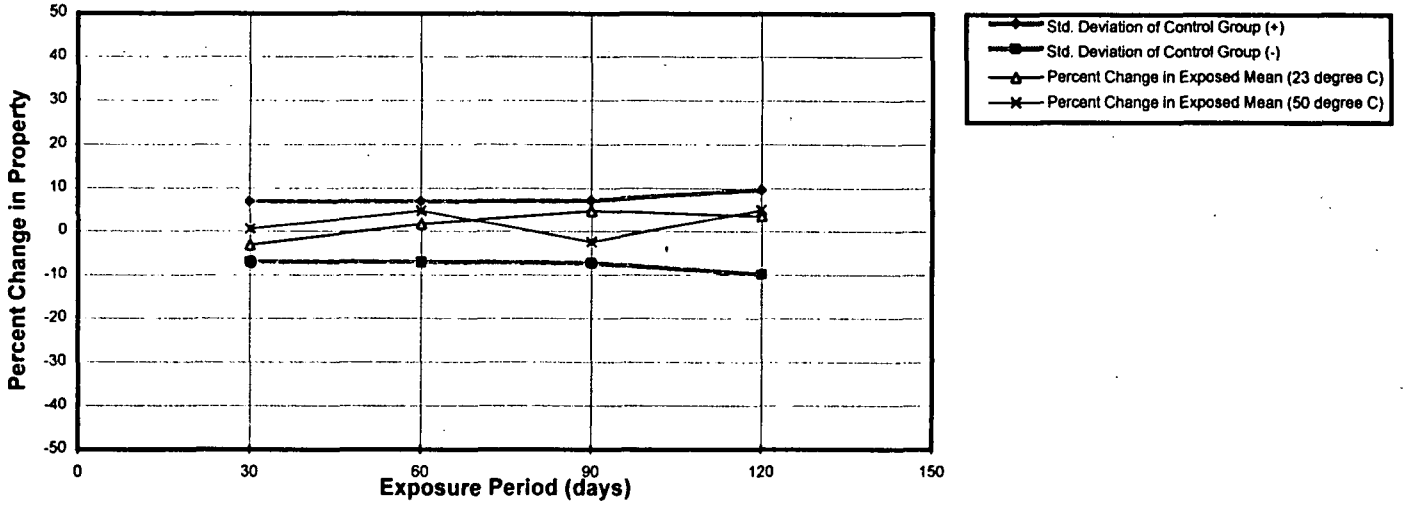
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

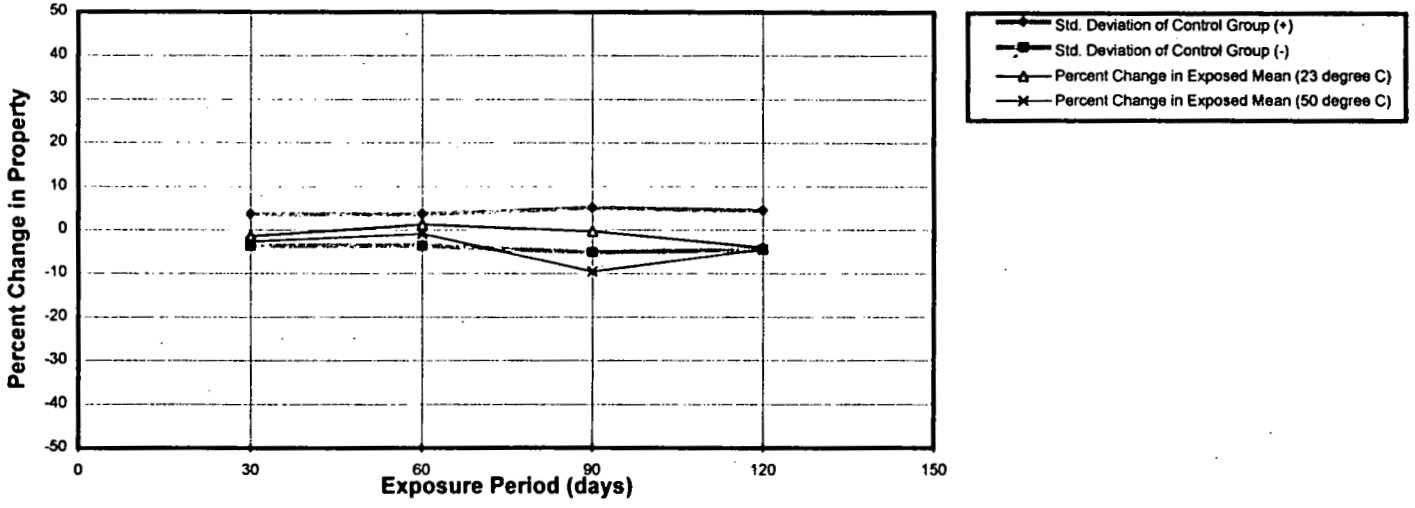
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

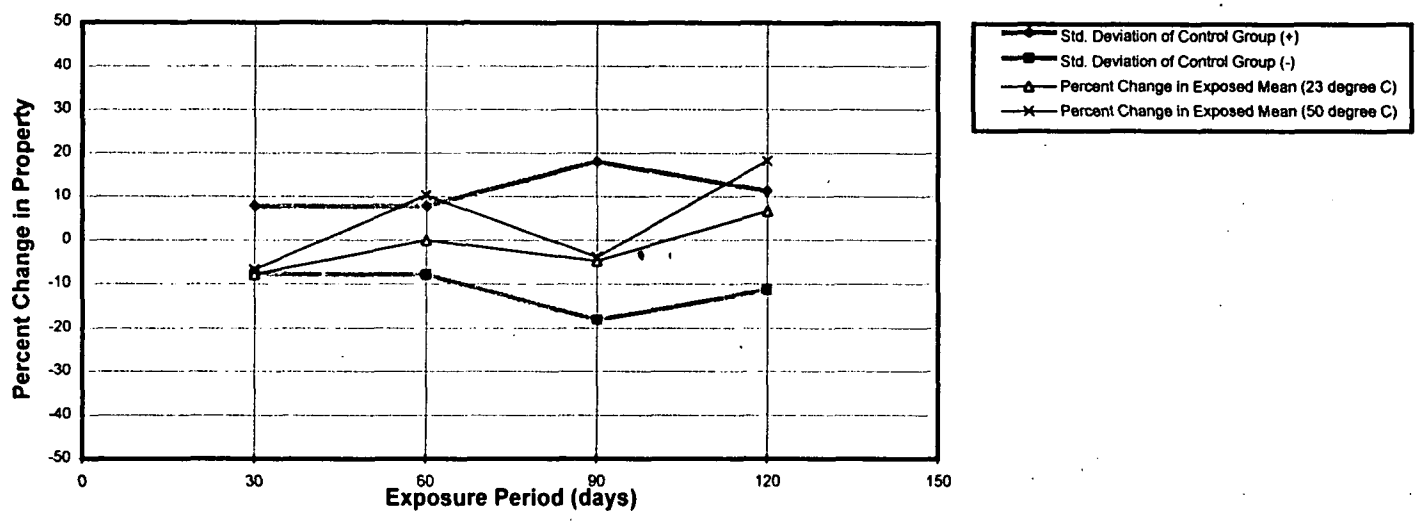
CHEMICAL COMPATIBILITY TEST RESULTS

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	4872.0
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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

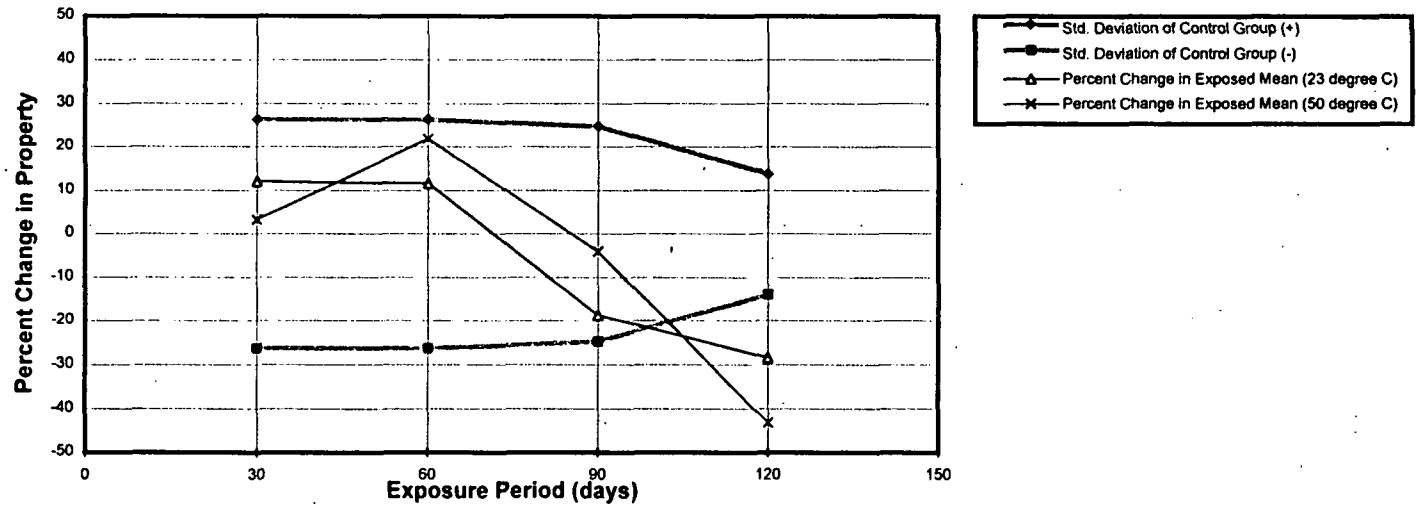
CHEMICAL COMPATIBILITY TEST RESULTS

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	2487.5
	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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

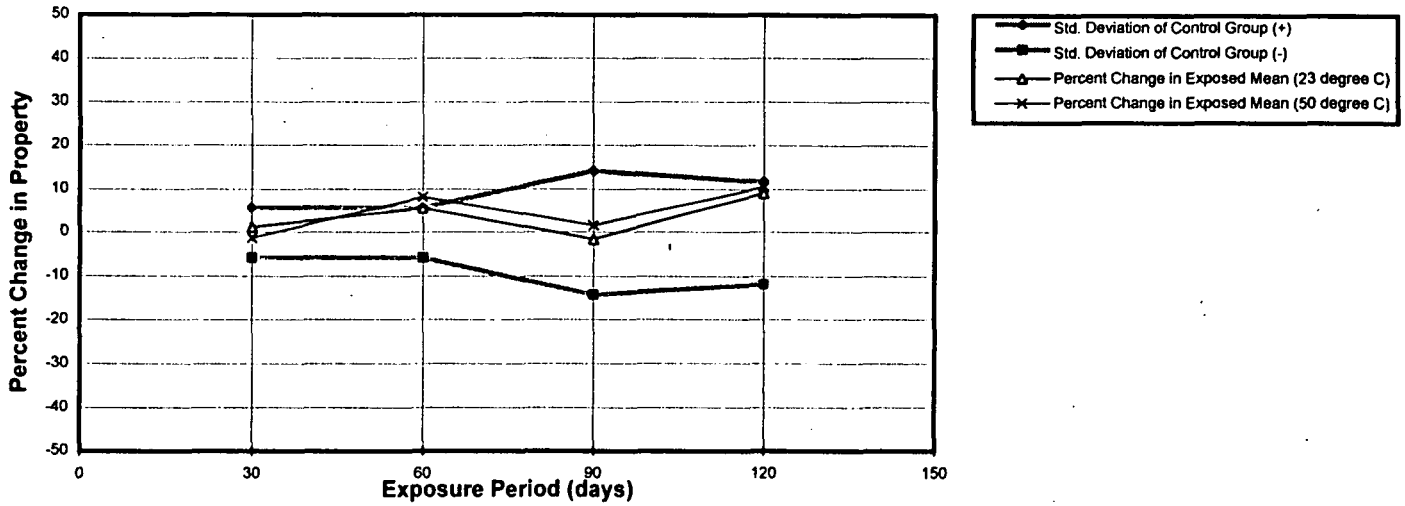
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

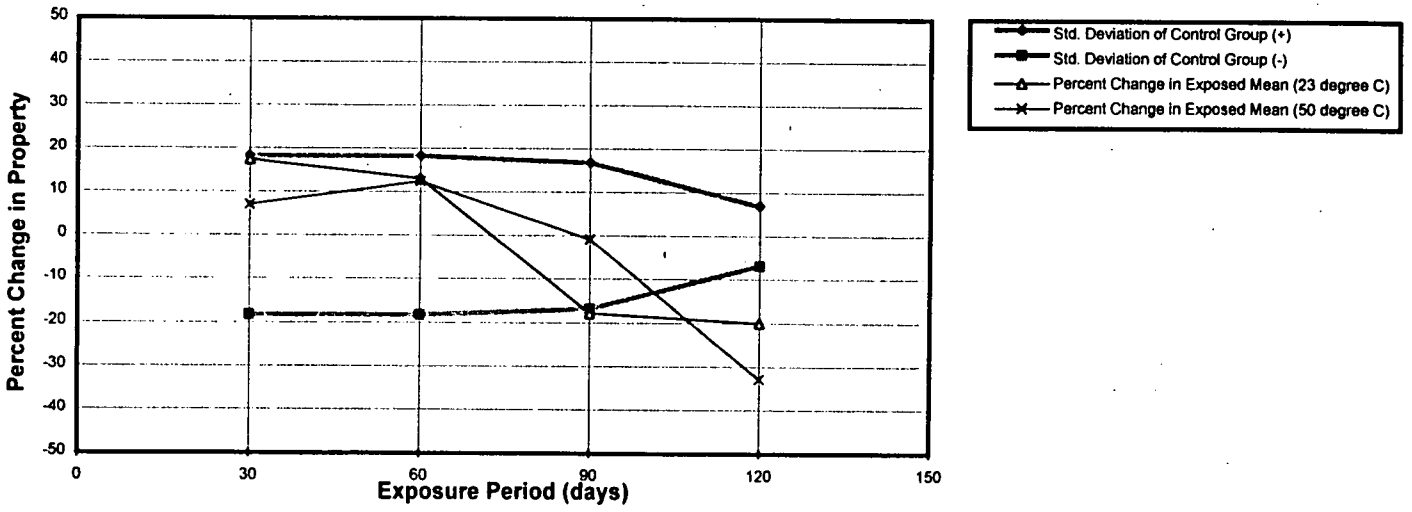
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

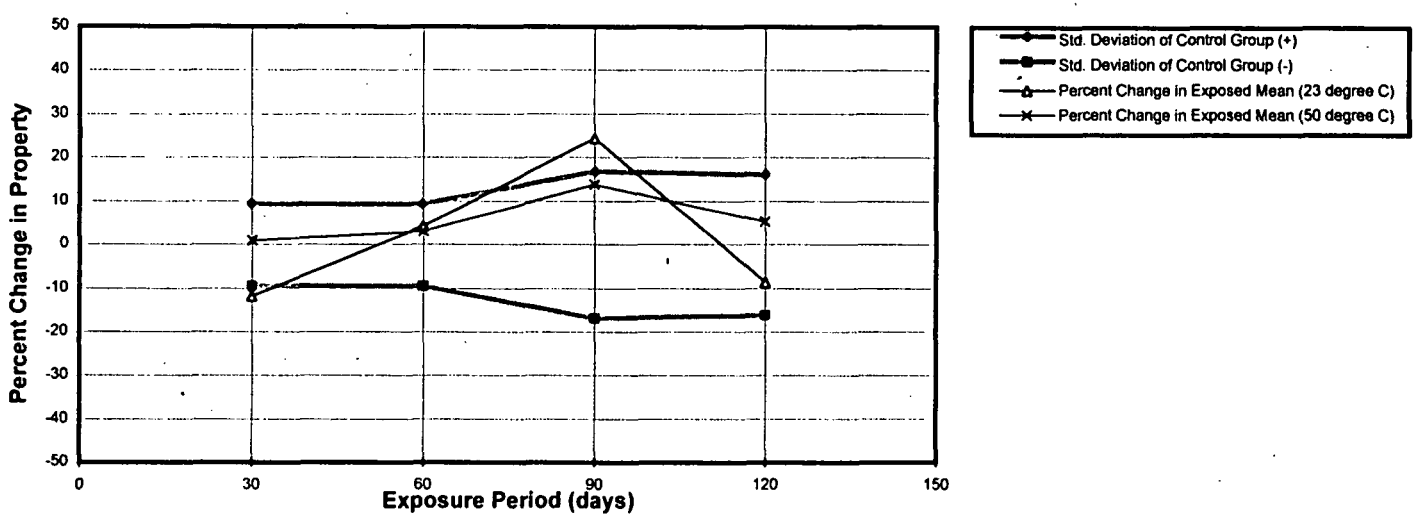
CHEMICAL COMPATIBILITY TEST RESULTS

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



GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

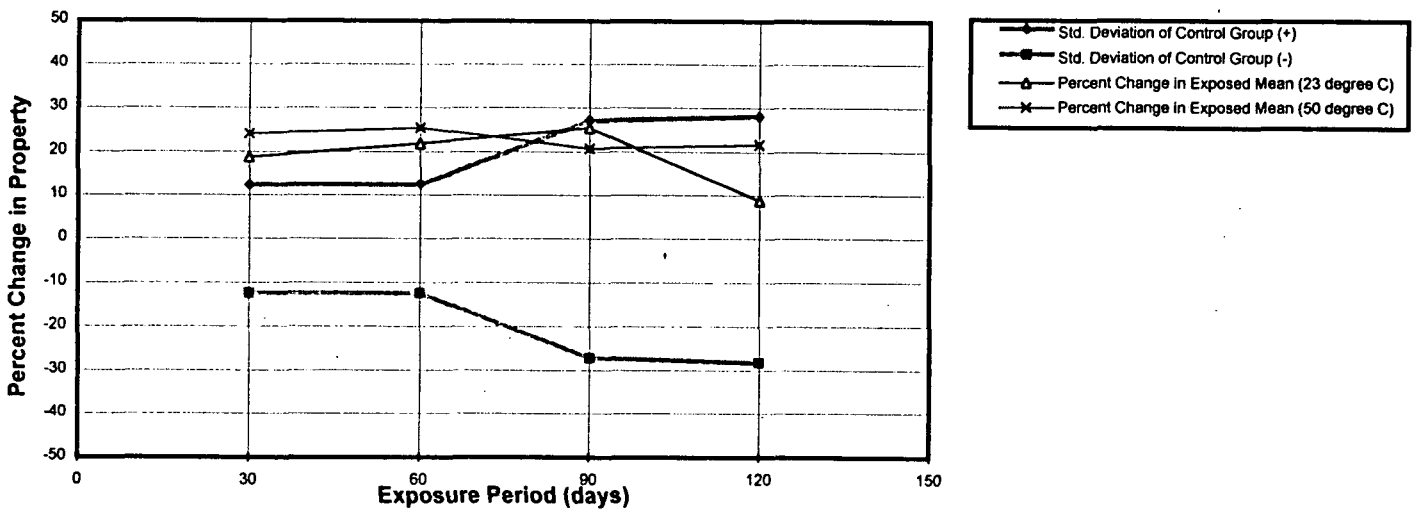
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

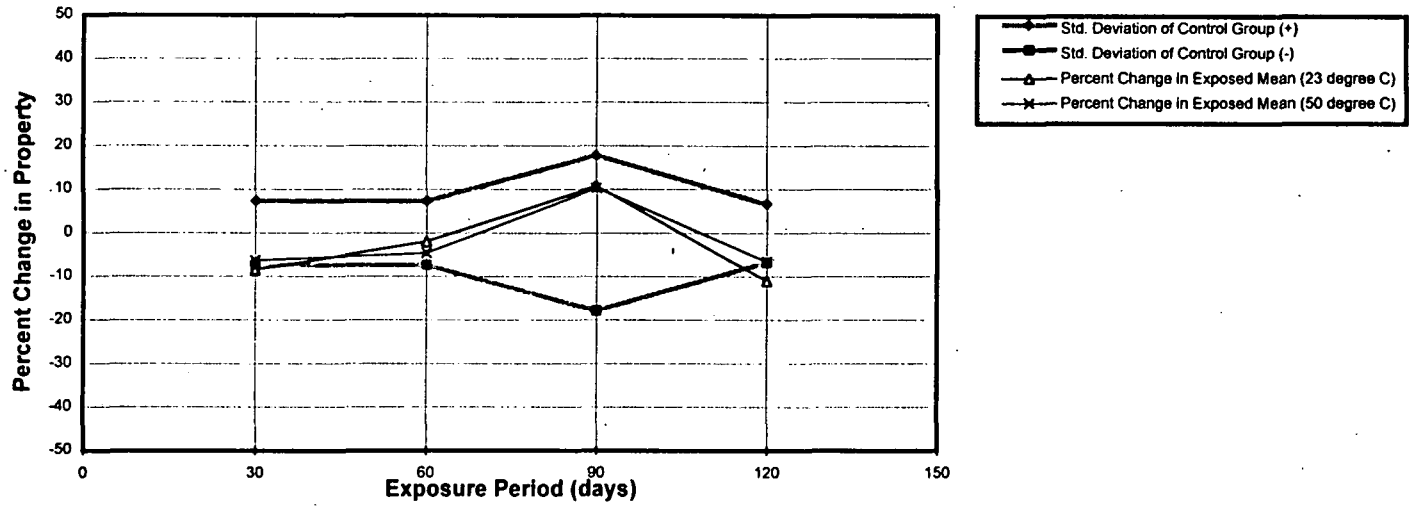
CHEMICAL COMPATIBILITY TEST RESULTS

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



GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

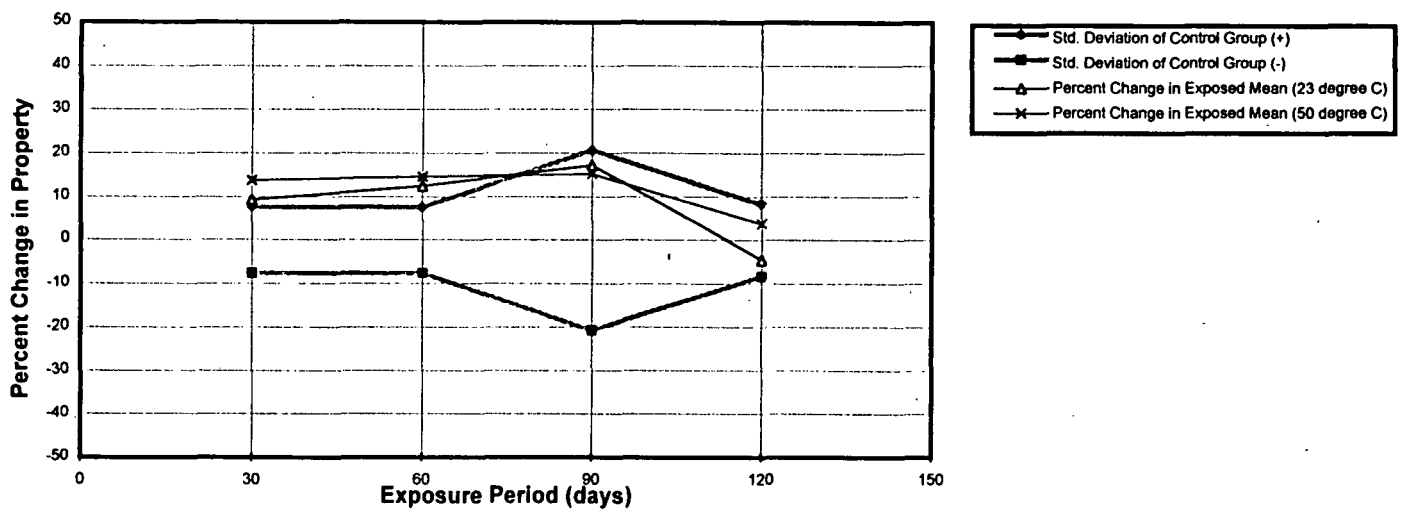
CHEMICAL COMPATIBILITY TEST RESULTS

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



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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

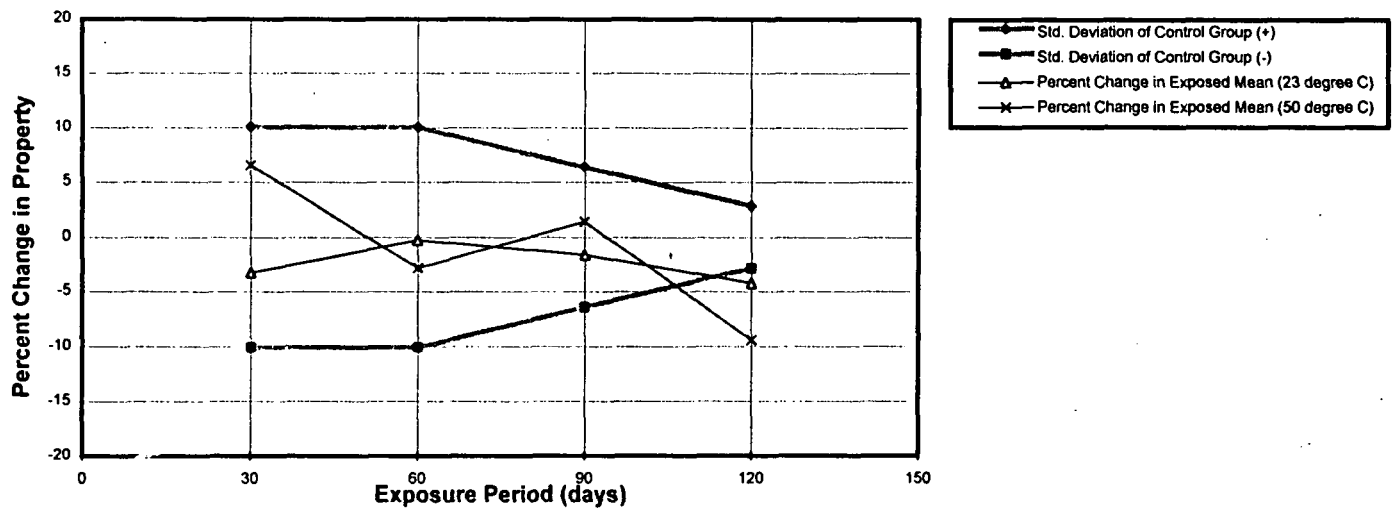
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

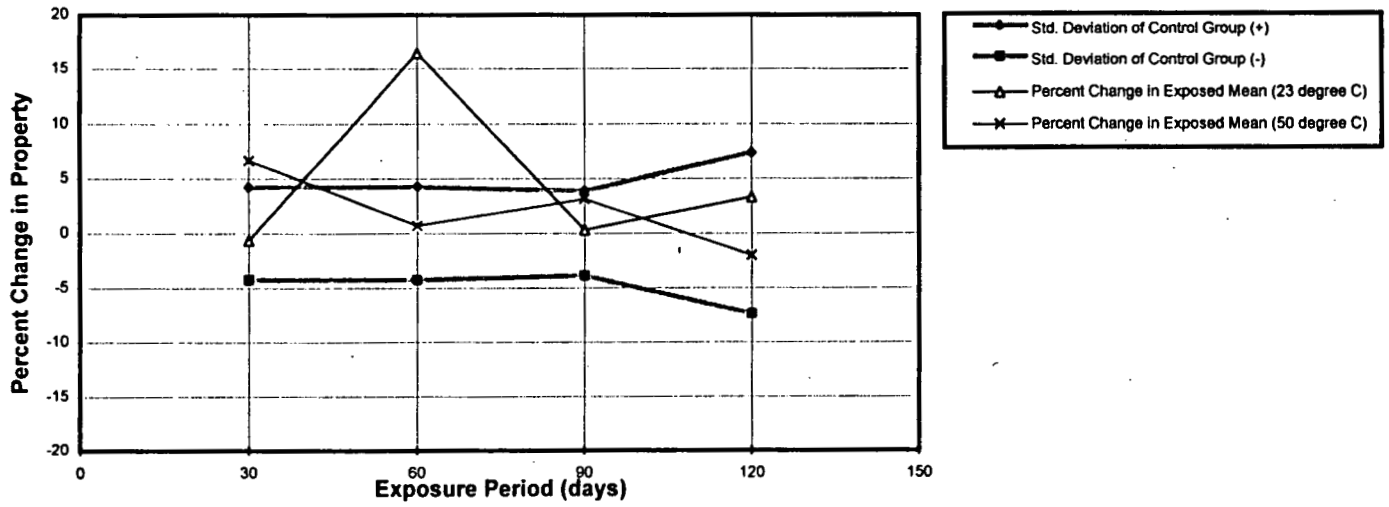
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

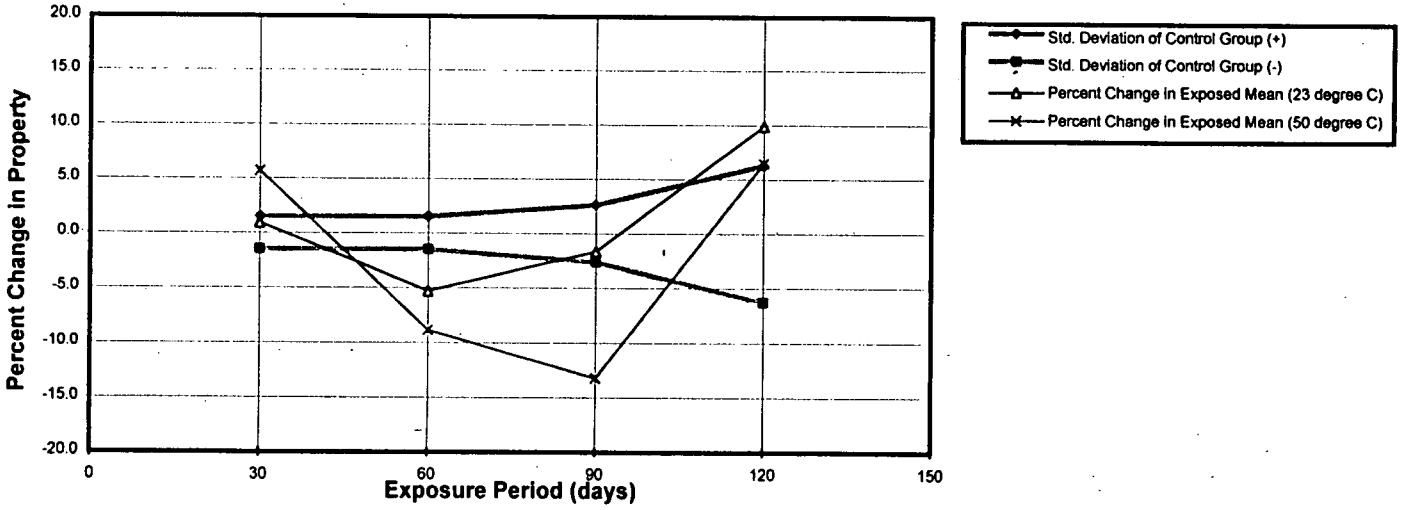
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

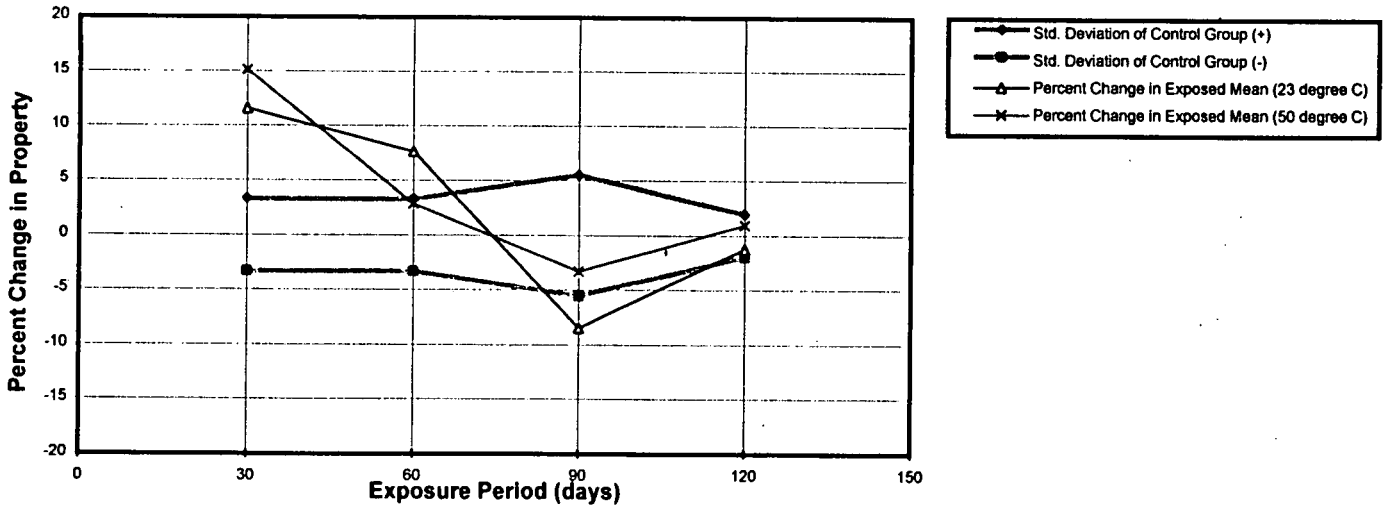
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

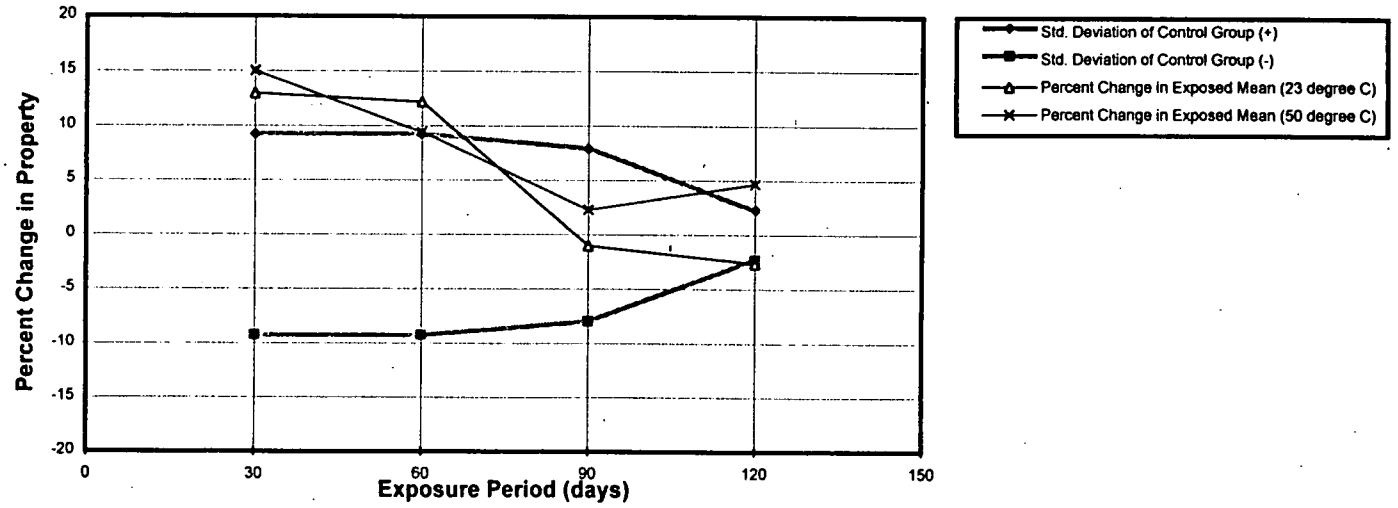
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

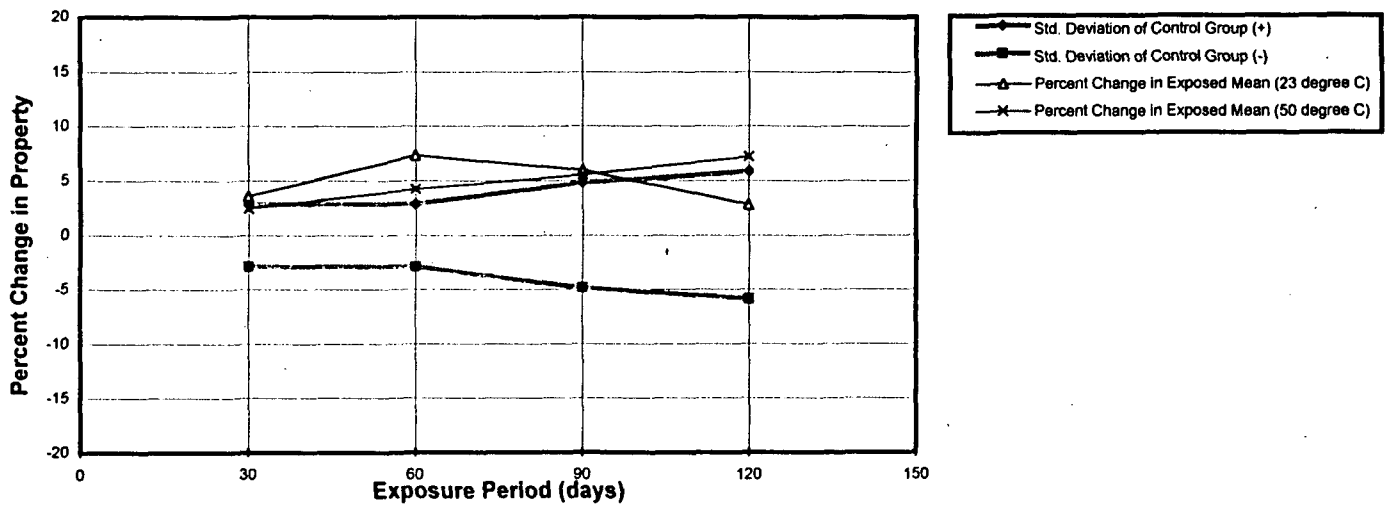
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

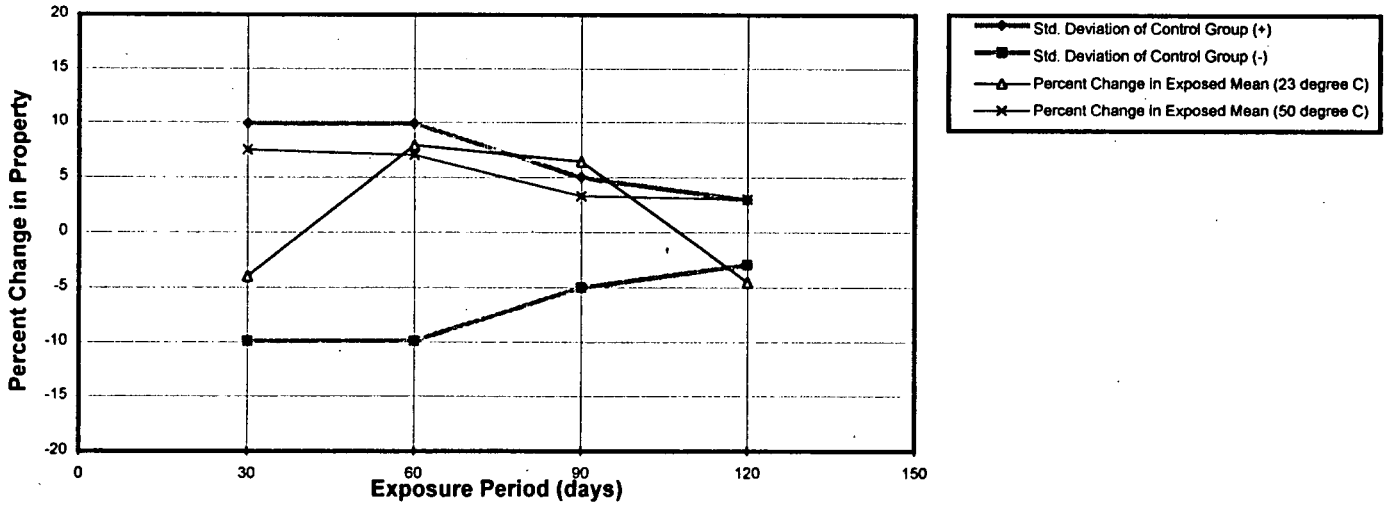
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

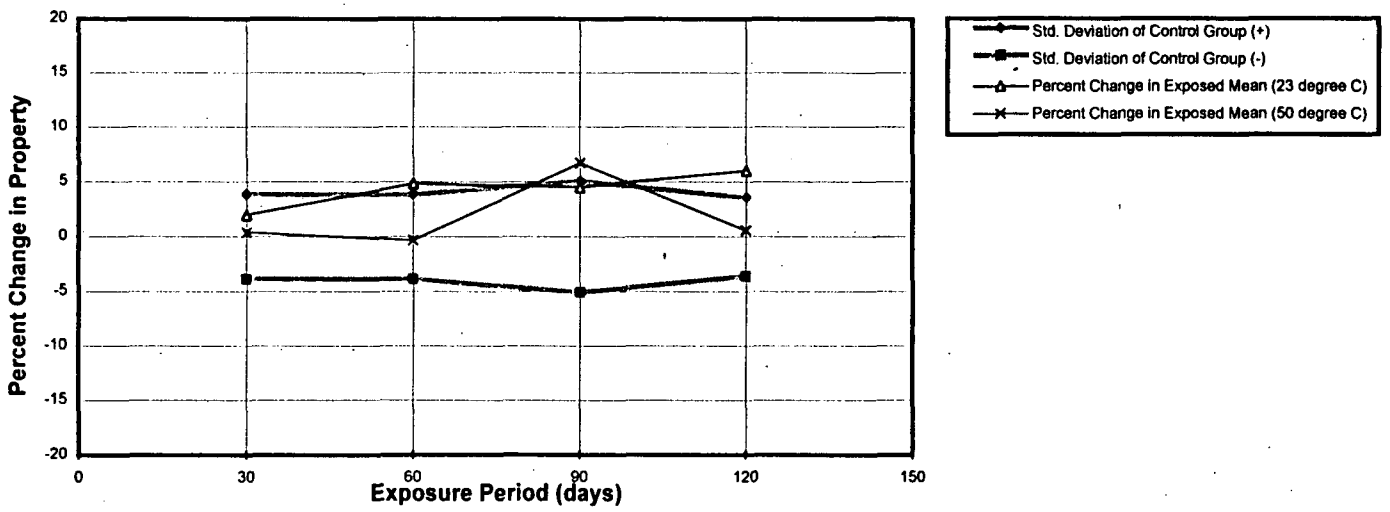
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

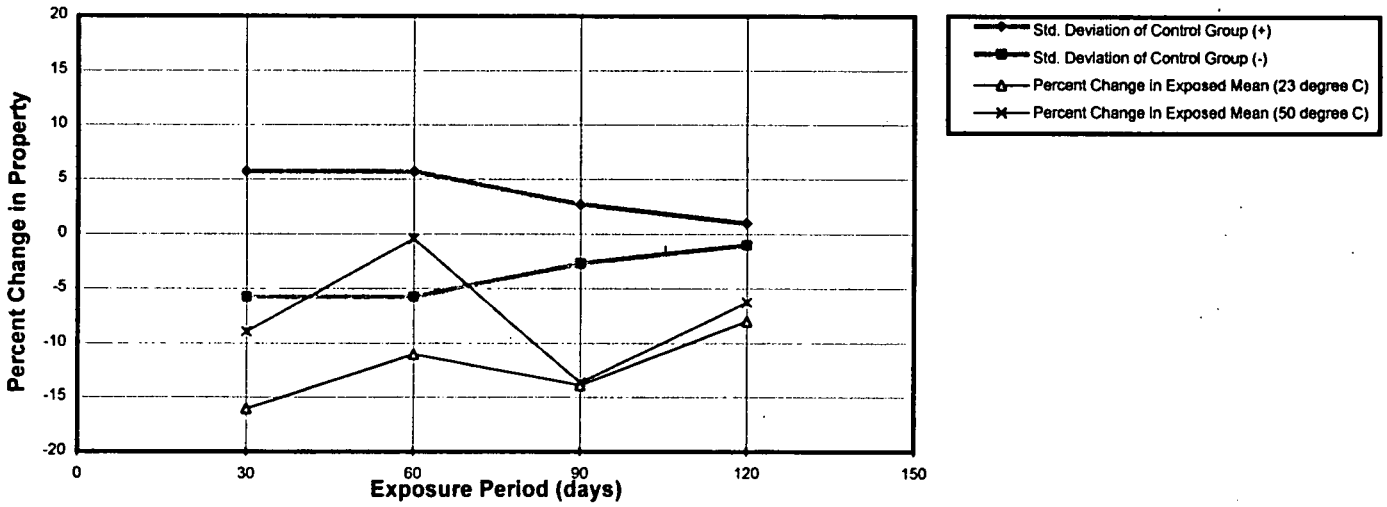
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

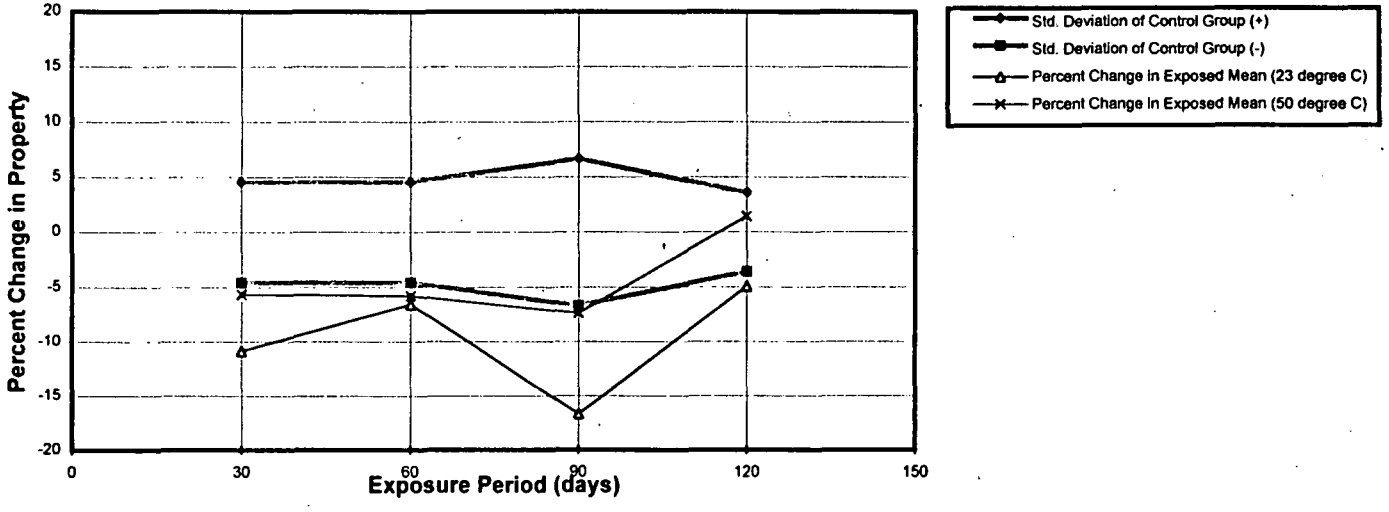
CHEMICAL COMPATIBILITY TEST RESULTS

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



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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
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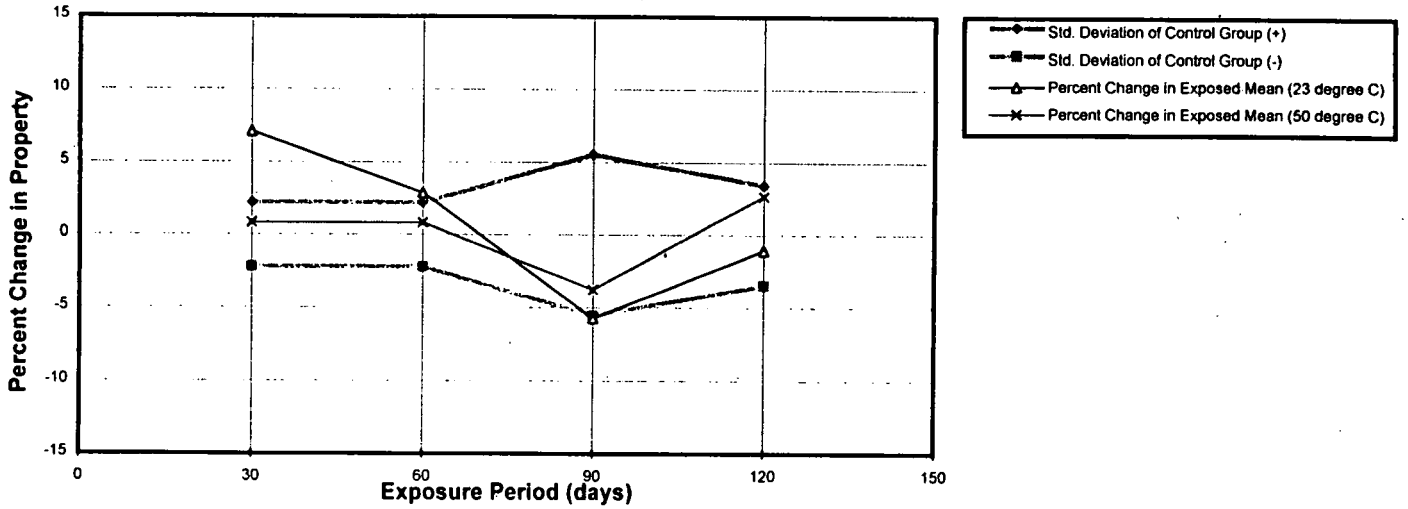
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

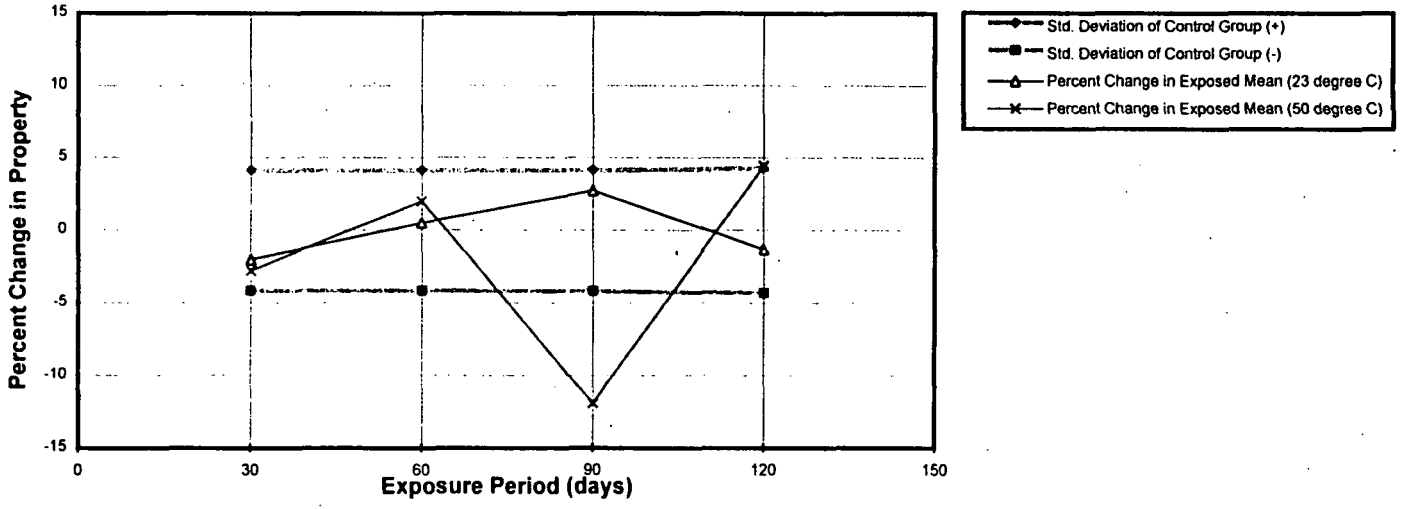
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

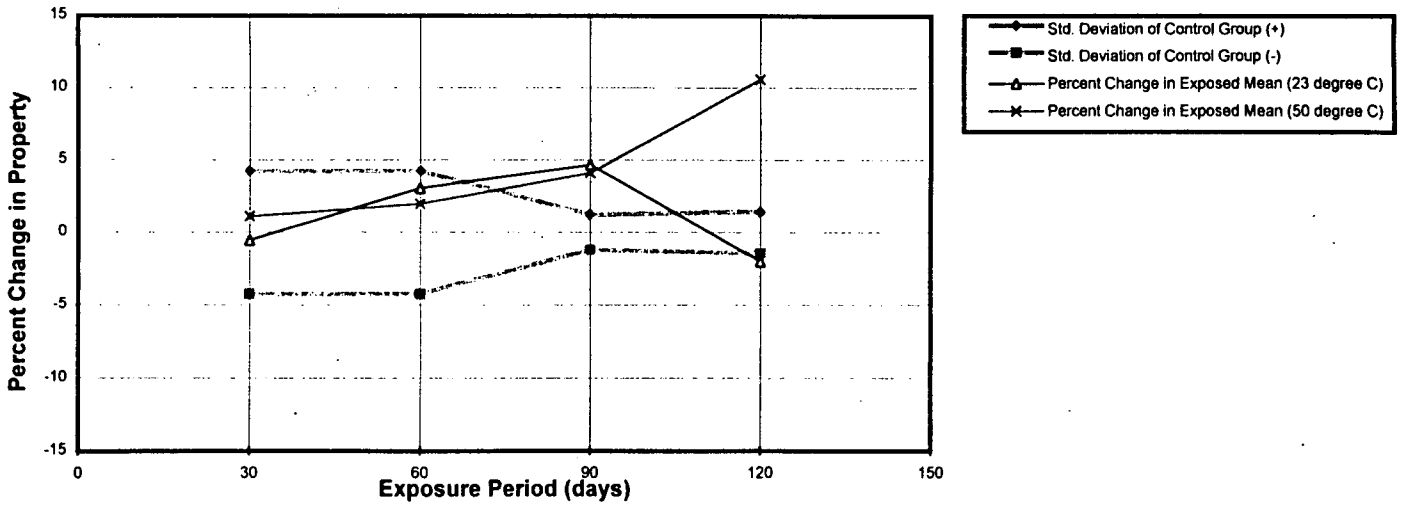
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

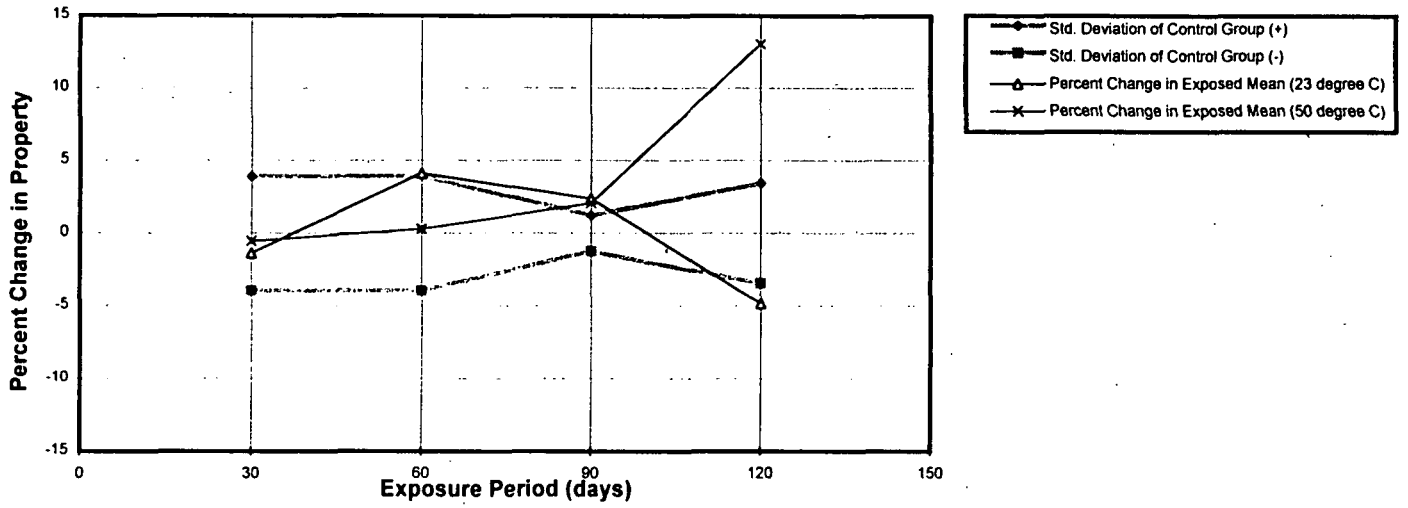
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
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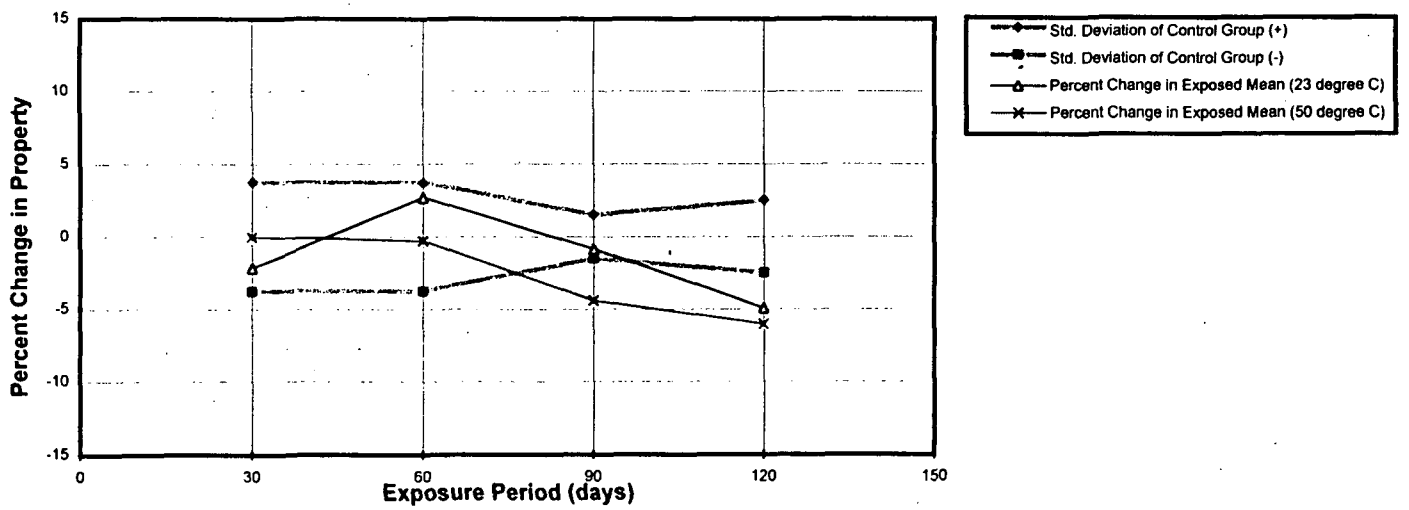
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

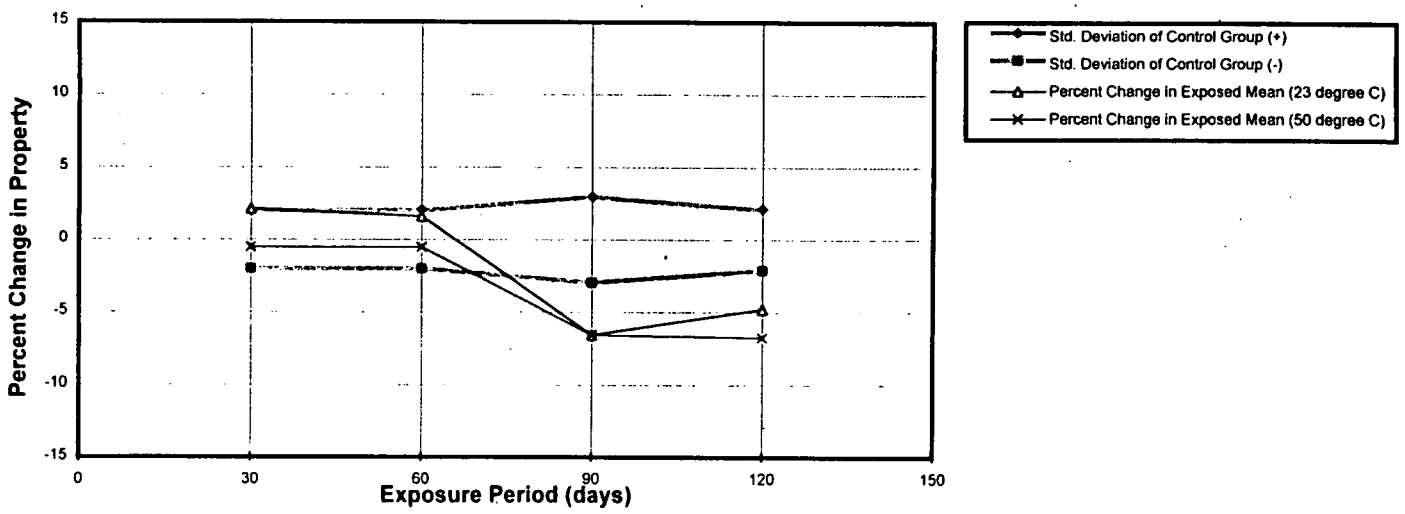
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

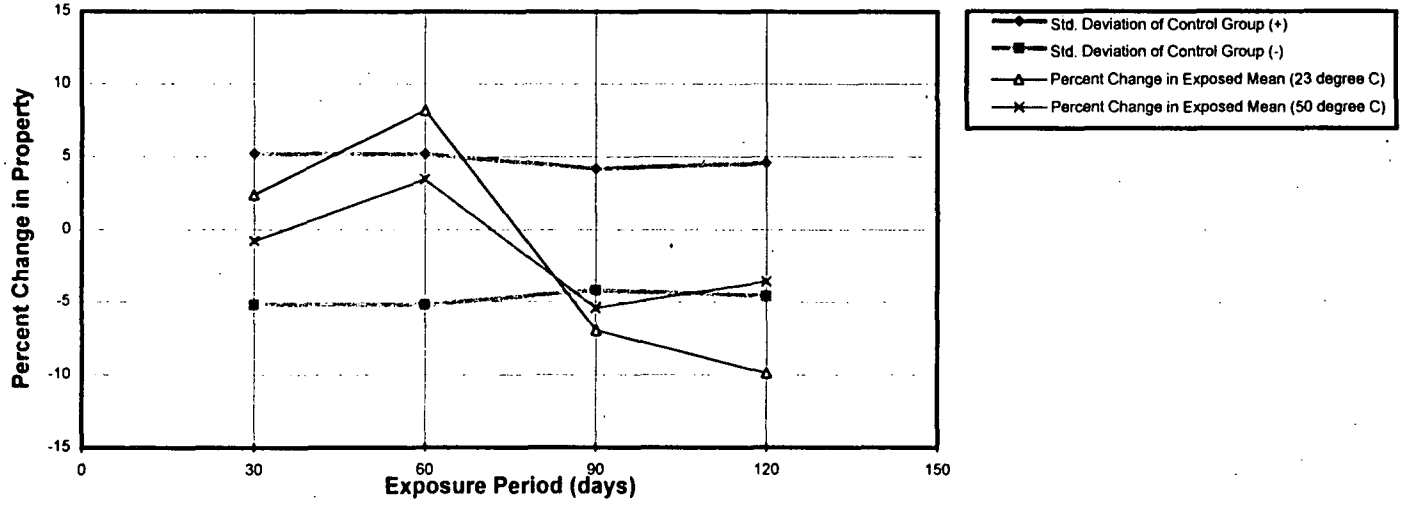
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

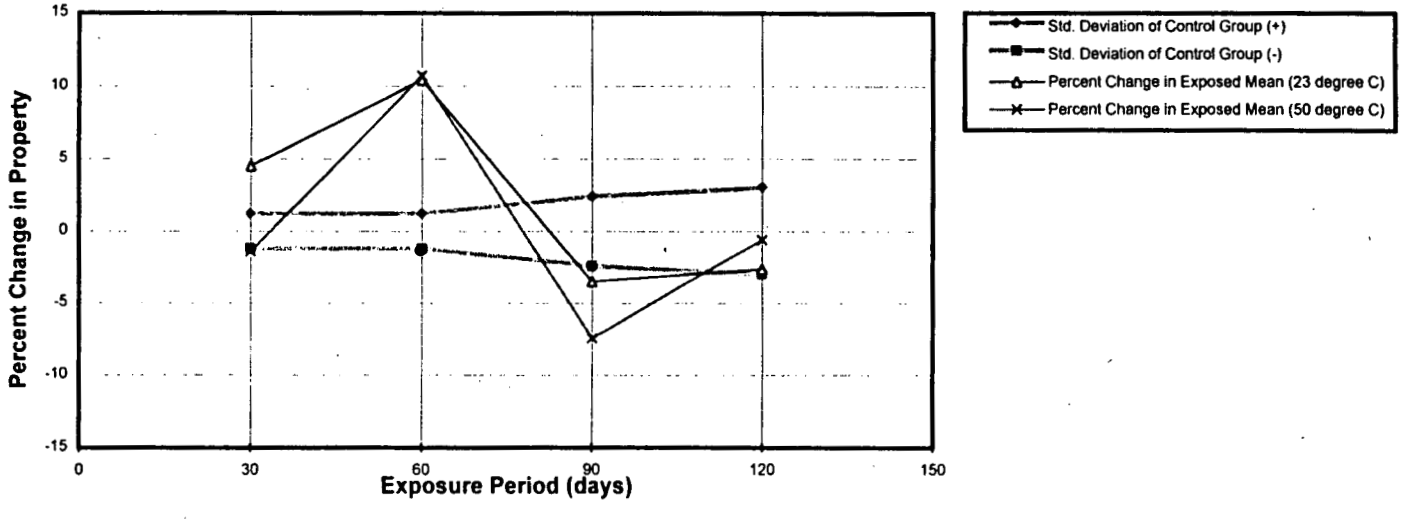
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

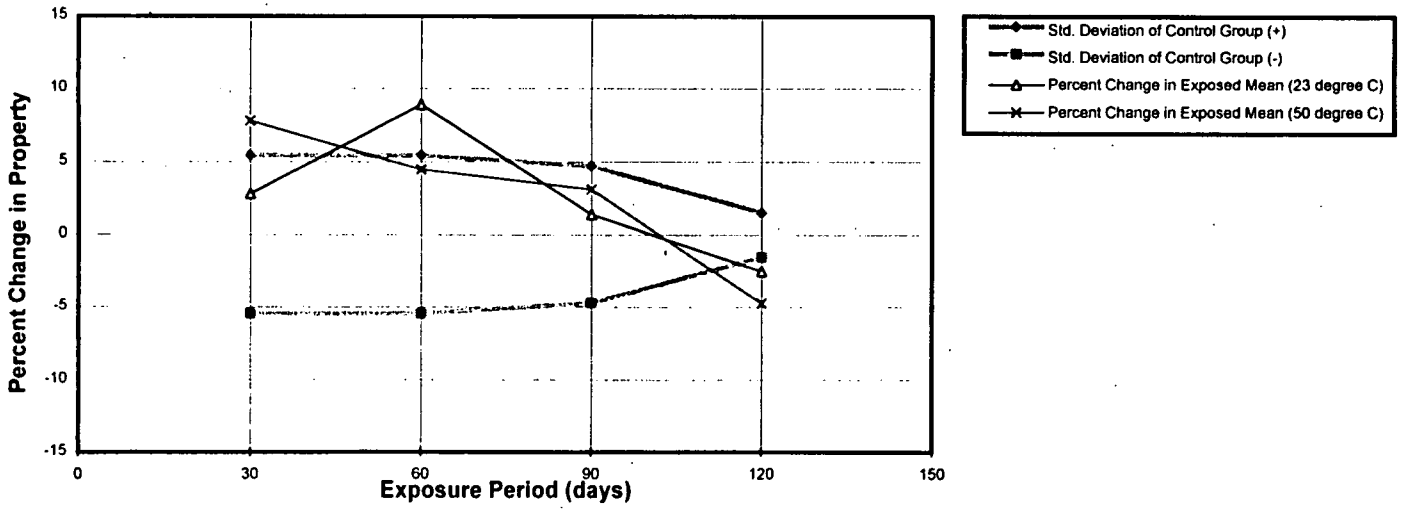
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

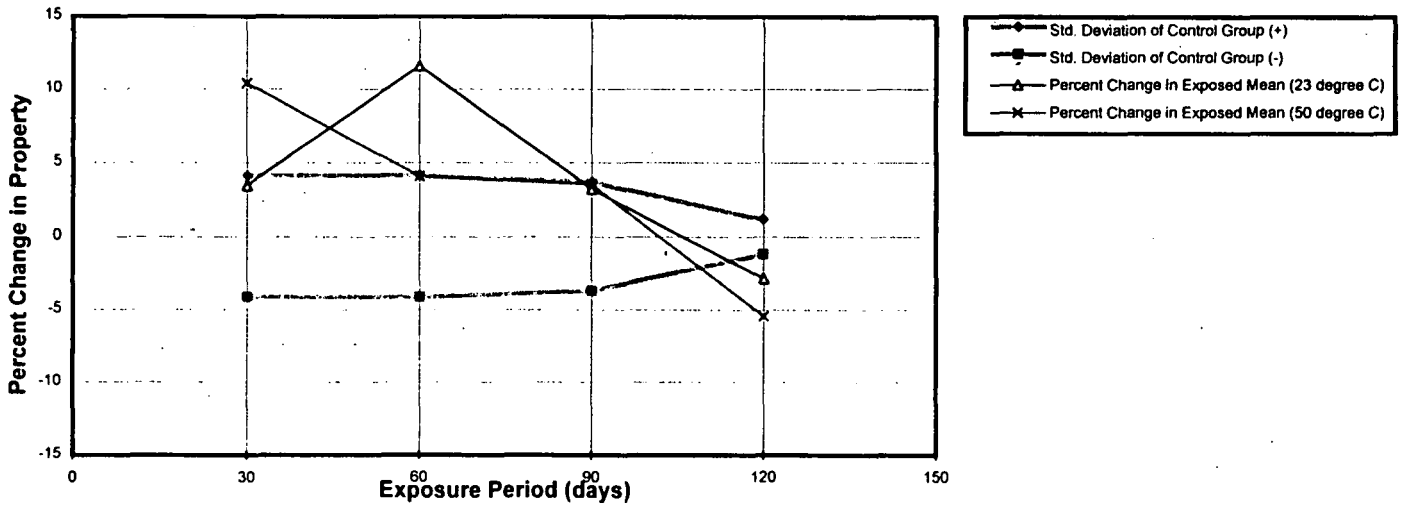
CHEMICAL COMPATIBILITY TEST RESULTS

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

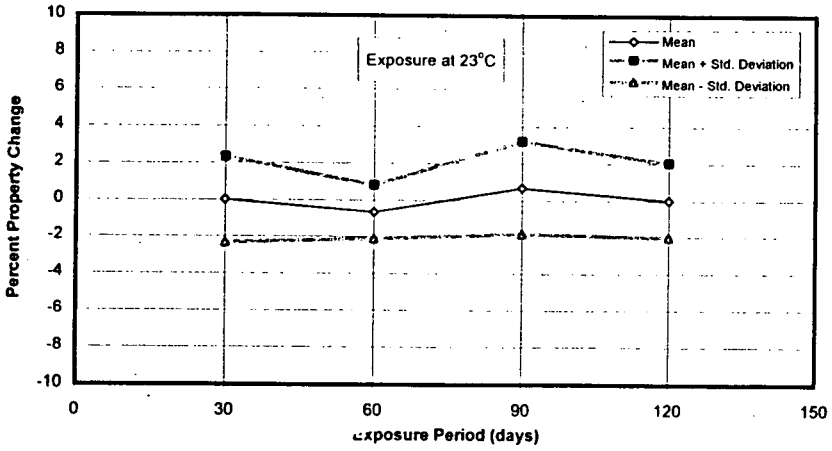
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 6/14/96

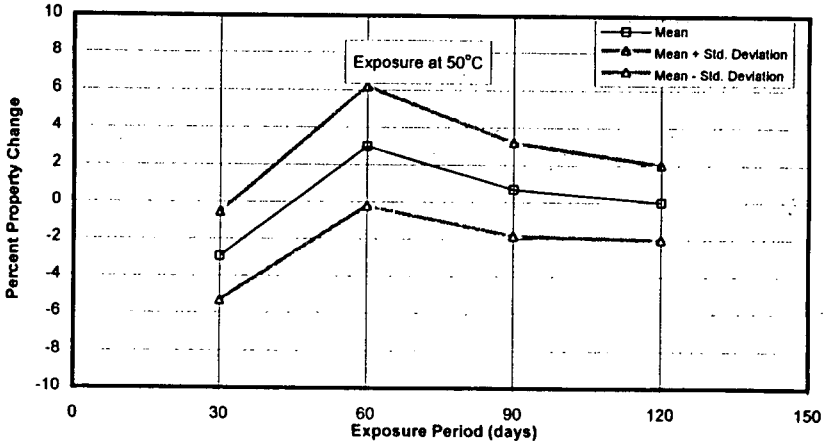
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: GSE-SLT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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*

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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

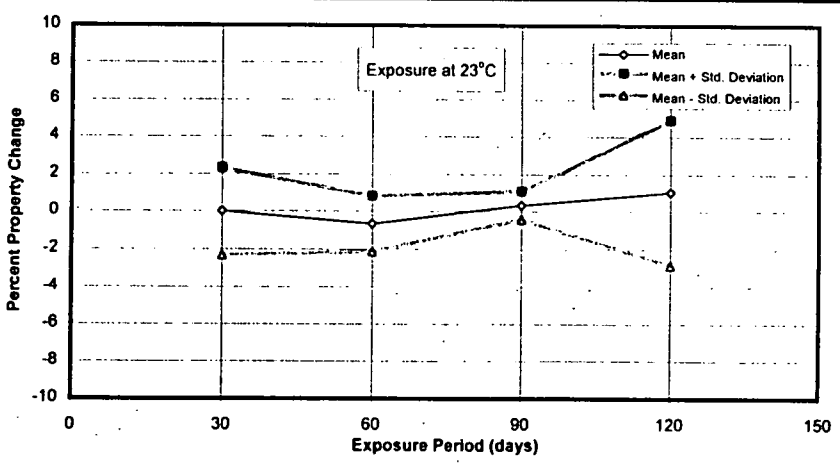
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 6/14/96

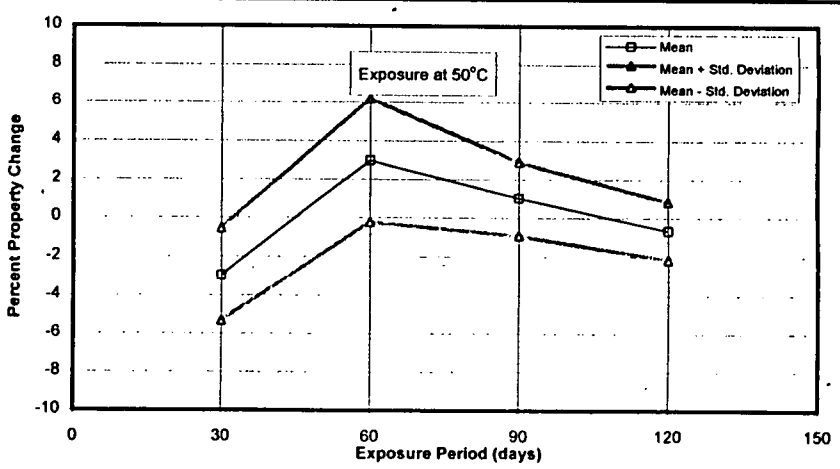
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: NSC
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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*

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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

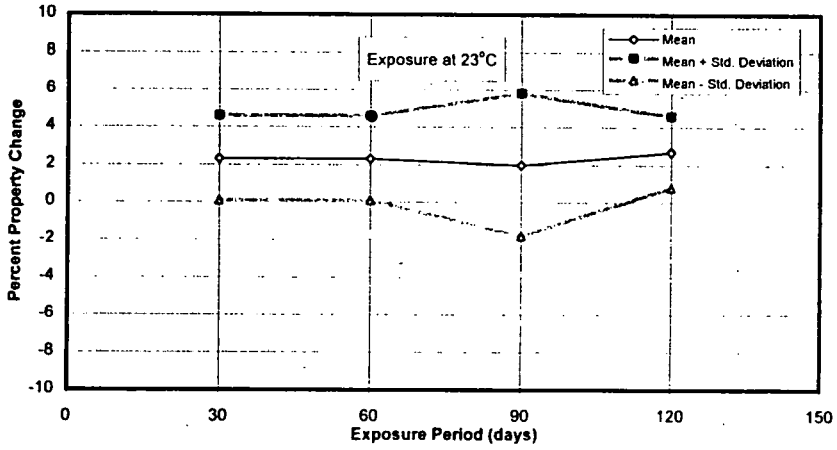
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 6/14/96

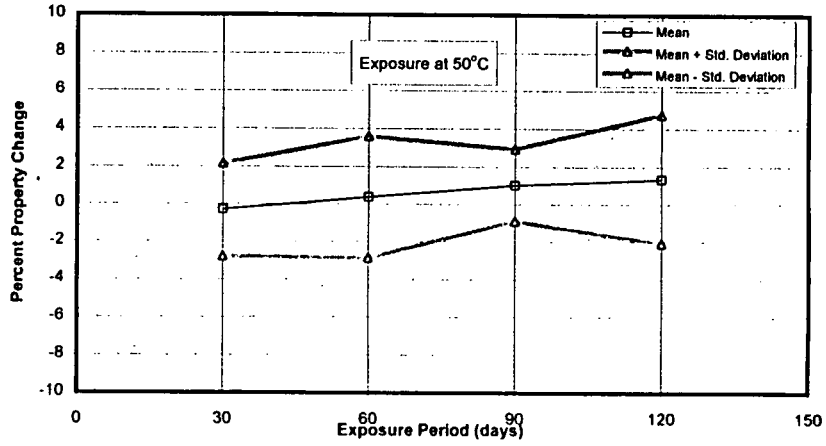
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: GSE Gundle
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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*

GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

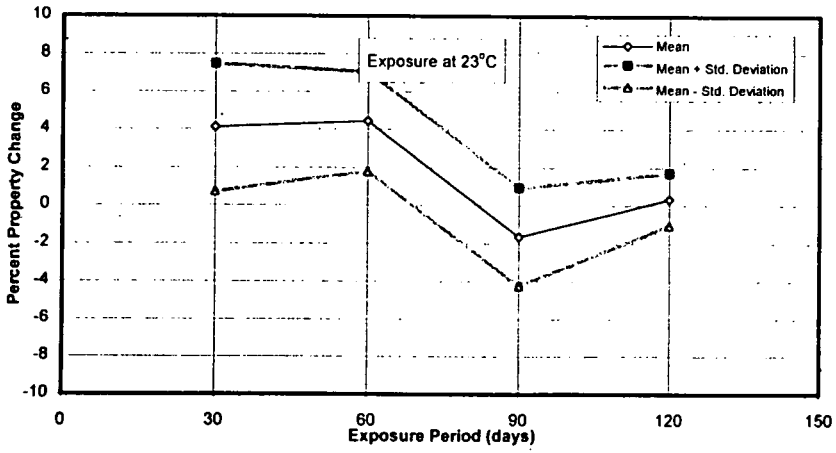
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 6/14/96

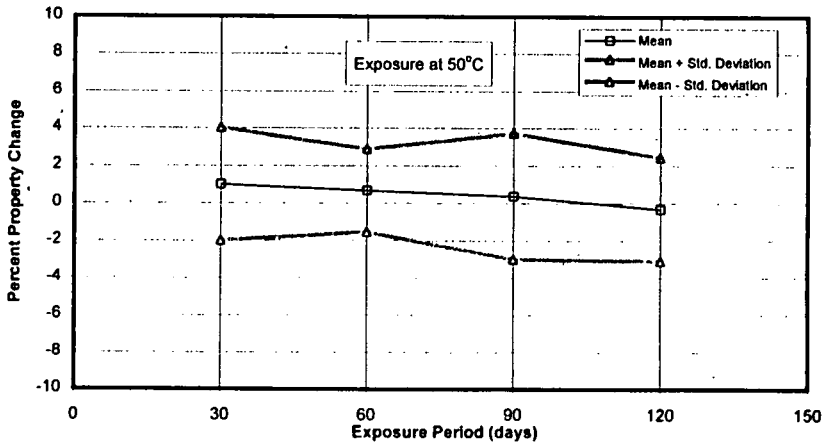
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: POLYFLEX
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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			2.636			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*

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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

CHEMICAL COMPATIBILITY TEST RESULTS

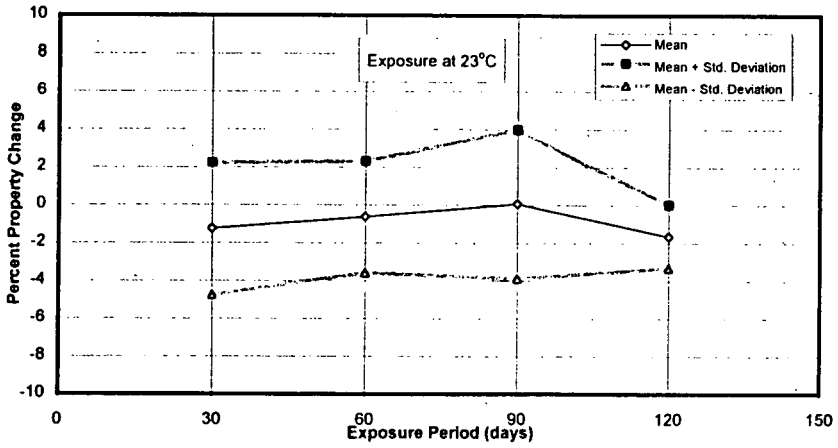
CLIENT: FERMCO
METHOD: ASTM D2240
DATE TESTED: 6/14/96

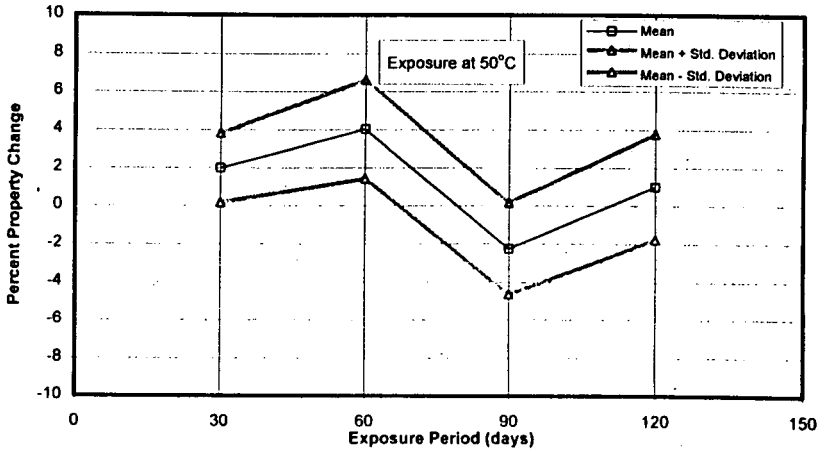
GEOSYNTEC JOB NO.: GE3900
MATERIAL TYPE: SERROT
CHARACTERISTICS: 80 mil HDPE Geomembrane
IMMERSION MEDIUM: Perched Ground Water

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*

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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

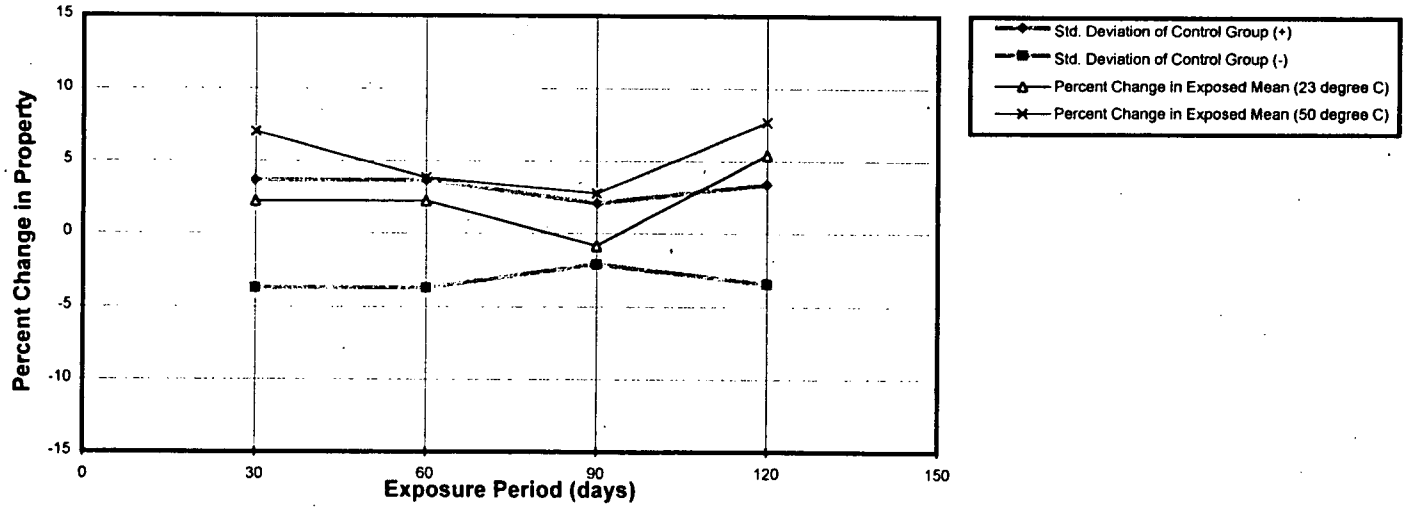
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

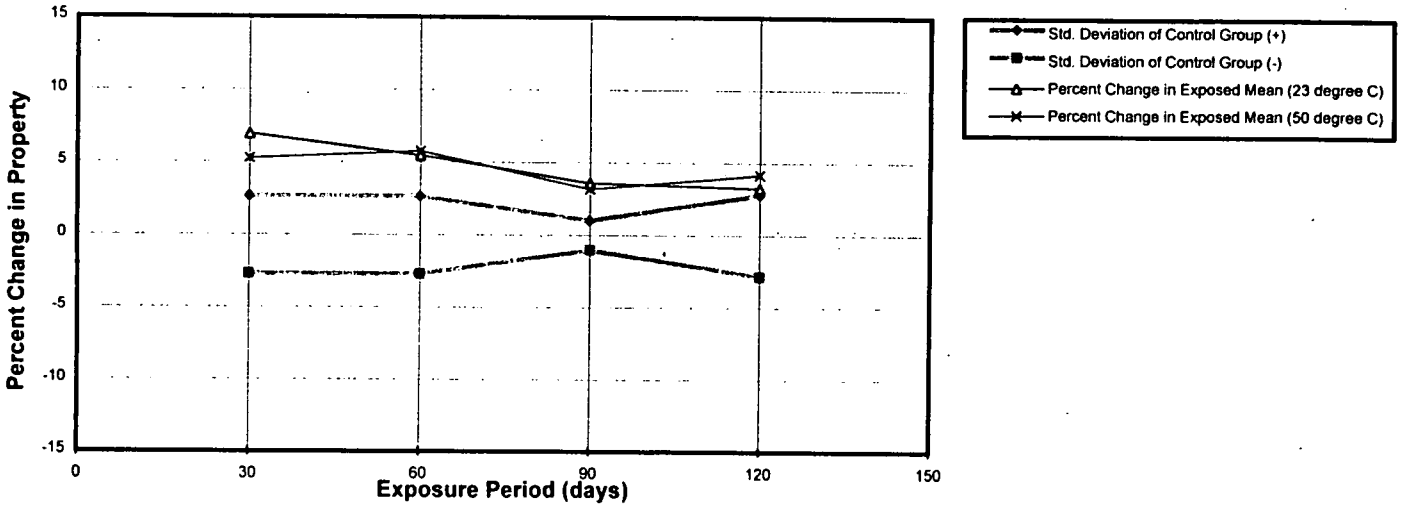
CHEMICAL COMPATIBILITY TEST RESULTS

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



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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

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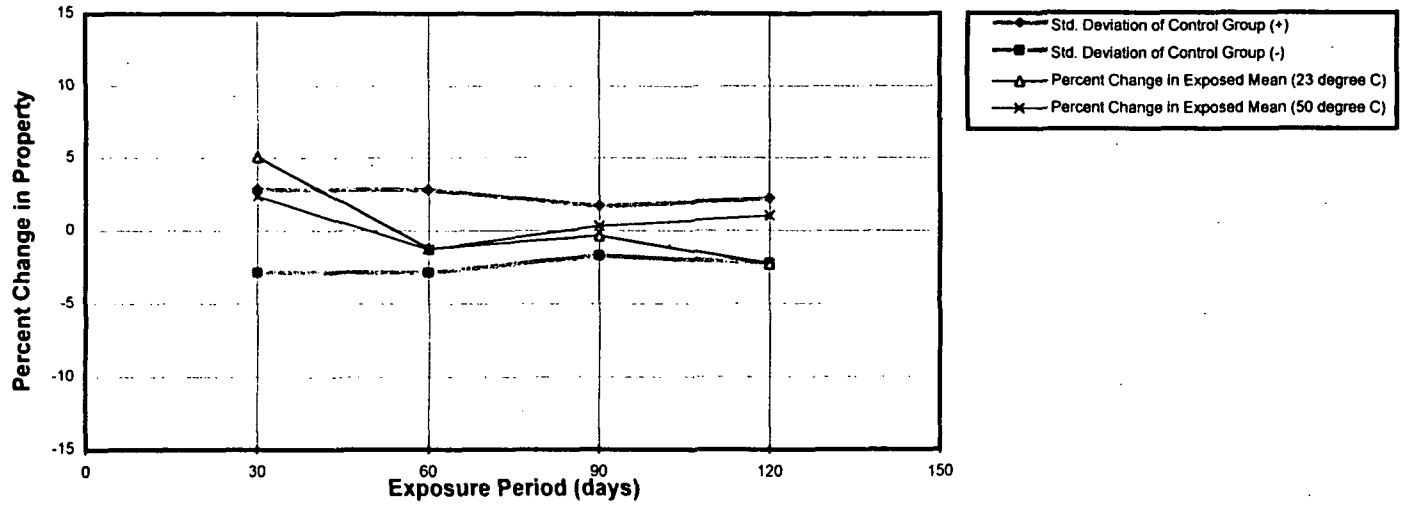
+5.08



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

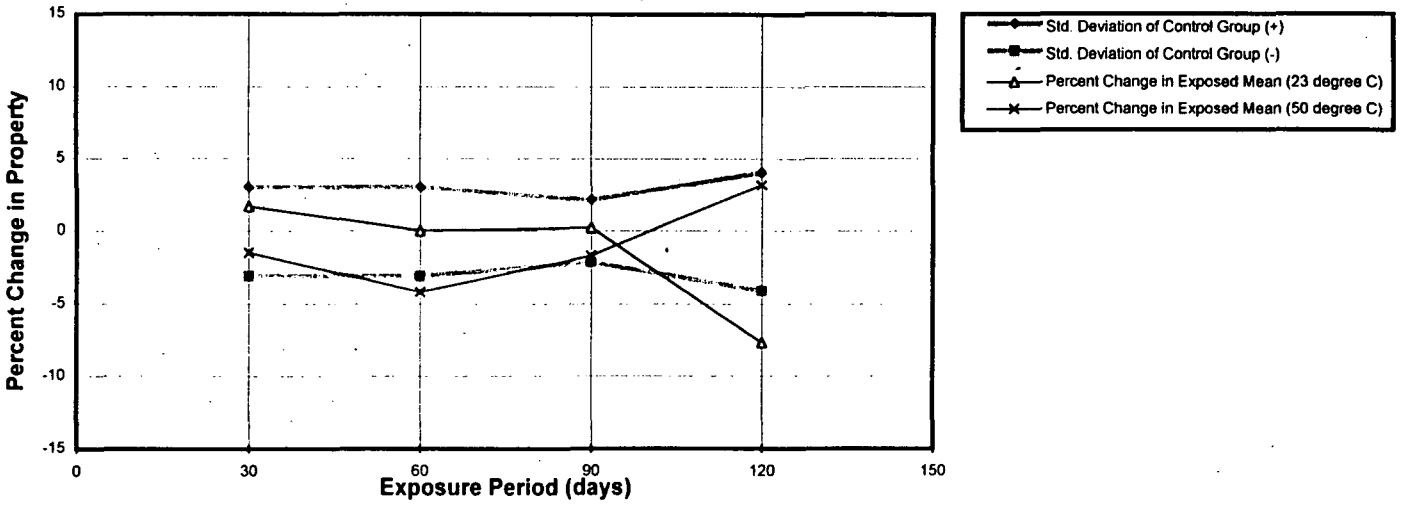
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

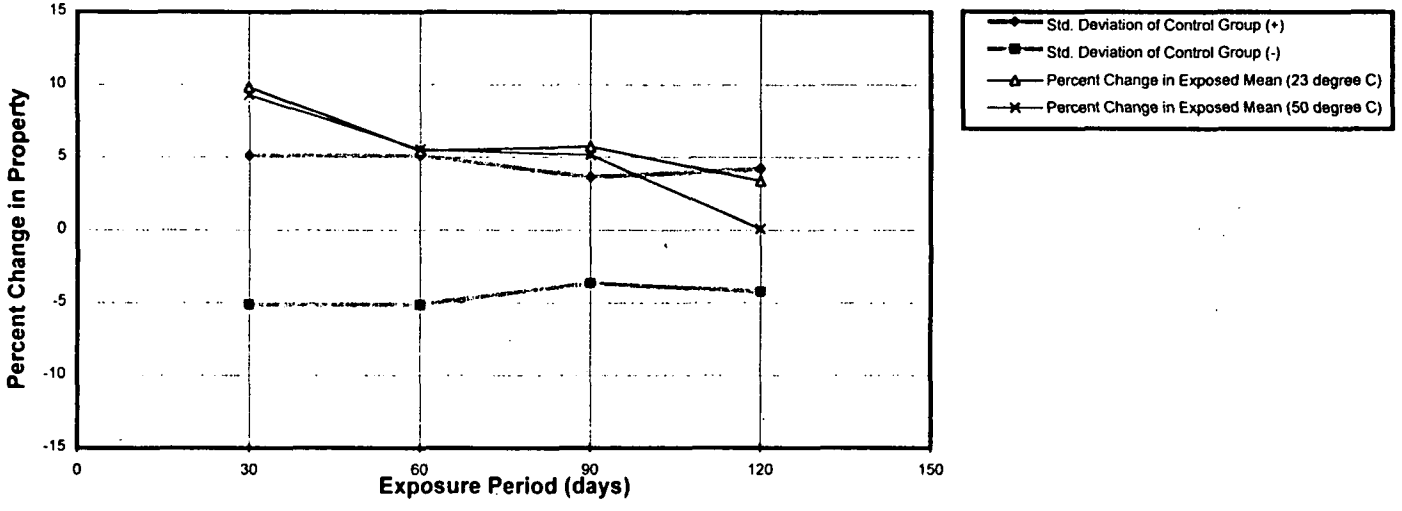
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

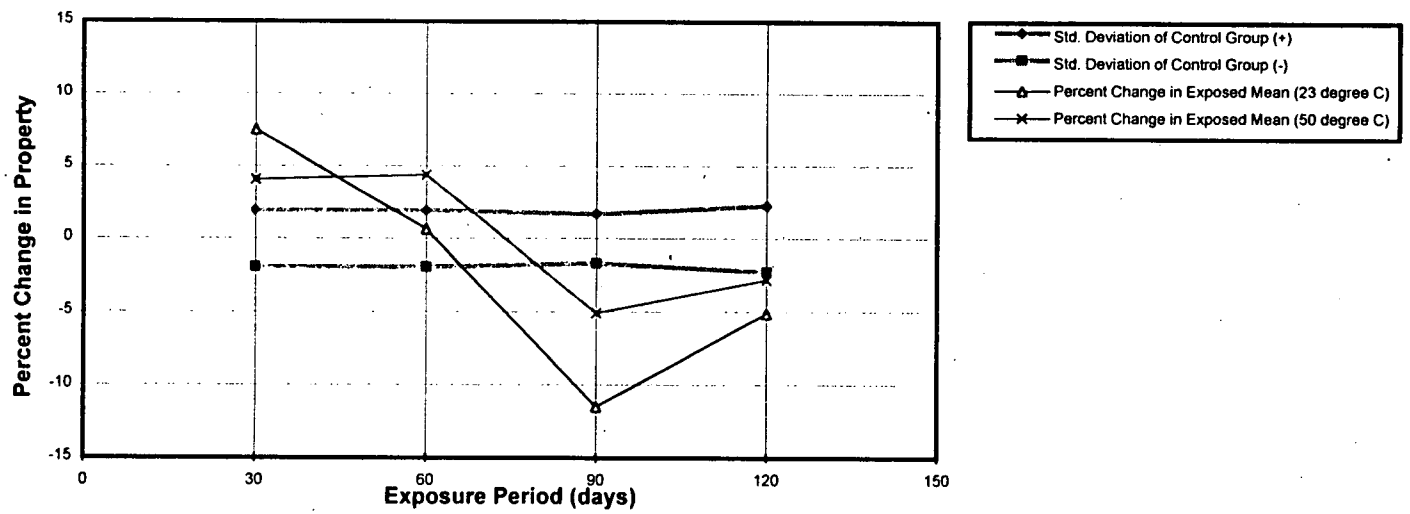
CHEMICAL COMPATIBILITY TEST RESULTS

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



000315

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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

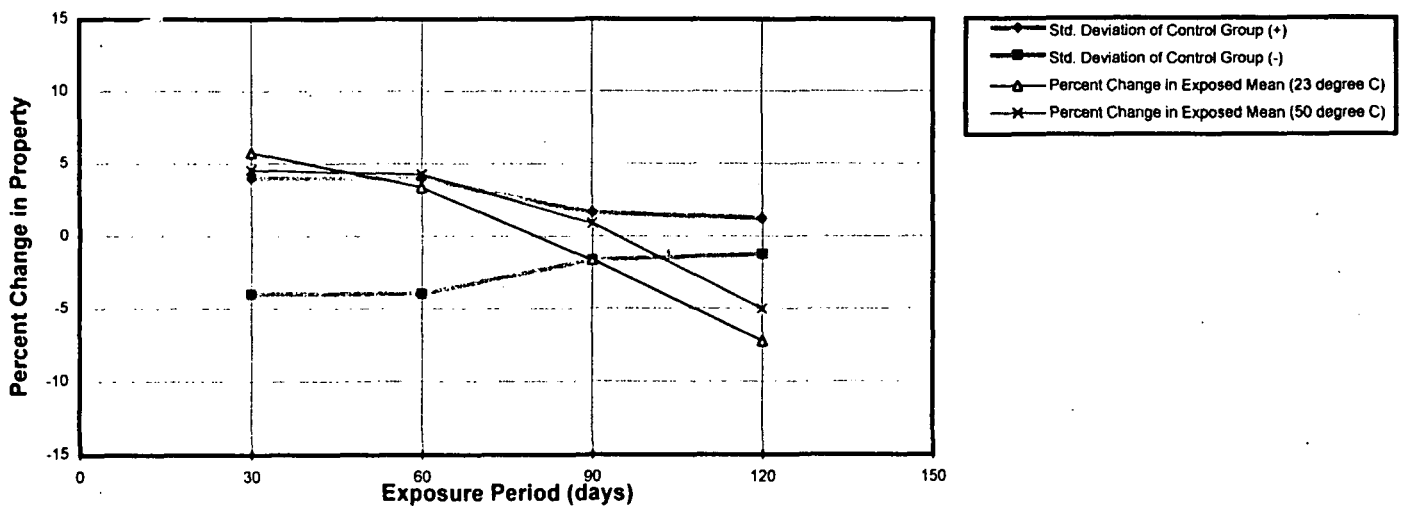
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

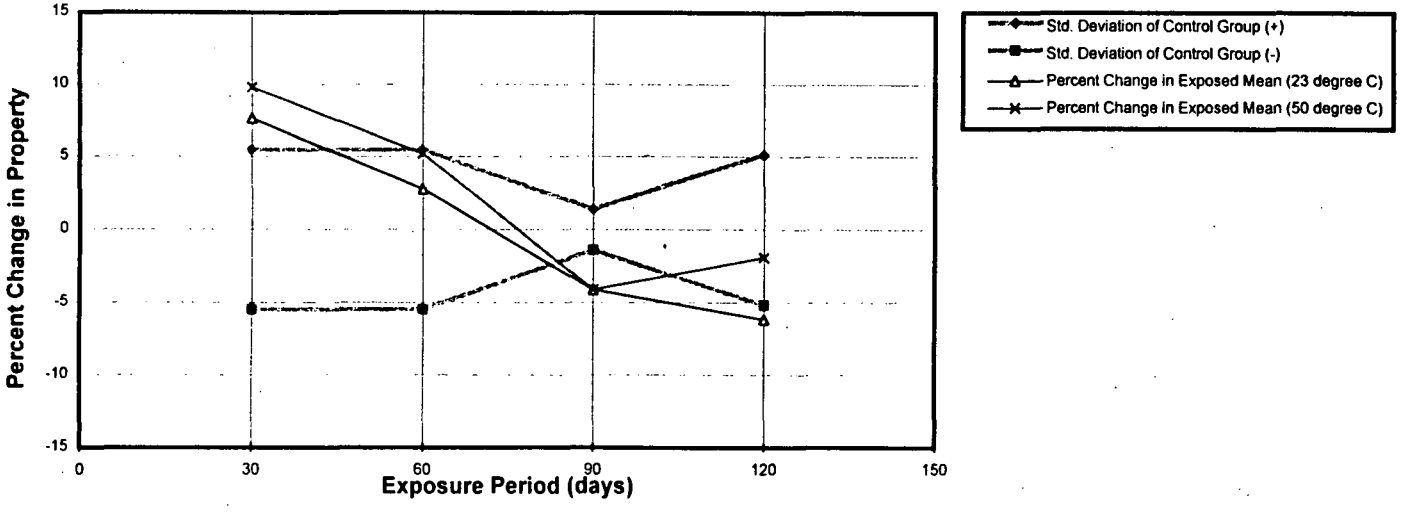
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

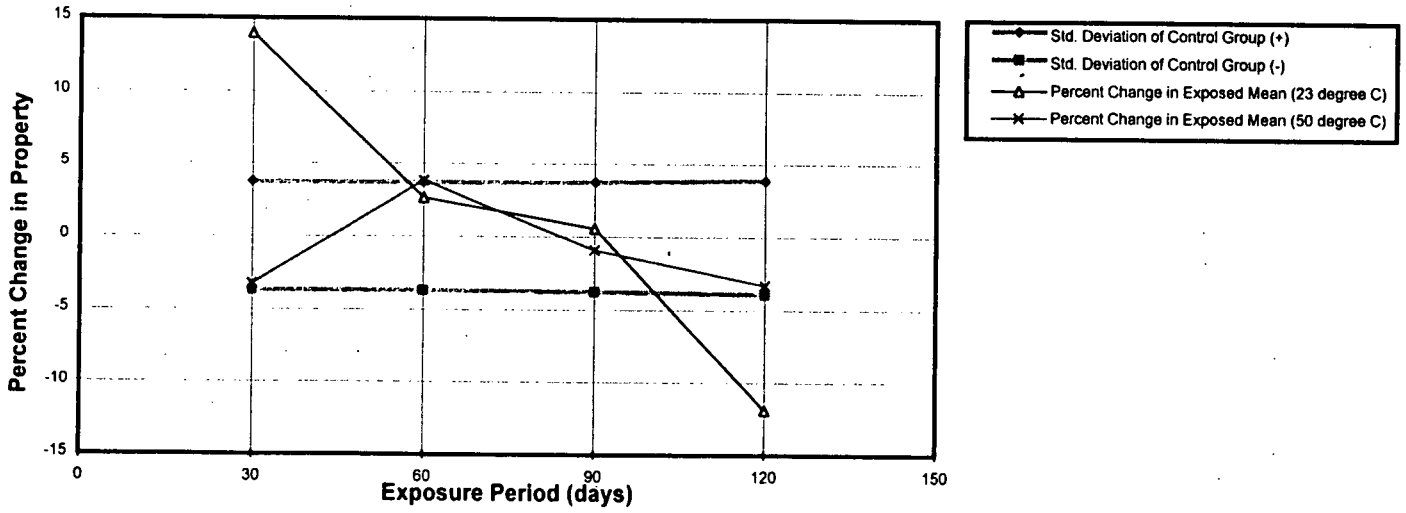
CHEMICAL COMPATIBILITY TEST RESULTS

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



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GEOSYNTEC CONSULTANTS
Materials Testing Laboratory

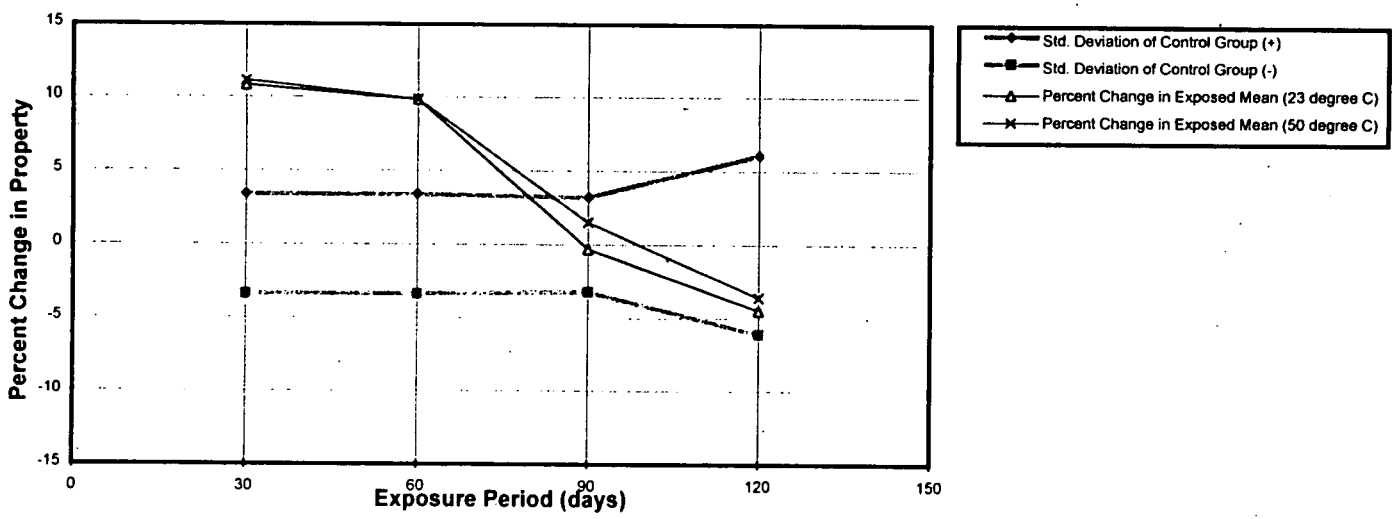
CHEMICAL COMPATIBILITY TEST RESULTS

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



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.

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. D. Hu

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
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PHILLIPS CHEMICAL COMPANY
A DIVISION OF PHILLIPS PETROLEUM COMPANY
BOX 792 • PHONE: 713 475-3666
PASADENA, TEXAS 77501-0792

PHILLIPS PLASTICS RESINS
Houston Chemical Complex

October 17, 1995

JHV# 15394-95

FAX: 214-647-0829

Poly America, Inc.
2000 West Marshall Drive
Grand Prairie, TX 75051

ATTN: Dee Averitte

This letter will certify that the Marlex* resin shown below, as supplied by Phillips Chemical Company, conforms to our manufacturing specification.

Type:	HHM TR-400G
Lot Number:	7151197
P.O. Number:	5247
Date Shipped:	10/16/95
Package:	PSPX 2262
Quantity:	177700 LBS.
HLMI (Flow Rate):	11.4 G/10 MIN
Melt Index:	.090 G/10 MIN
Density:	.937 G/CC

J. H. Vaden
Quality Assurance Manager

JHV:PSN:sr

• Reg. U.S. Pat. Off.

cc: QA-File-RC

Mr. Jim Nobert
Poly America, Inc.
2000 West Marschall Drive
Grand Prairie, TX 75051

UNION CARBIDE
UNION CARBIDE CORPORATION
P.O. Box 186, Port Lavaca, TX 77979
Fax: 1214-647-0829

Poly America Inc.
2000 West Marshall
Grand Prairie, TX 75051-2795
Attn: A. Bertrand

PRODUCT QUALITY REPORT

01/23/95

Product Name: DHDB-1525 NT

Shipped To: Poly America Inc.
2000 W. Marshall
Grand Prairie, TX 75051-2795

Customer Order No.: 2549-4
Internal Order No.: 178455

Blend	Quantity	Container Id	Ship Date
164509	193213	UNPX123466	01/20/95

The following test data was obtained :

Blend : 164509
Sample Id : PE240894
Date of Manufacture : 01/17/95

Test Description	Unit	Results
Melt Index	g/10min	.16
Density	g/cu cm	.9397

Wayne Daggs

Wayne Daggs

Quality Assurance Department

827

GSE

Roll Test Data Report

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 11/01/96 #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 713-847-3885 D Corp

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

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 Battleground Road, Deer Park, Texas 77536 Mailing Address: P.O. Box 1000 Deer Park, Texas 77536-0000 1-800-338-2488 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

NSC

GEOMEMBRANE STANDARD TESTING

Date: 01/23/96

Page: 1

Bill(s) of Lading:

ROLL NUMBER	THICK (mil)	STRESS AT YIELD (psi) MD	STRESS AT YIELD (psi) TD	STRESS AT BREAK (psi) MD	STRESS AT BREAK (psi) TD	STRAIN AT YIELD (%) MD	STRAIN AT YIELD (%) TD	STRAIN AT BREAK (%) MD	STRAIN AT BREAK (%) TD	FABR DISP	FABR CONT (%)	DIMENSIONAL STABILITY MD	DIMENSIONAL STABILITY TD
C08L9757-5A0900021	82.8	2410	2500	4450	4440	17.7	16.8	832	902	A1	2.52	-0.8	0.4
C08L9757-5A0900061	83.6									A1	2.54		
C08L9757-5A1000041	82.5	2480	2540	5130	5270	18.3	17.6	935	1040	A1	2.54	0.0	0.6
C08L9757-5A1000081	82.1	2410	2610	4970	5170	18.4	17.2	929	1010	A1	2.59	0.0	0.4
C08L9757-5A1000121	81.7									A1	2.54		

Jane Allen

Jane Allen
Quality Control Manager

1-23-96
Date

01/23/96

NSC

POLYETHYLENE CERTIFICATE OF ANALYSIS

Customer: GEOSYNTEC

Resin Type: U.C.1527

Project Name: 9090

Project Number: SAMPLE

We hereby certify that the polyethylene resin for the above identified shipment, meets or exceeds the project specifications, below. Testing was performed on each resin blend.

Melt flow index was determined according to ASTM D 1238. Density was determined according to ASTM D 1505. Where appropriate, carbon black content was determined according to ASTM D 1603. The average test results are listed in the table below.

RESIN SPECIFICATIONS

Melt Flow Index	0.4 gram/10 minutes	Maximum
Density (with carbon black)	0.94 grams/cm^3	Minimum
Carbon Black Content	2% to 3%	Range

BLEND NUMBER	MELT FLOW INDEX	DENSITY	CARBON BLACK CONTENT
9757	0.16	0.936	

Jane Allen

Jane Allen
Quality Control Manager

1-23-96
Date:

Note: When no carbon black content value is listed, the resin contained no carbon black.

APPENDIX D

APPENDIX D

FOURIER-TRANSFORM INFRARED SURFACE ANALYSIS RESULTS

Part I: Rationale, Results and Discussions, and Conclusions

Part II: Fourier-Transform Infrared Spectra

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.

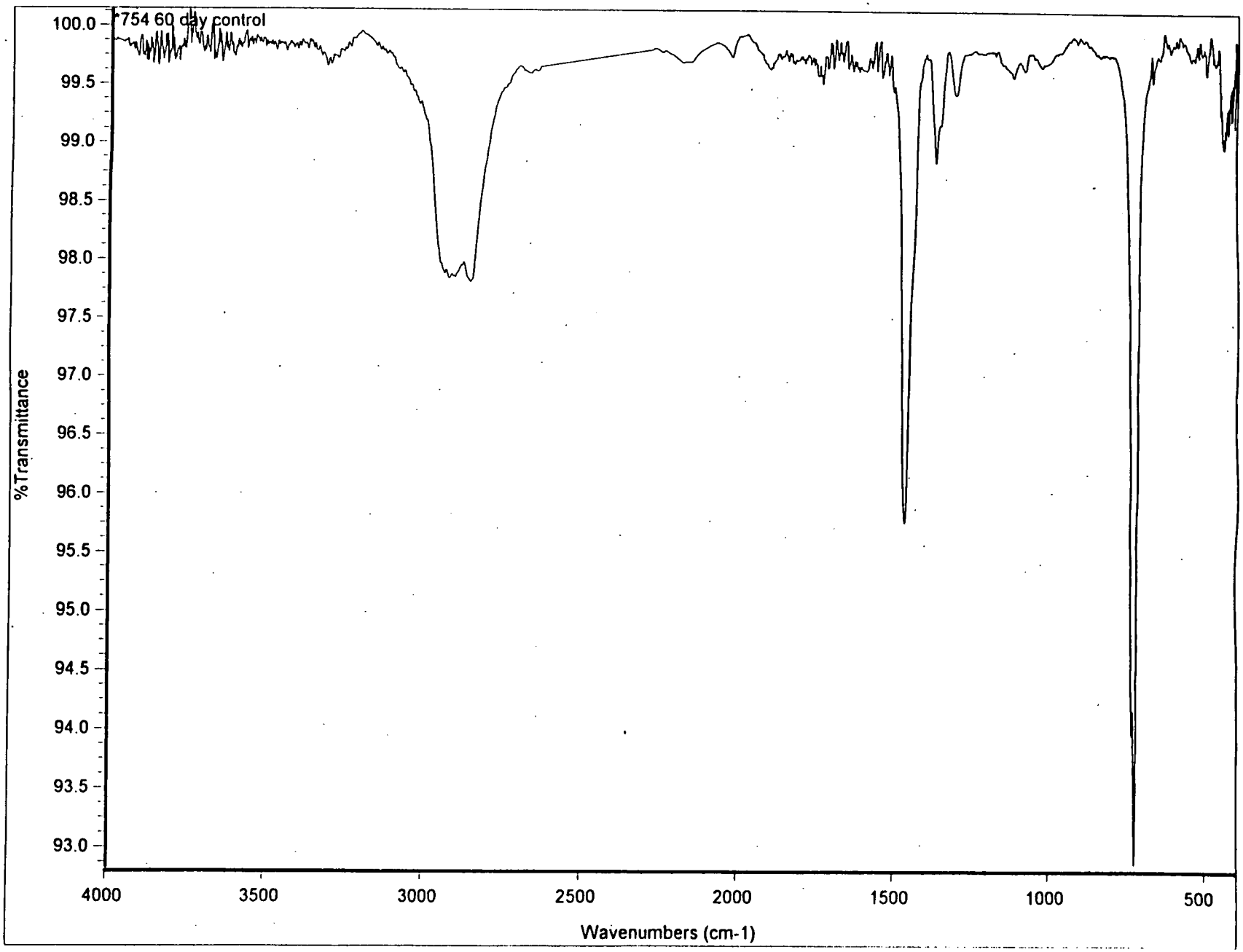
Part II: Fourier-Transform Infrared Spectra

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.



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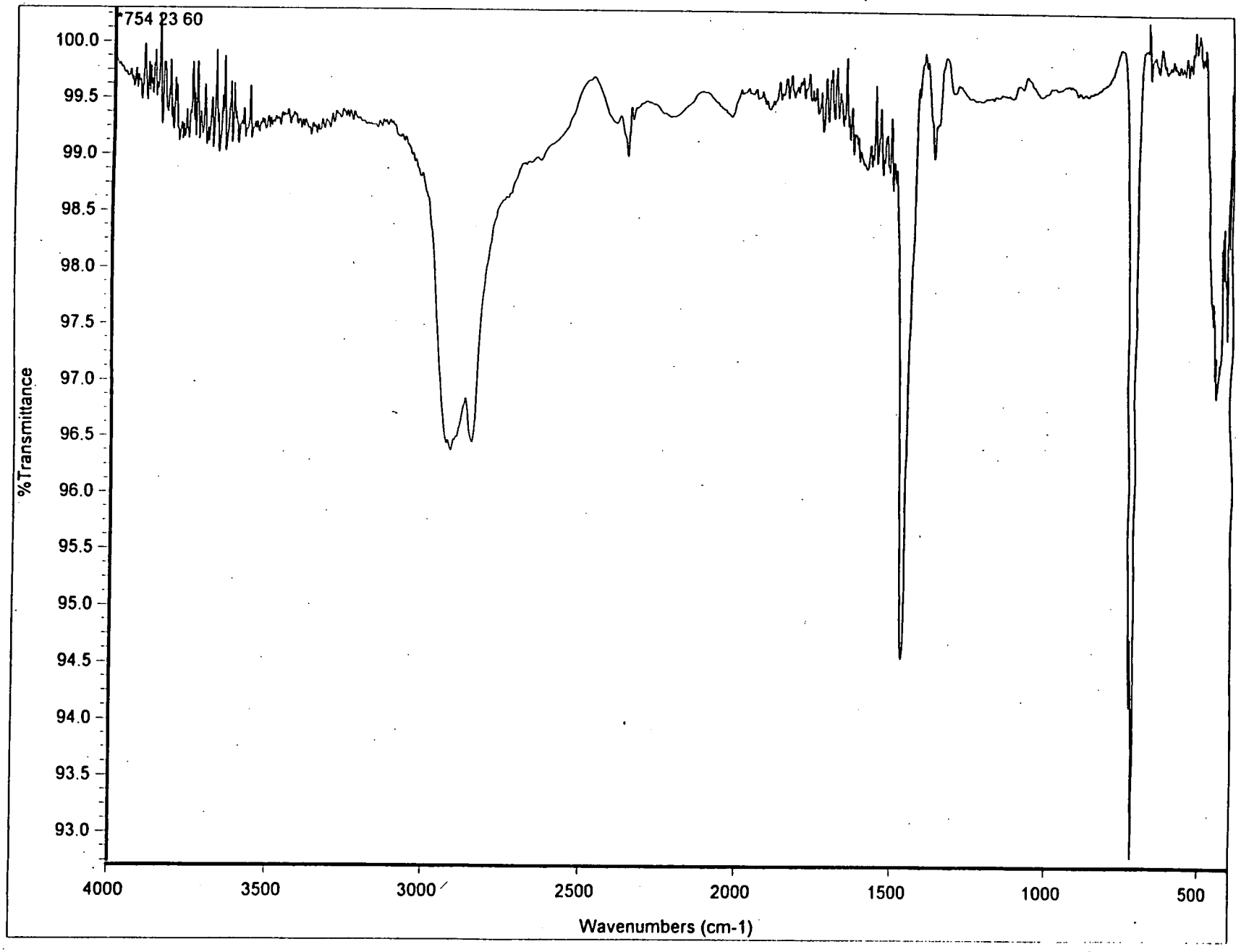

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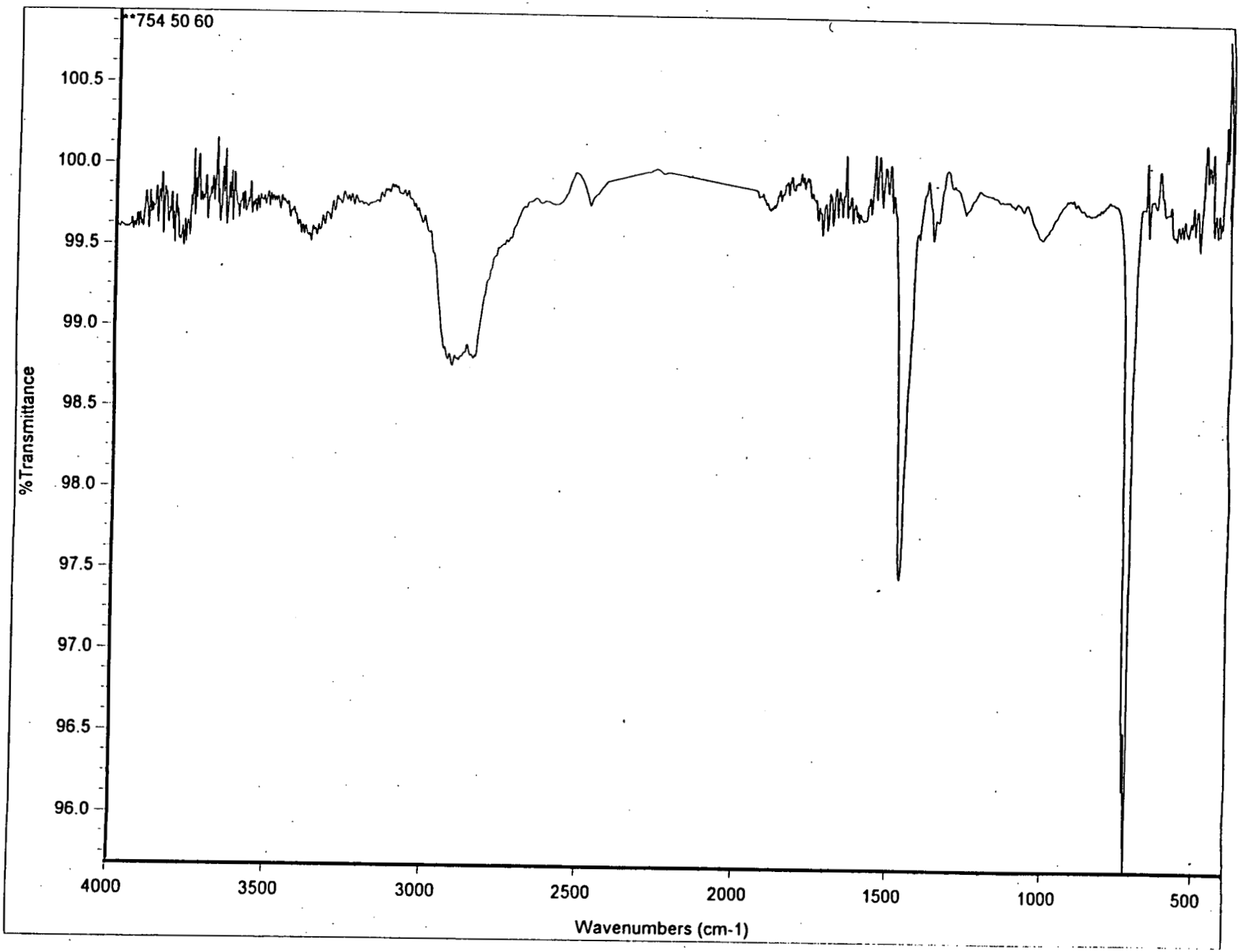

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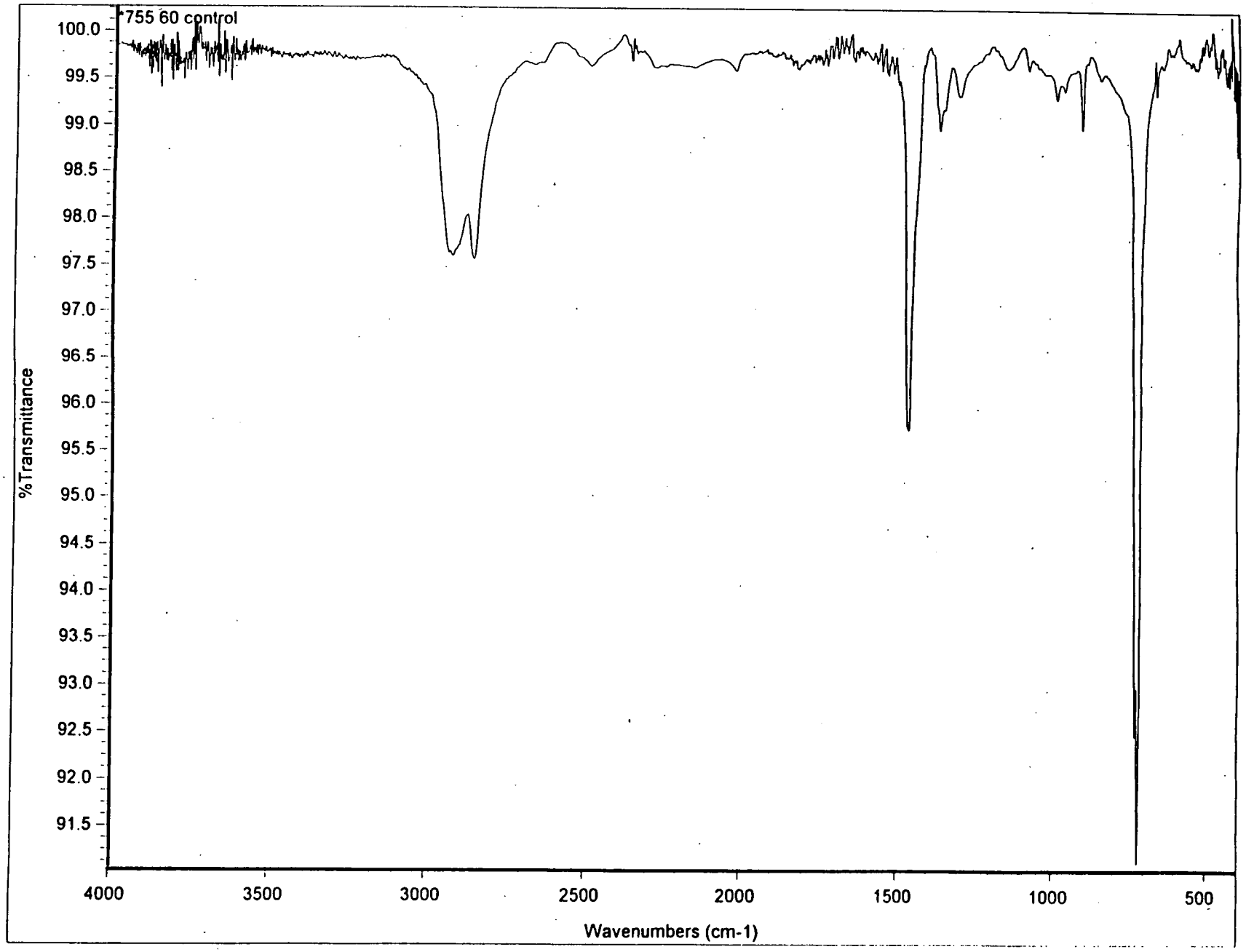

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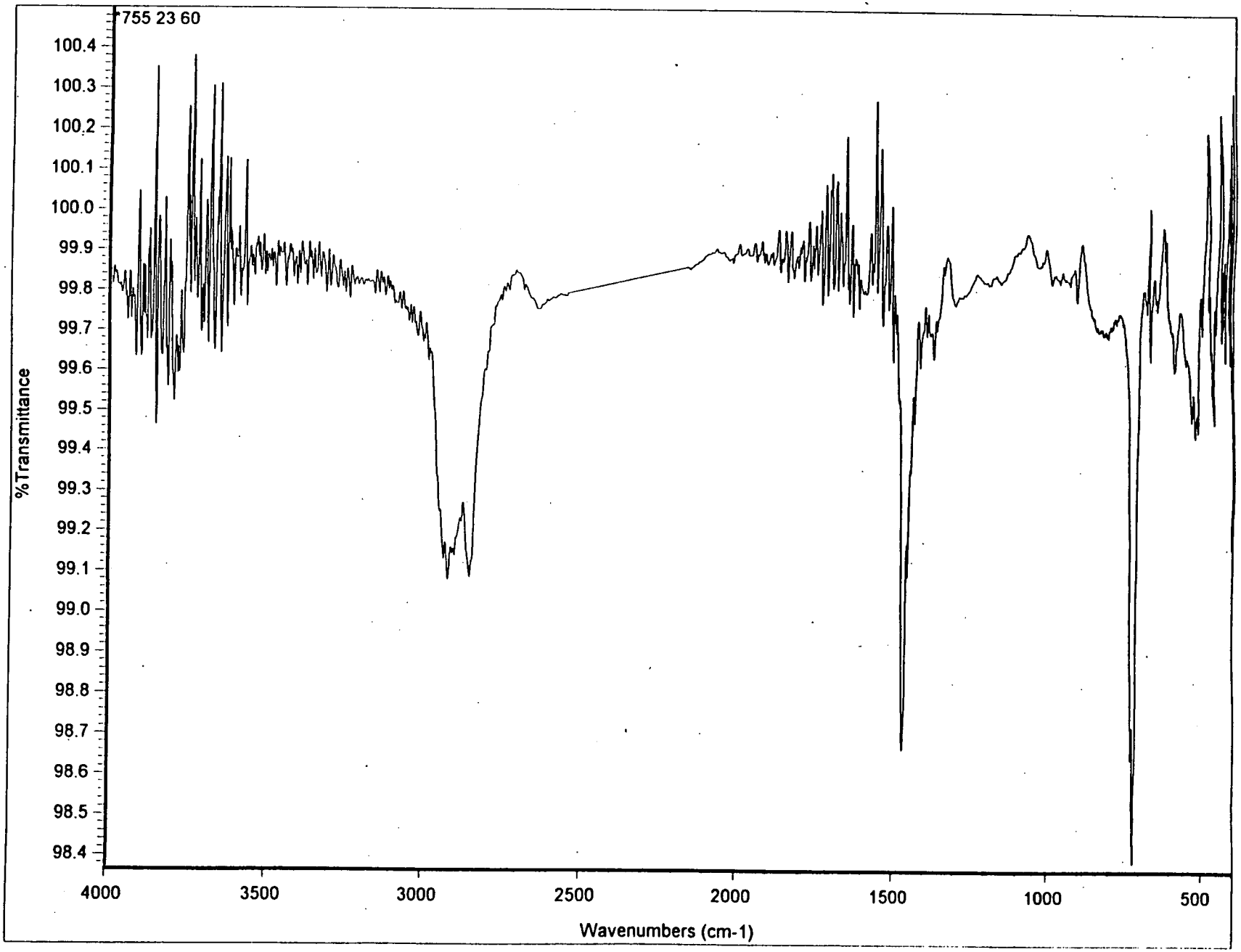

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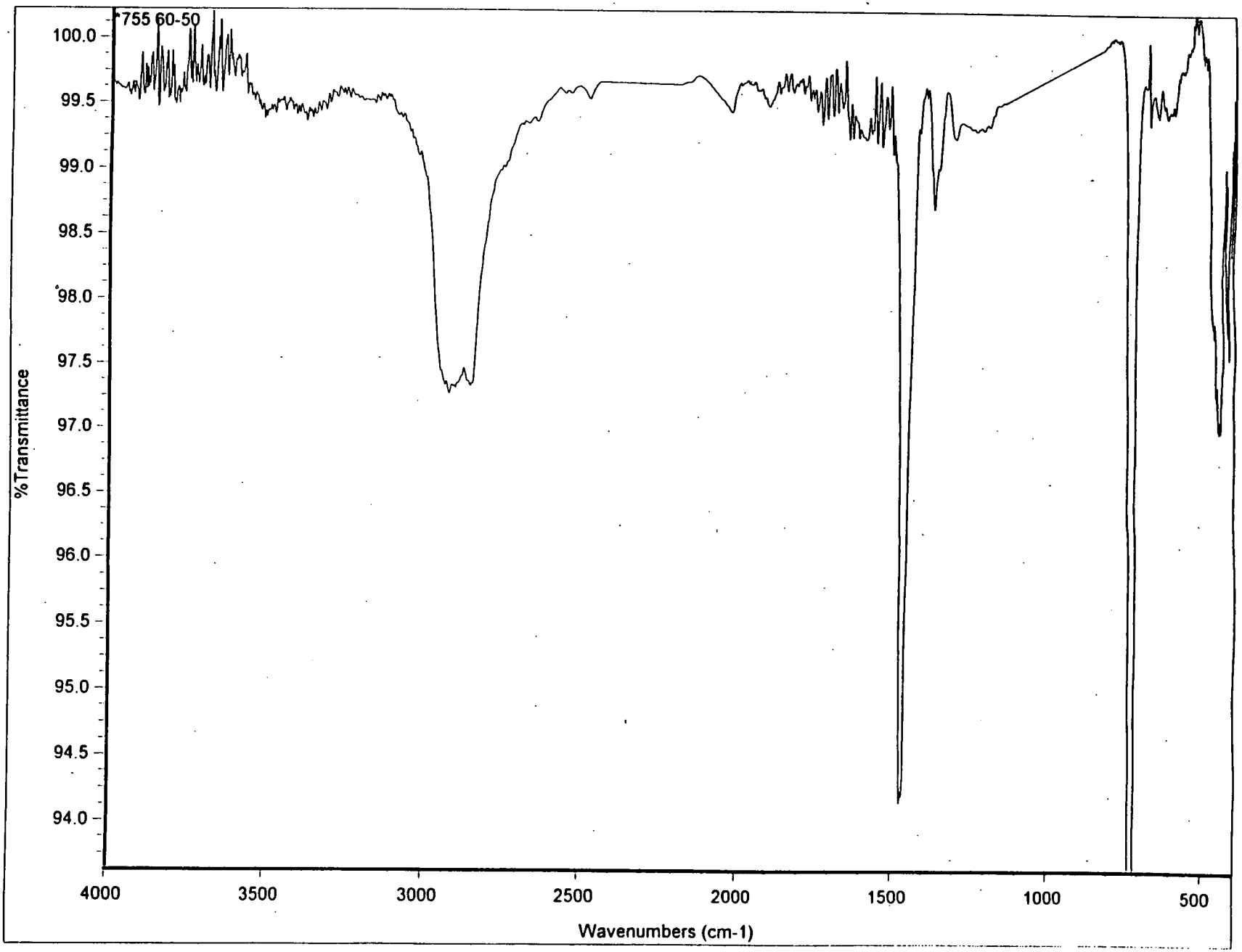

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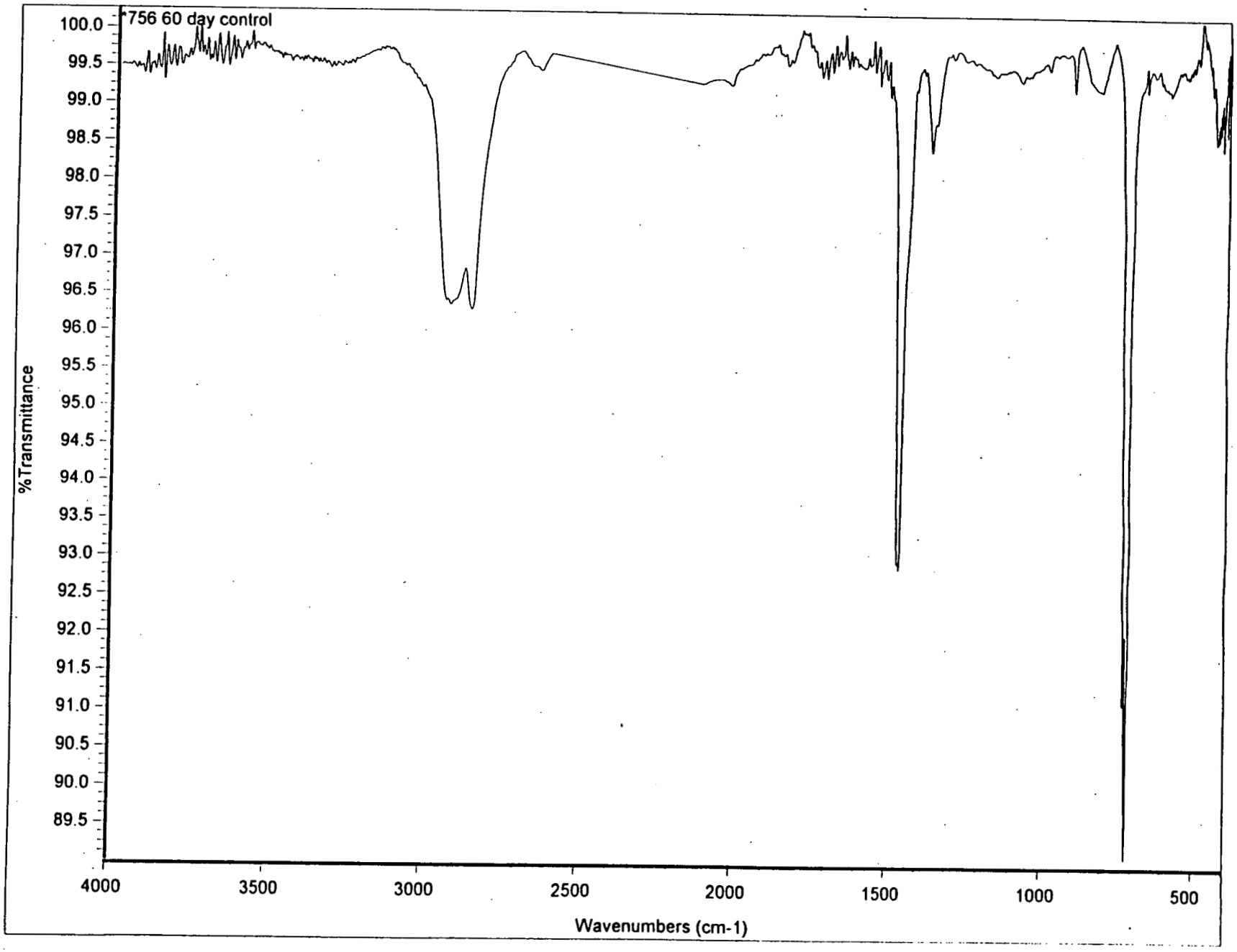

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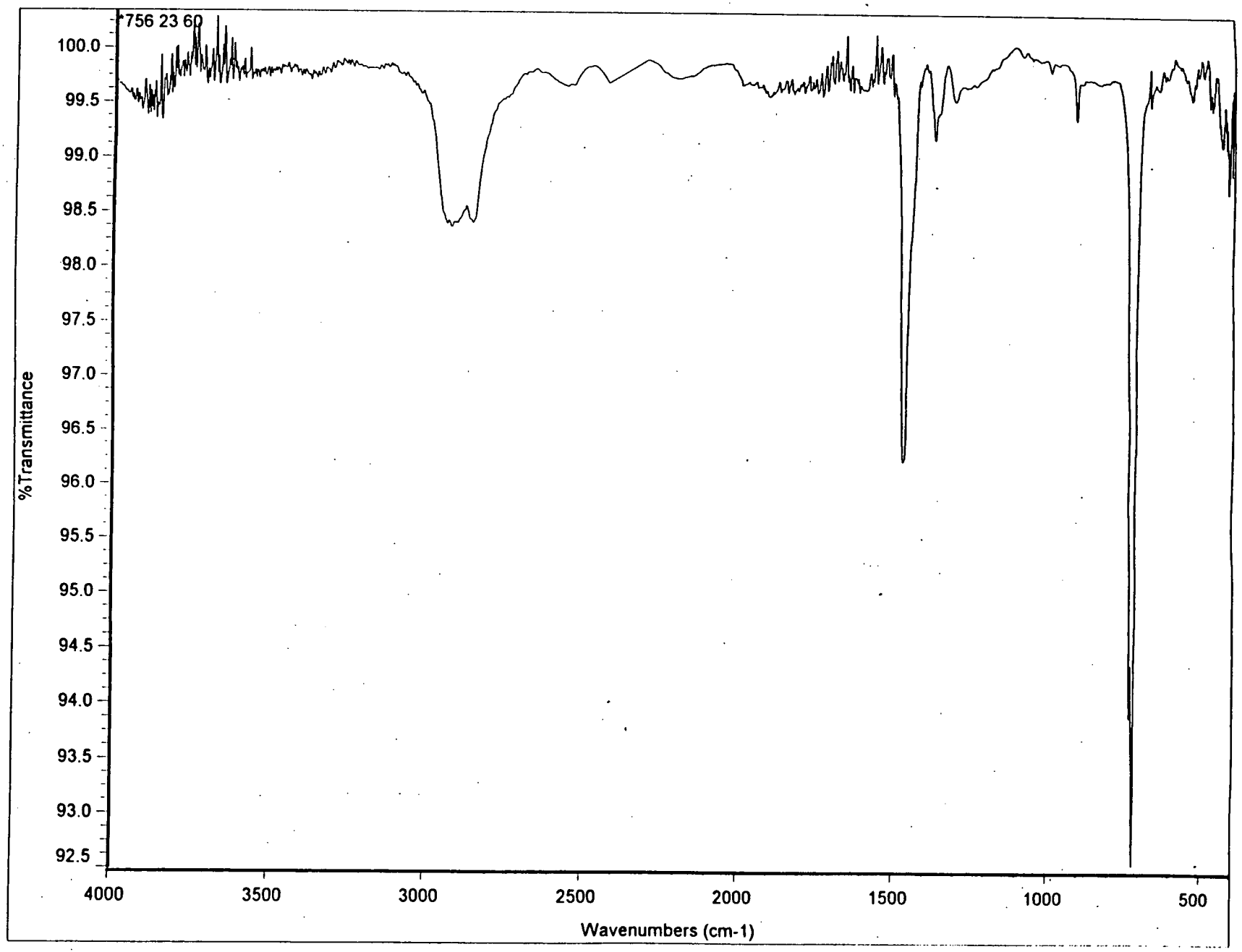

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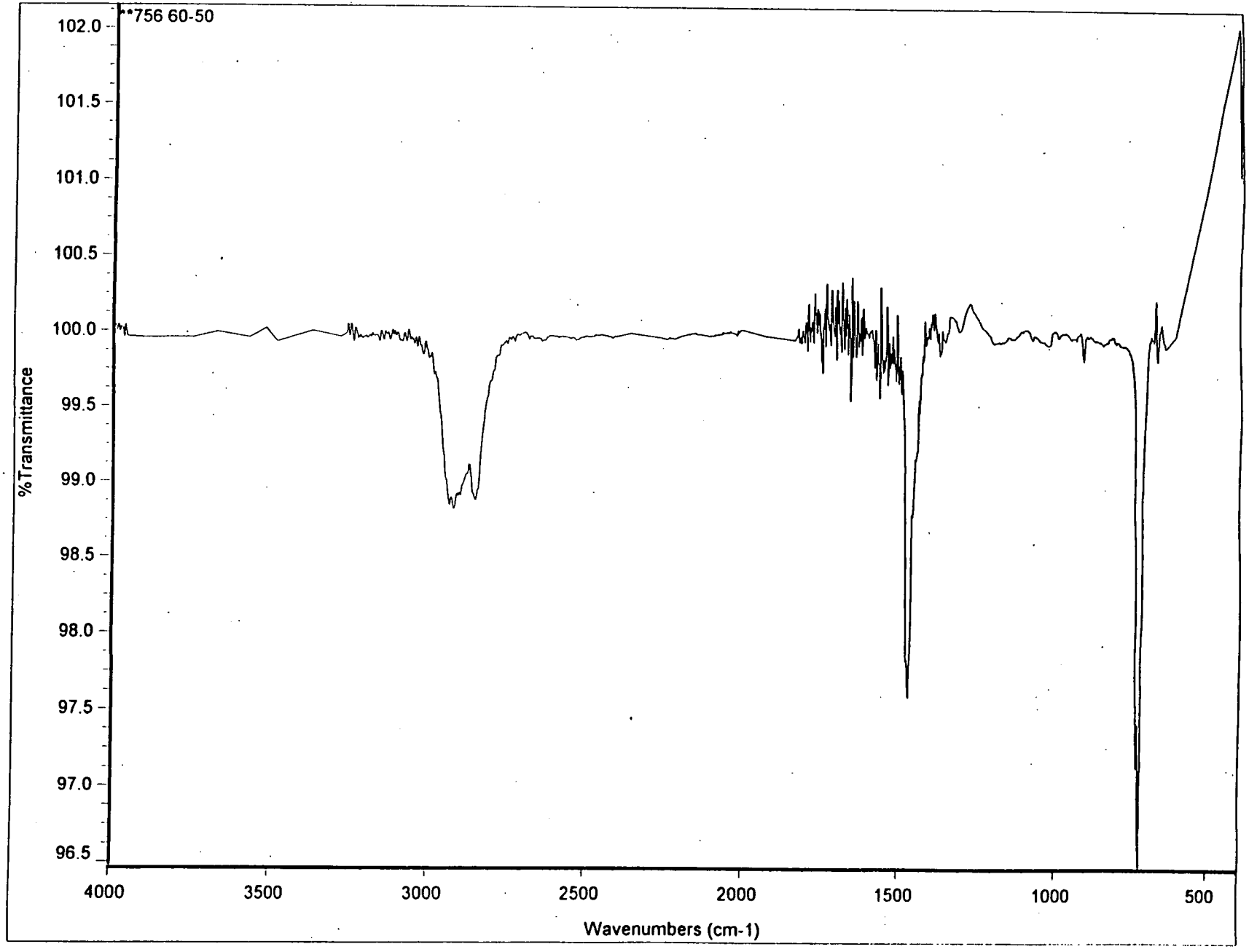

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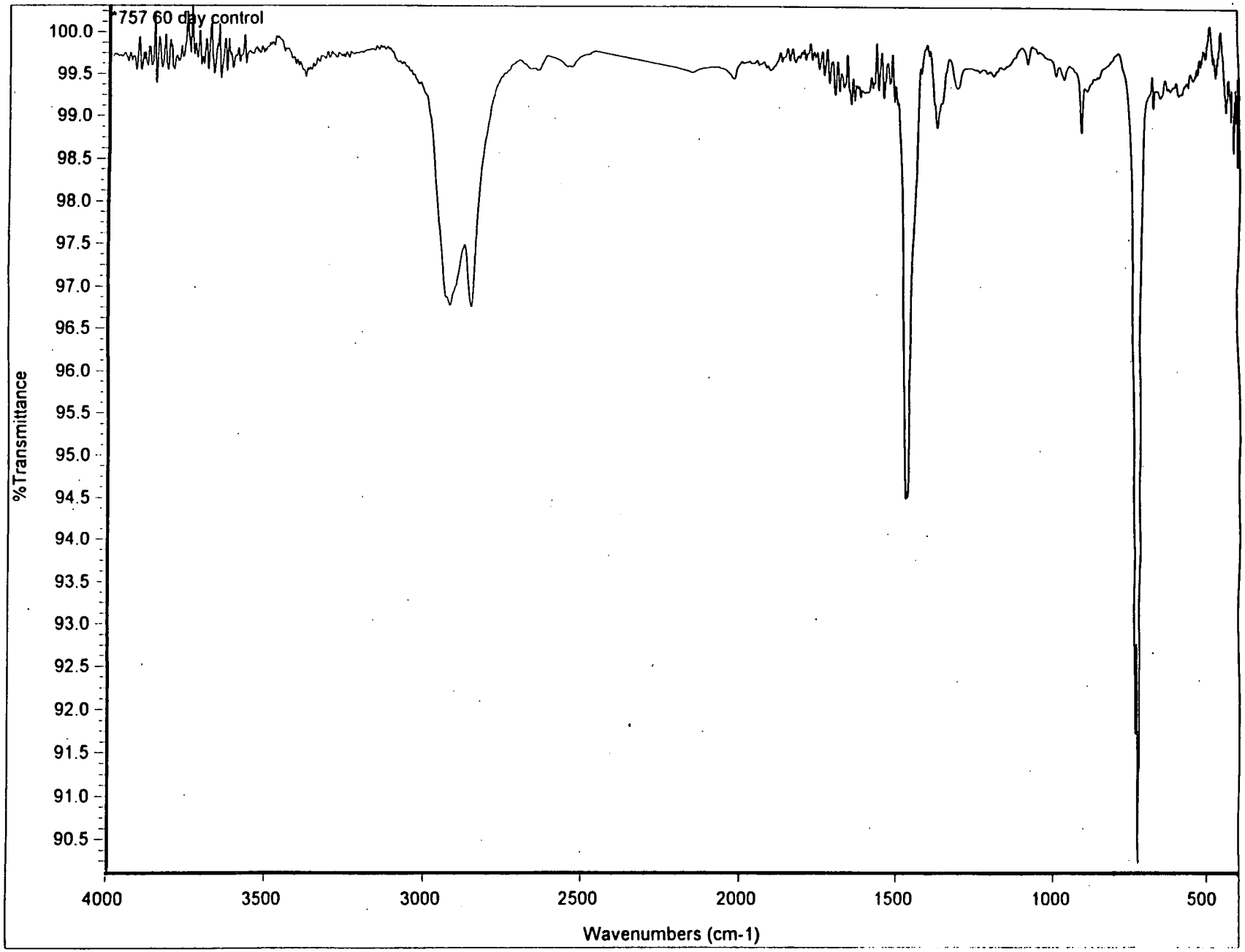

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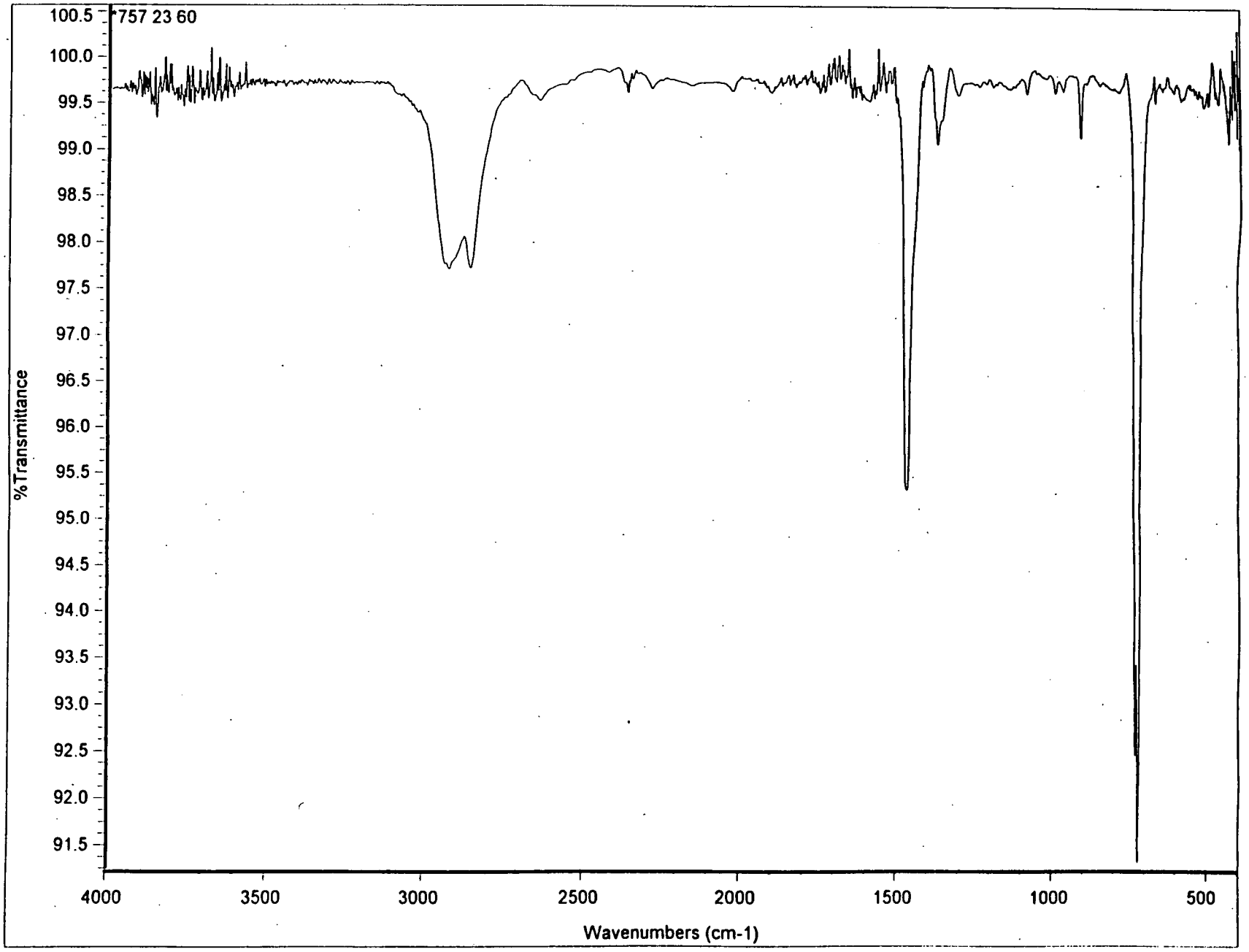

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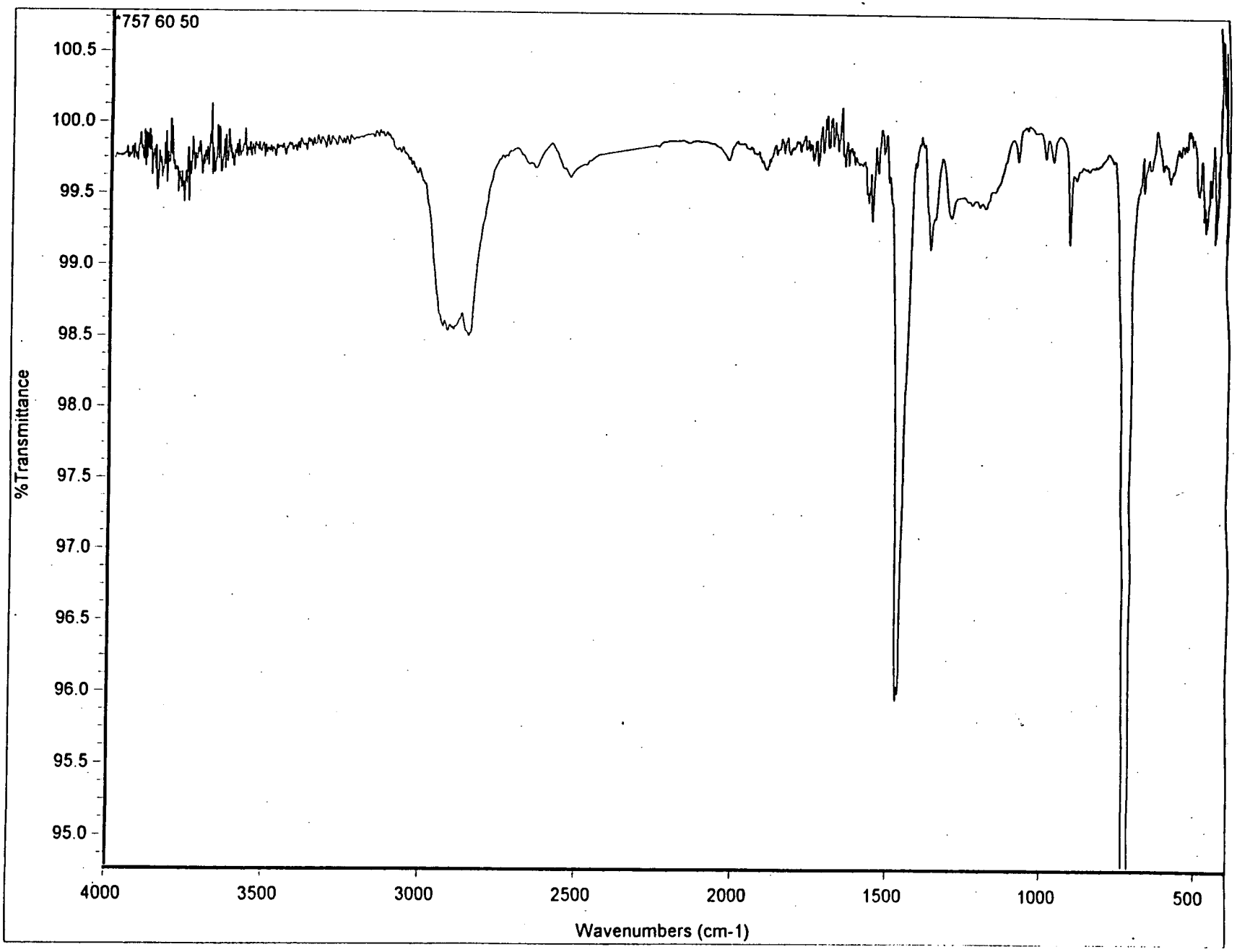

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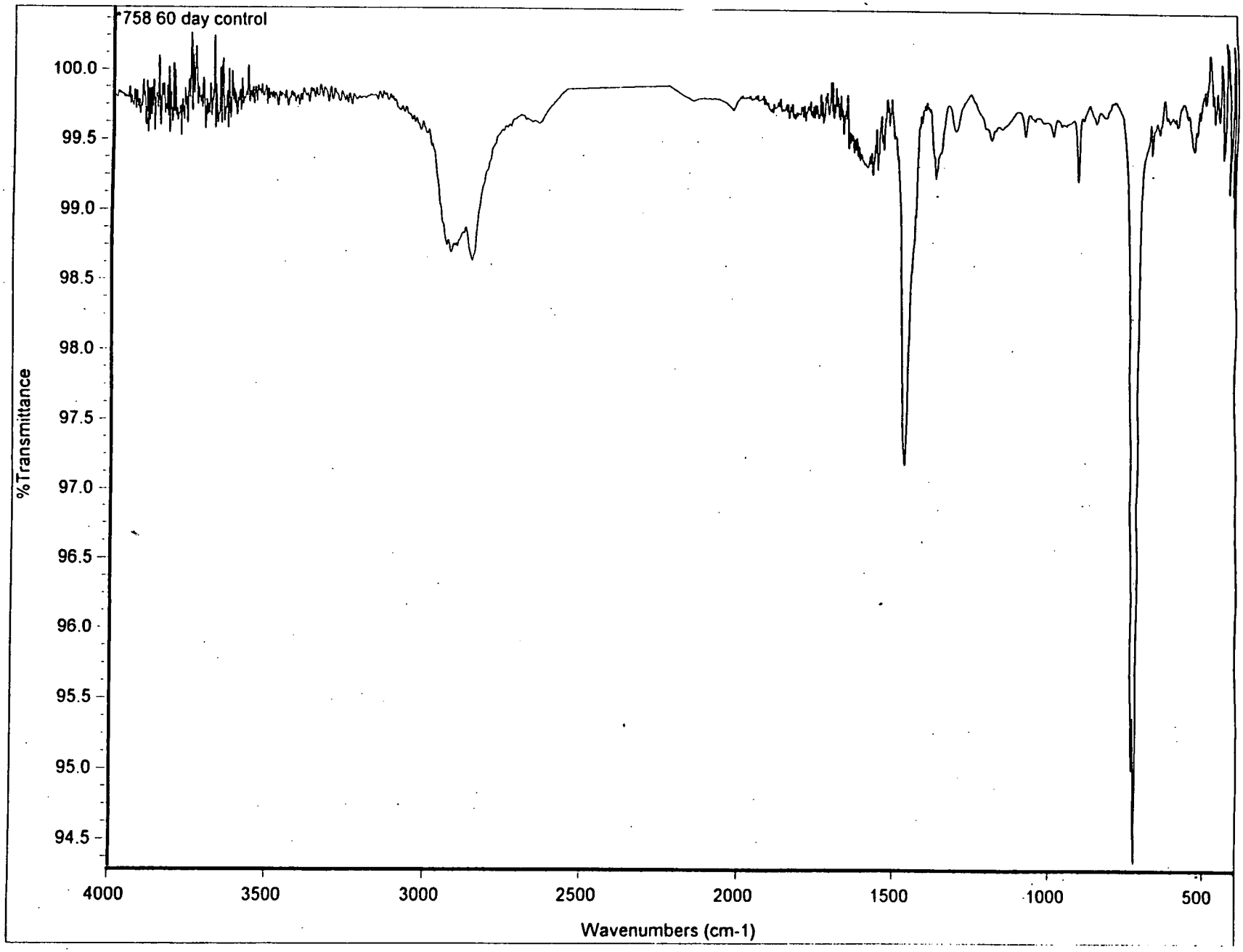

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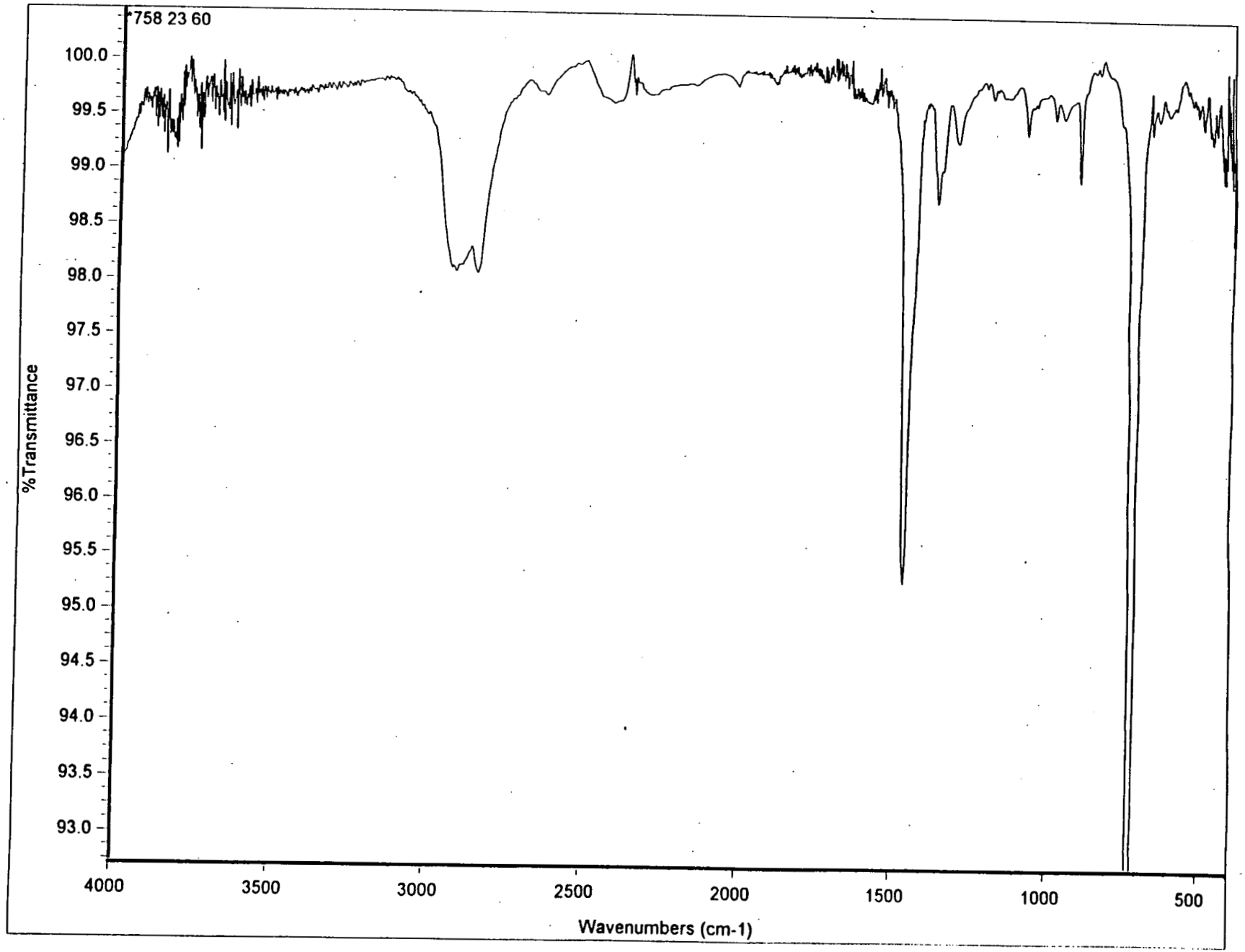

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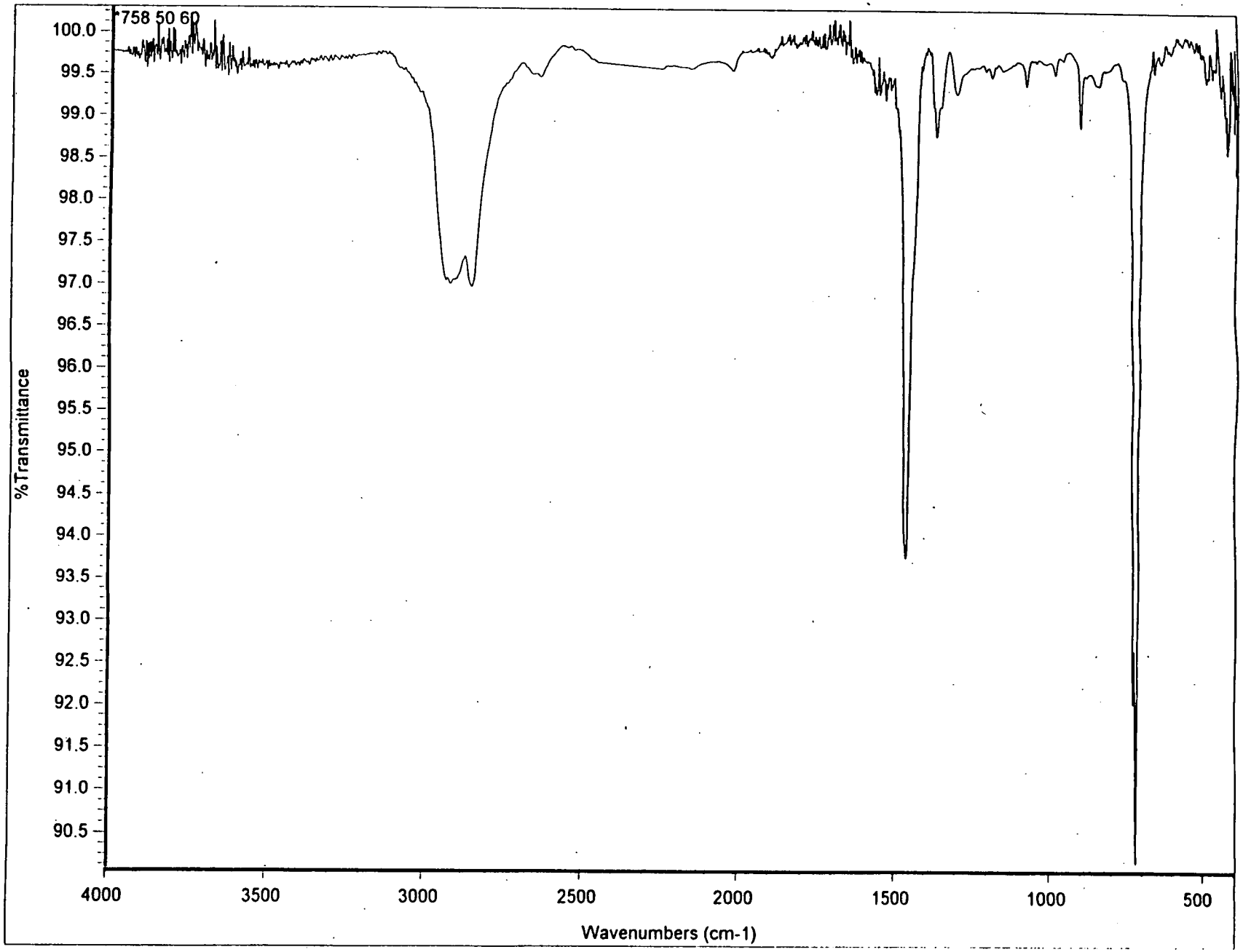

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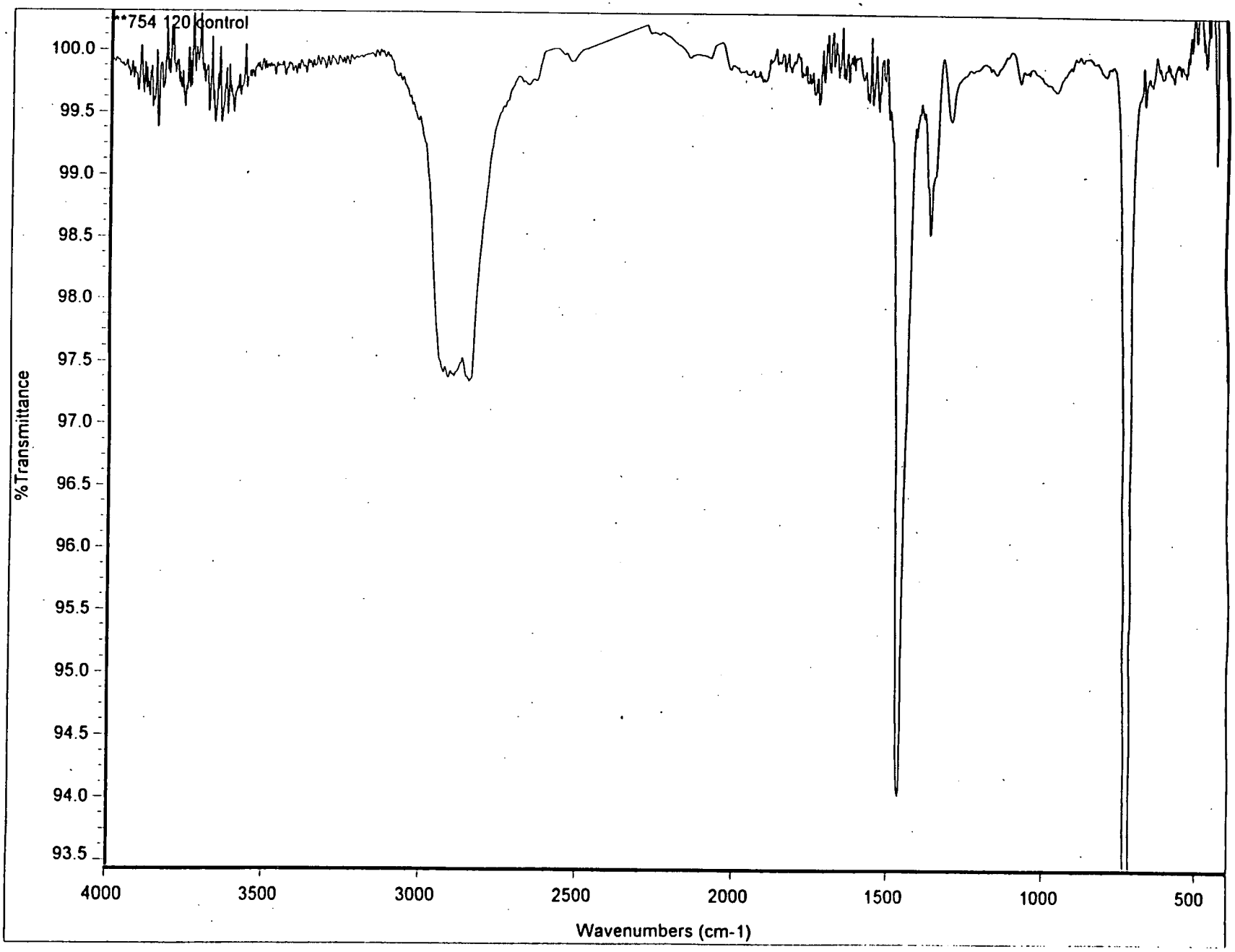

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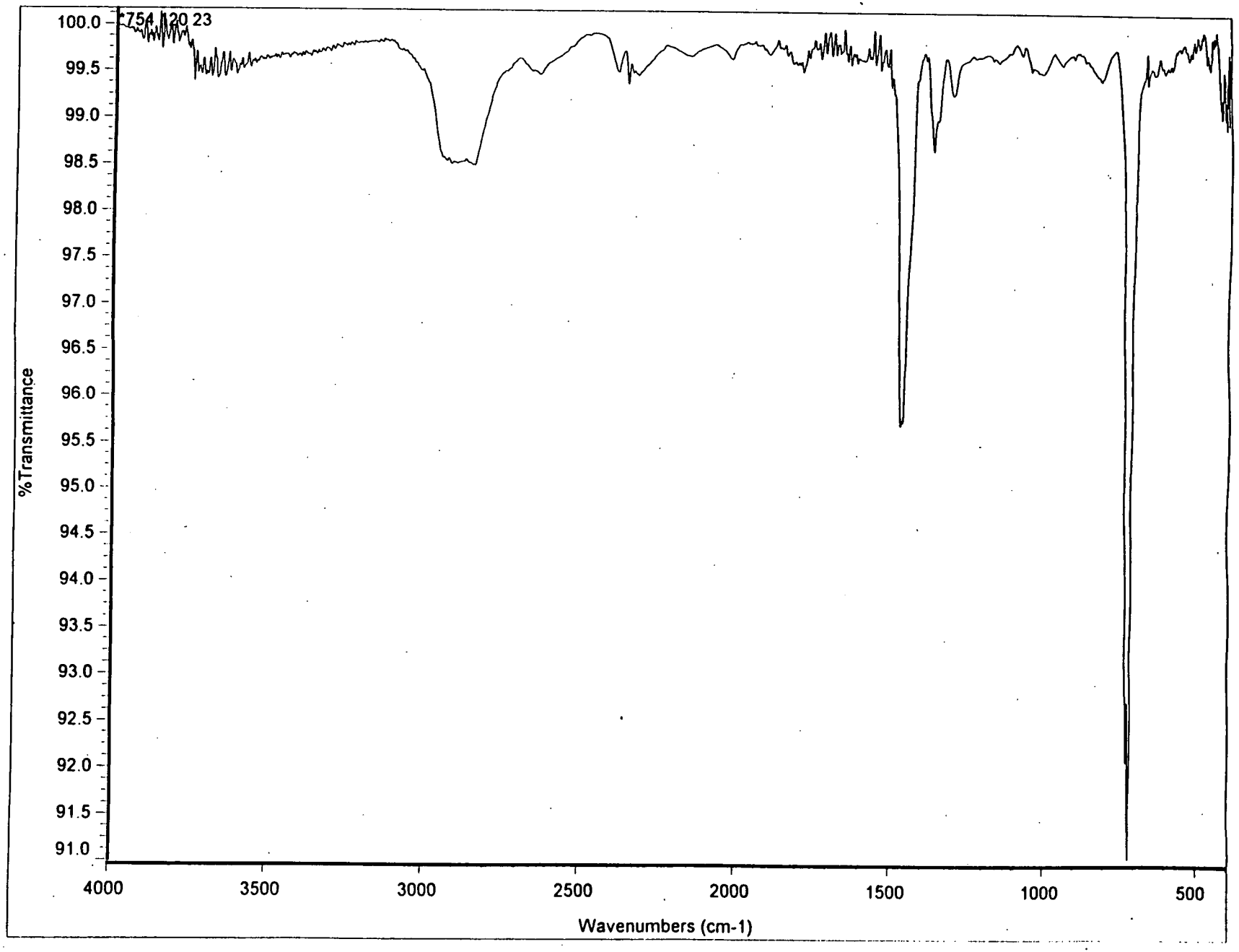

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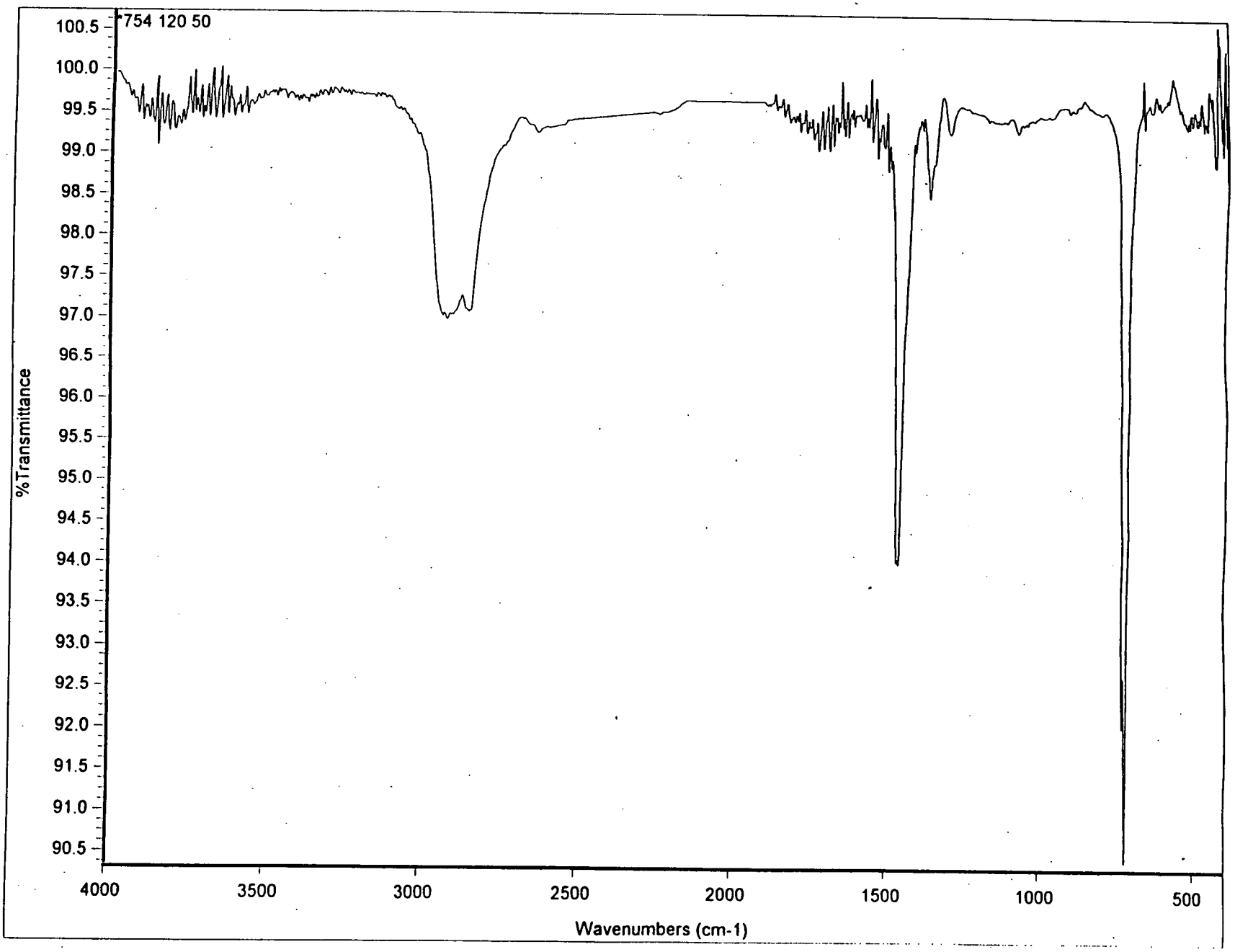

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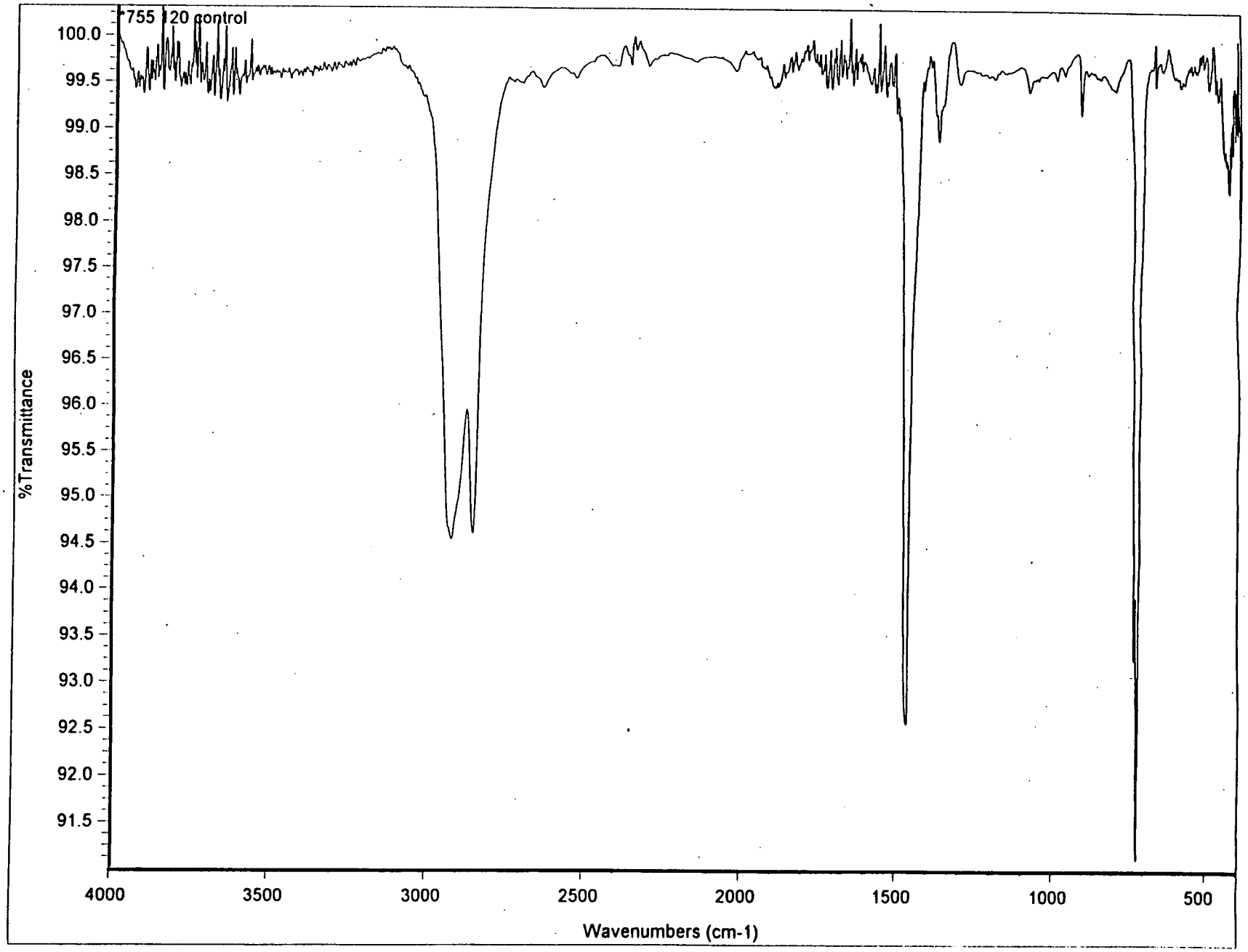

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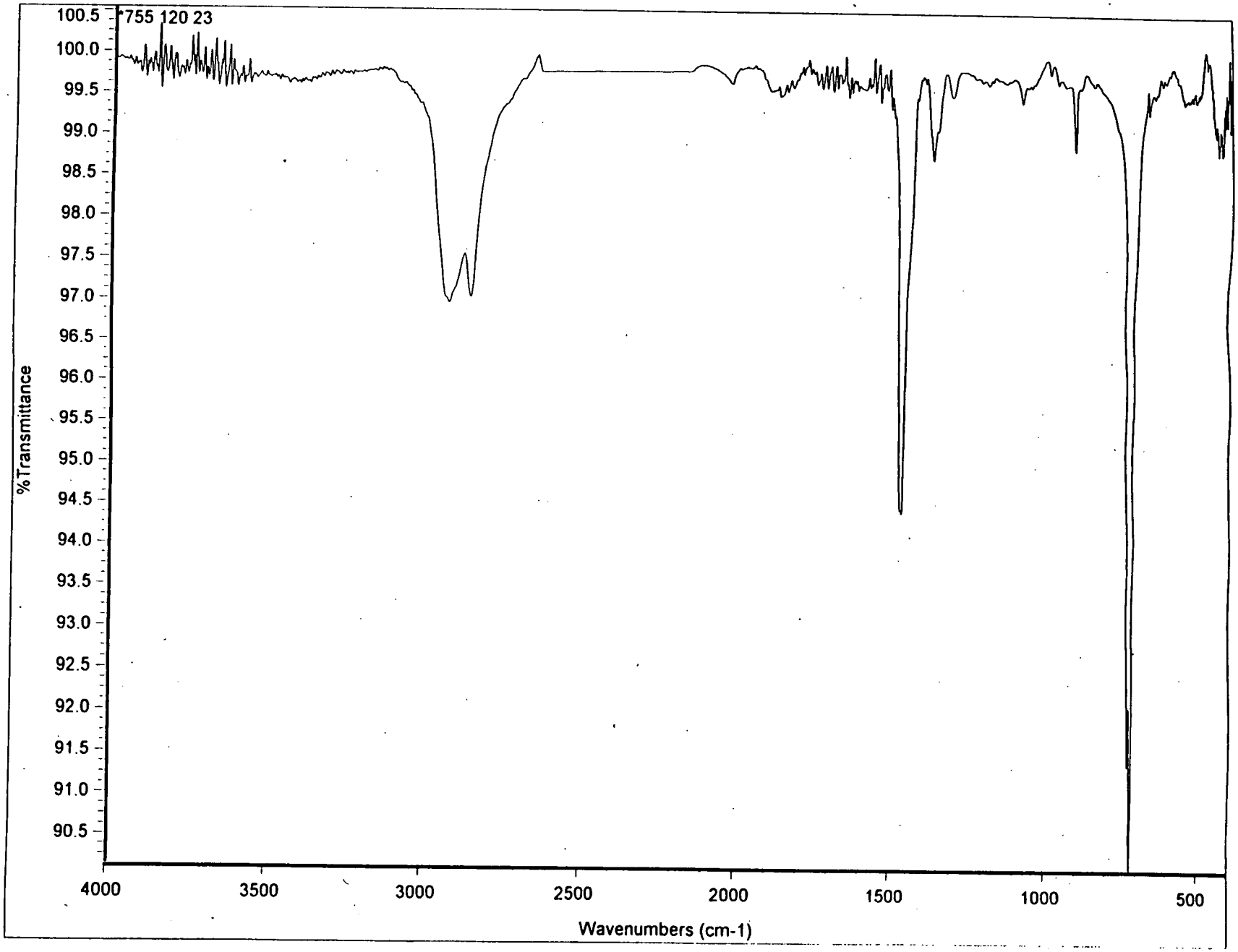

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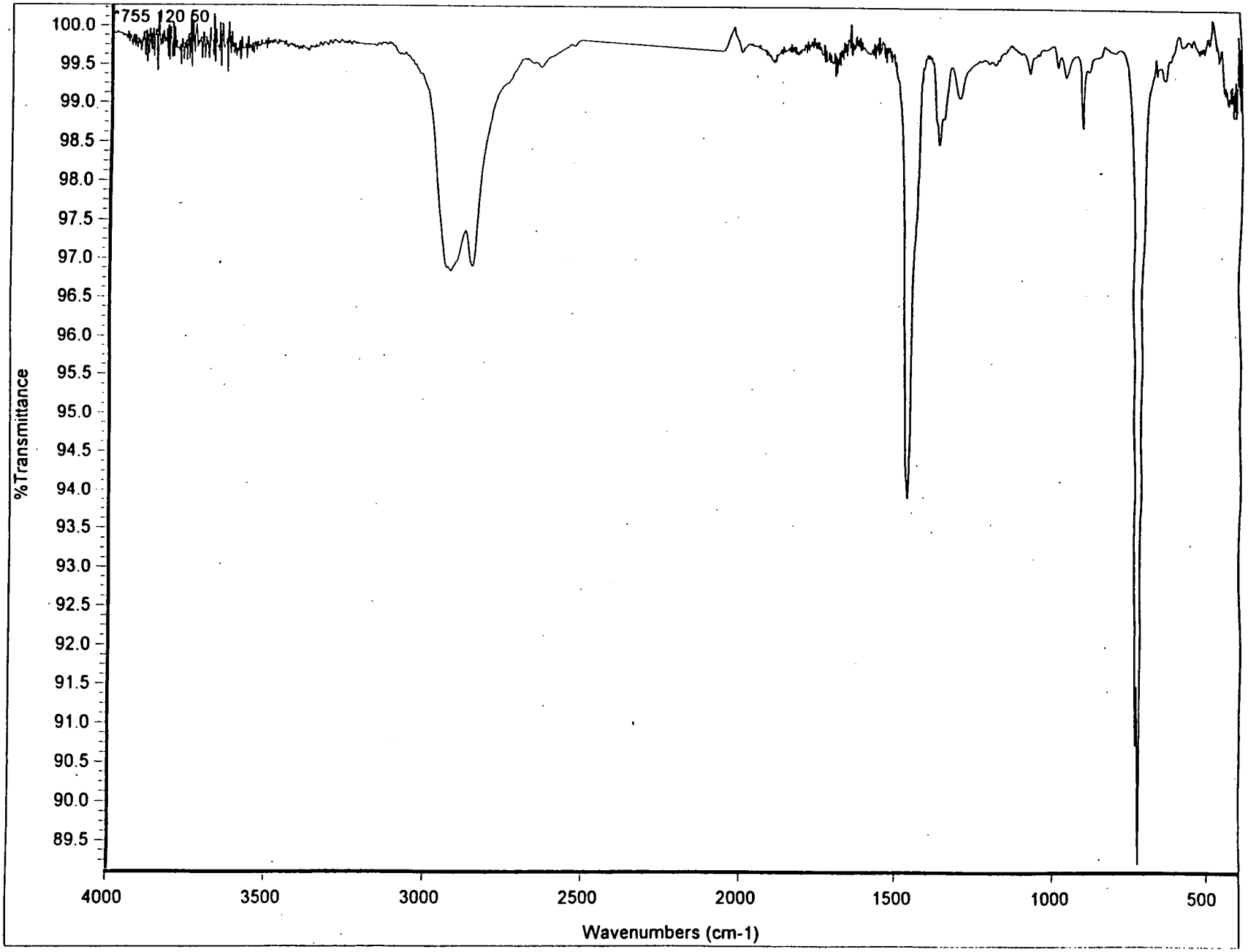

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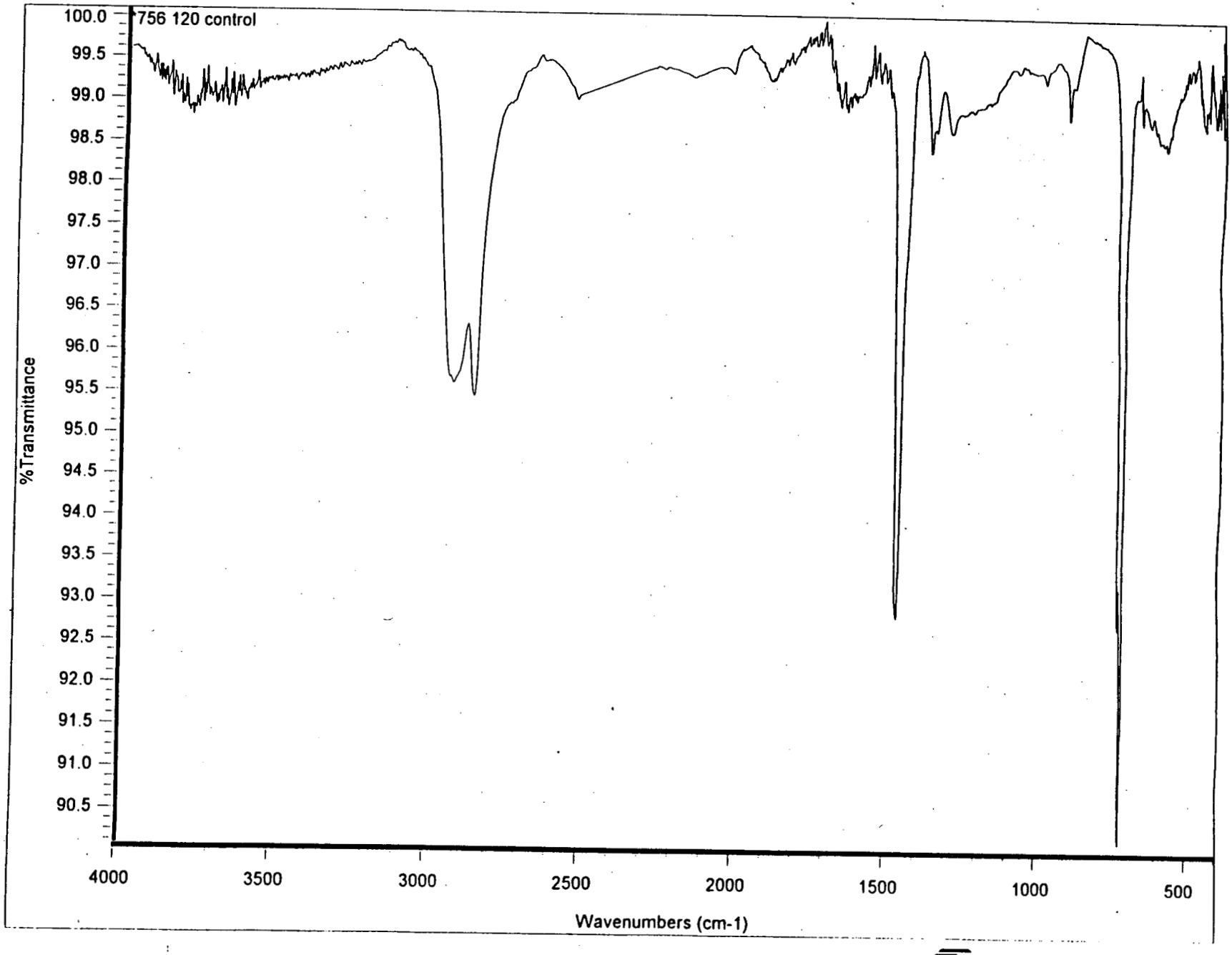

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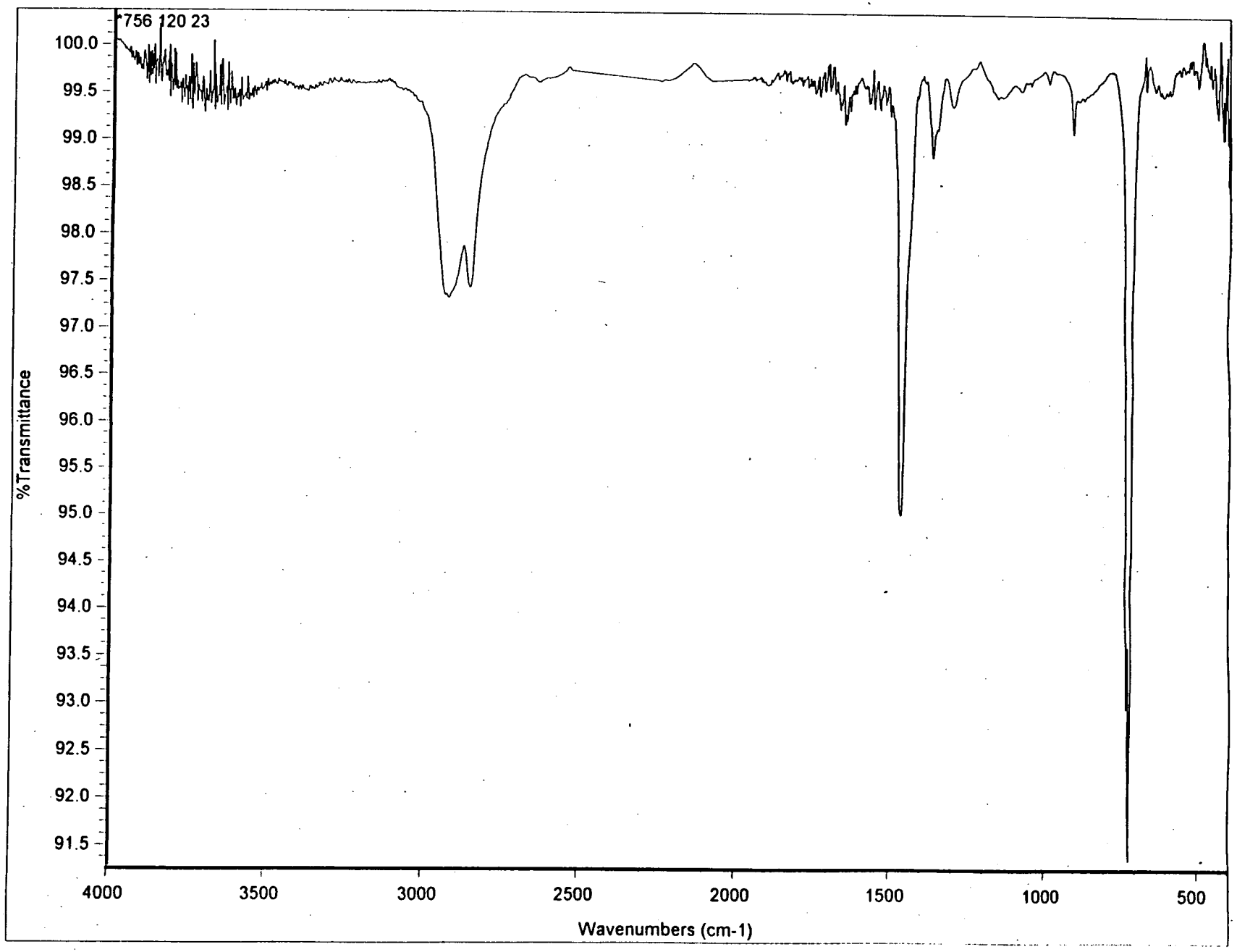

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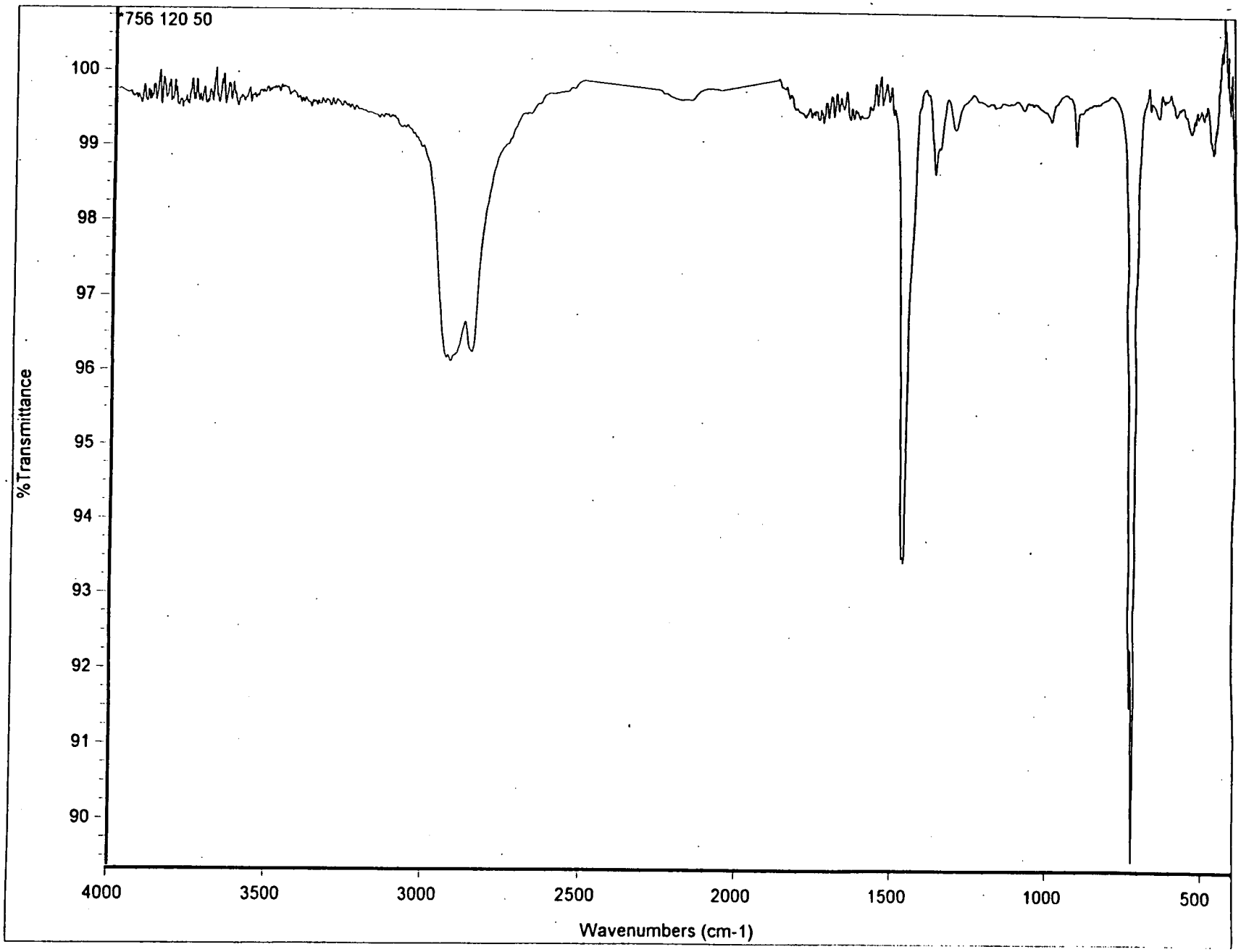

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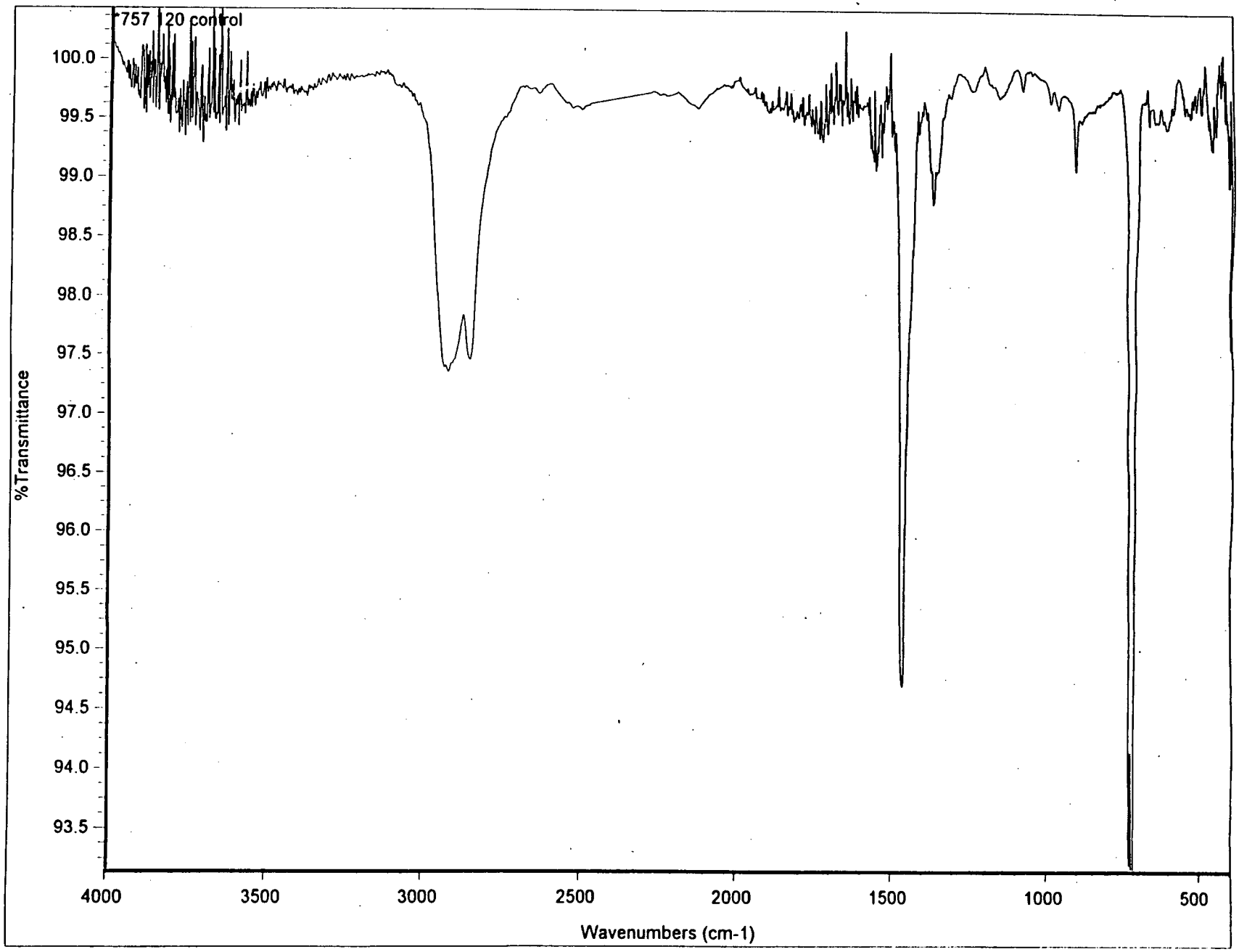

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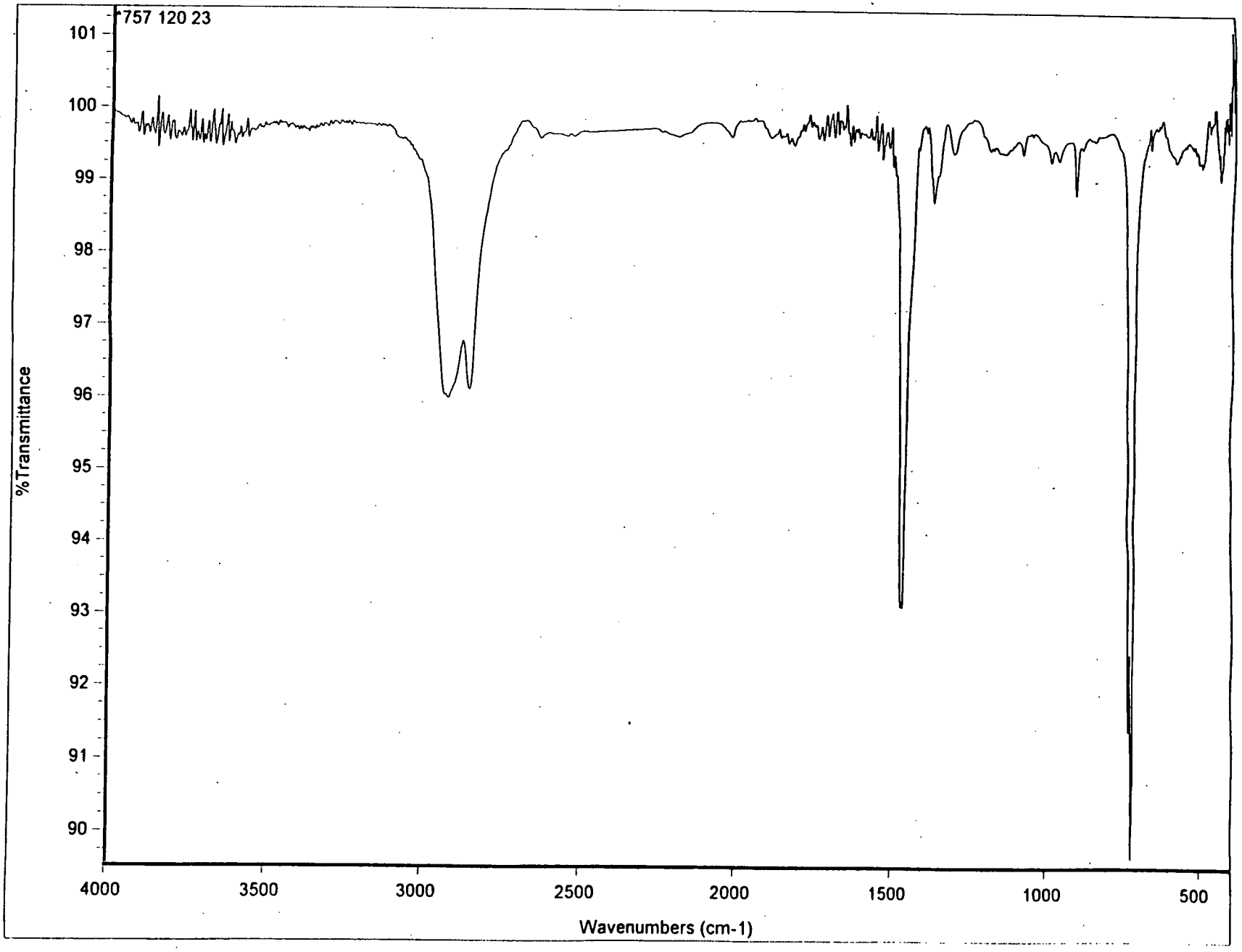

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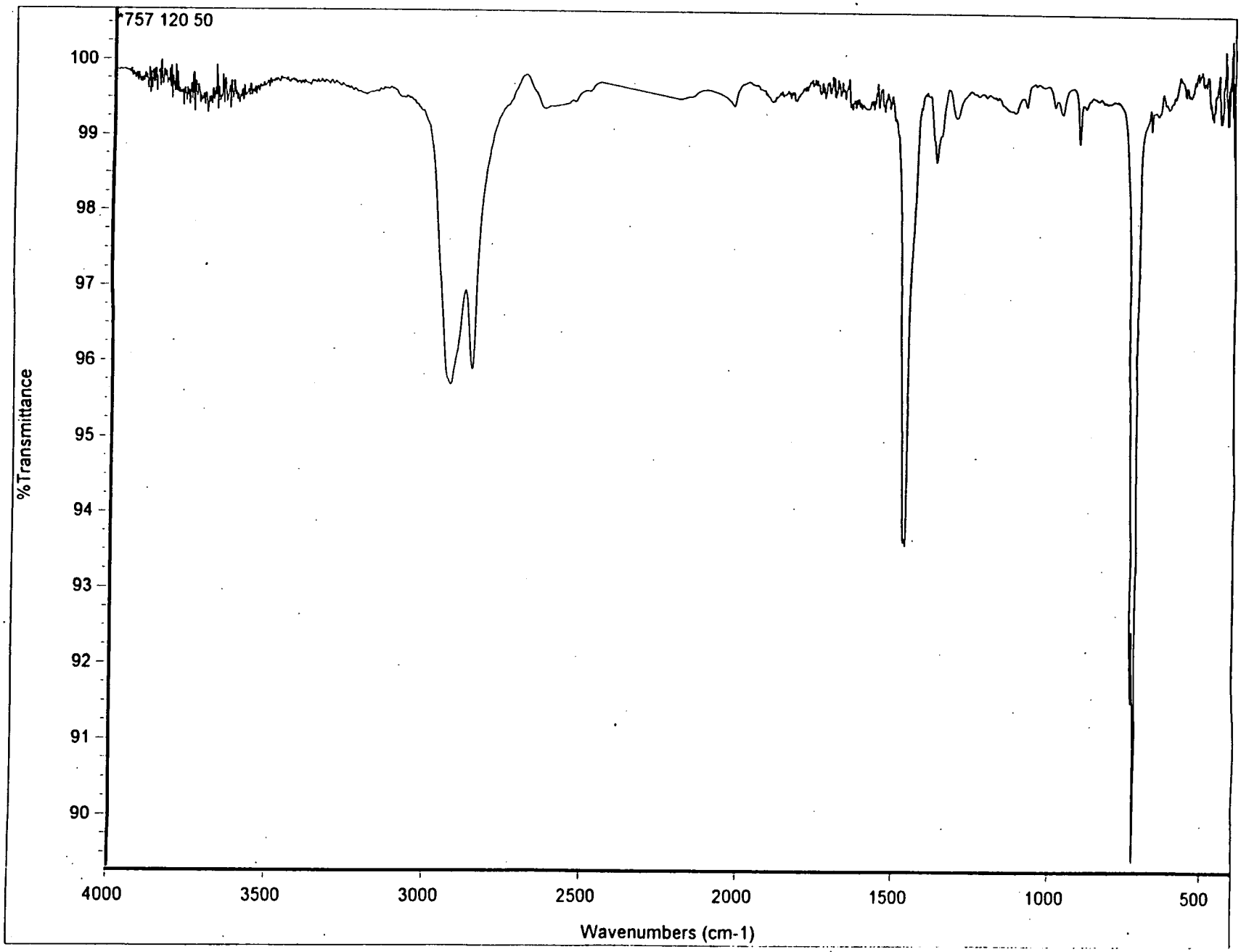

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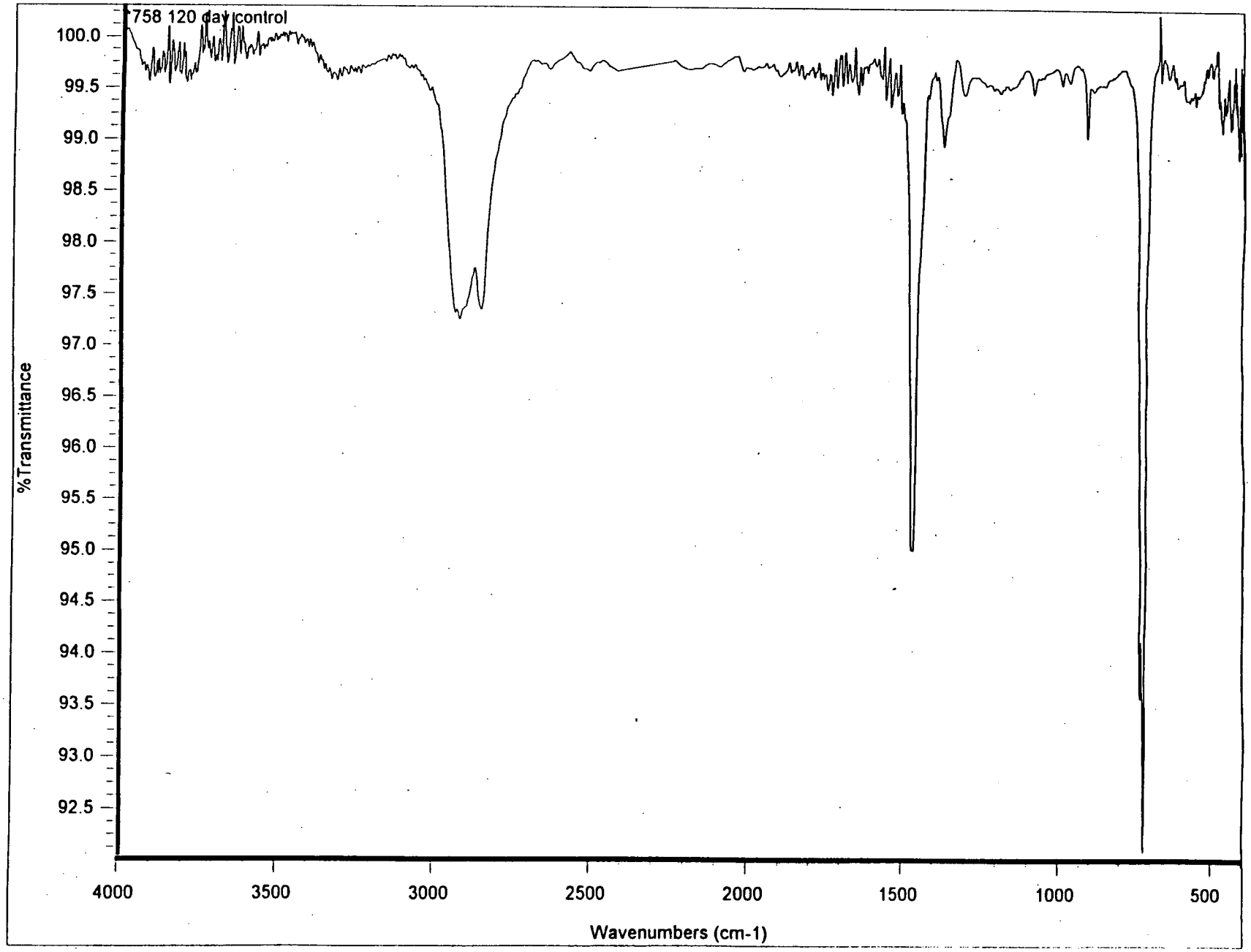

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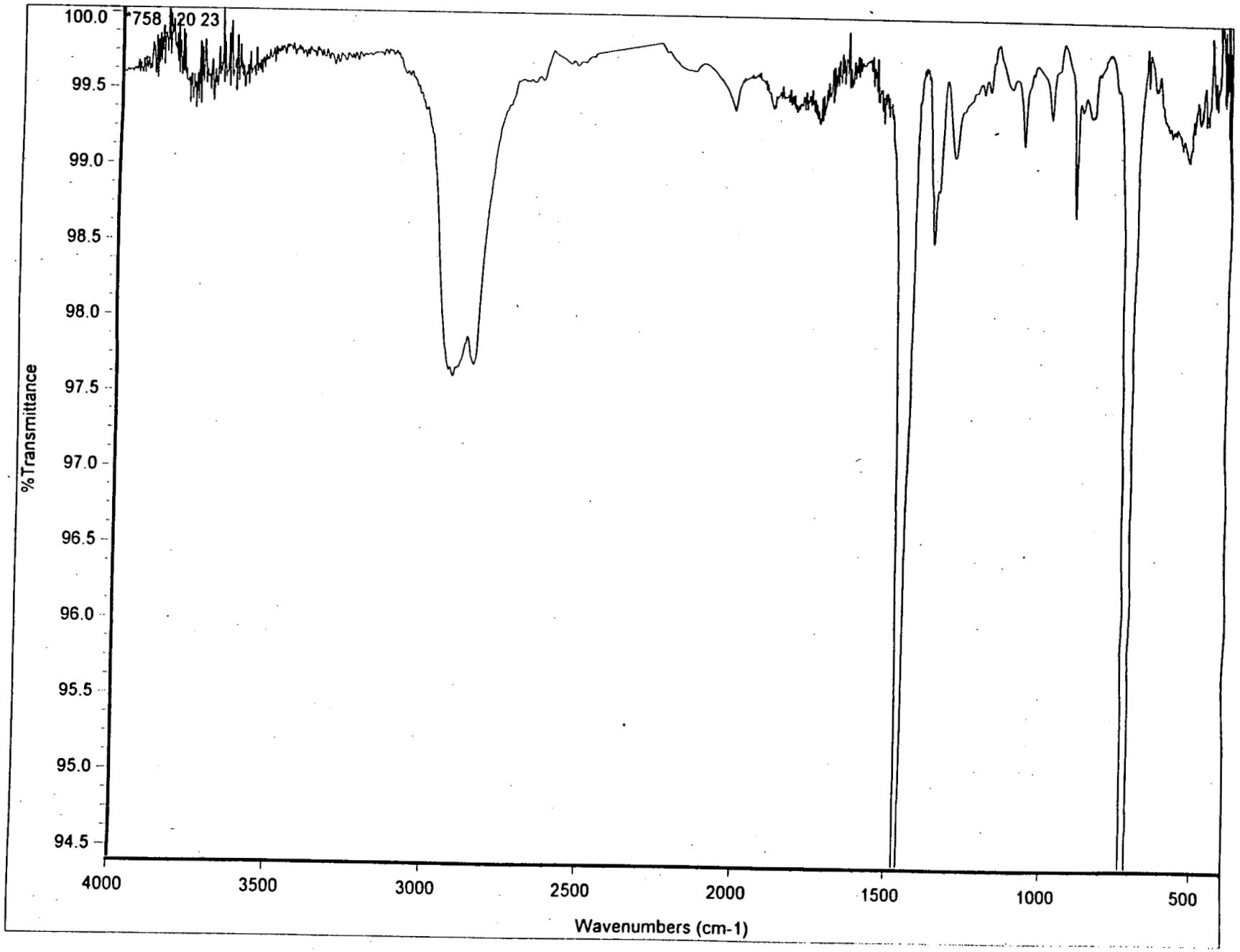

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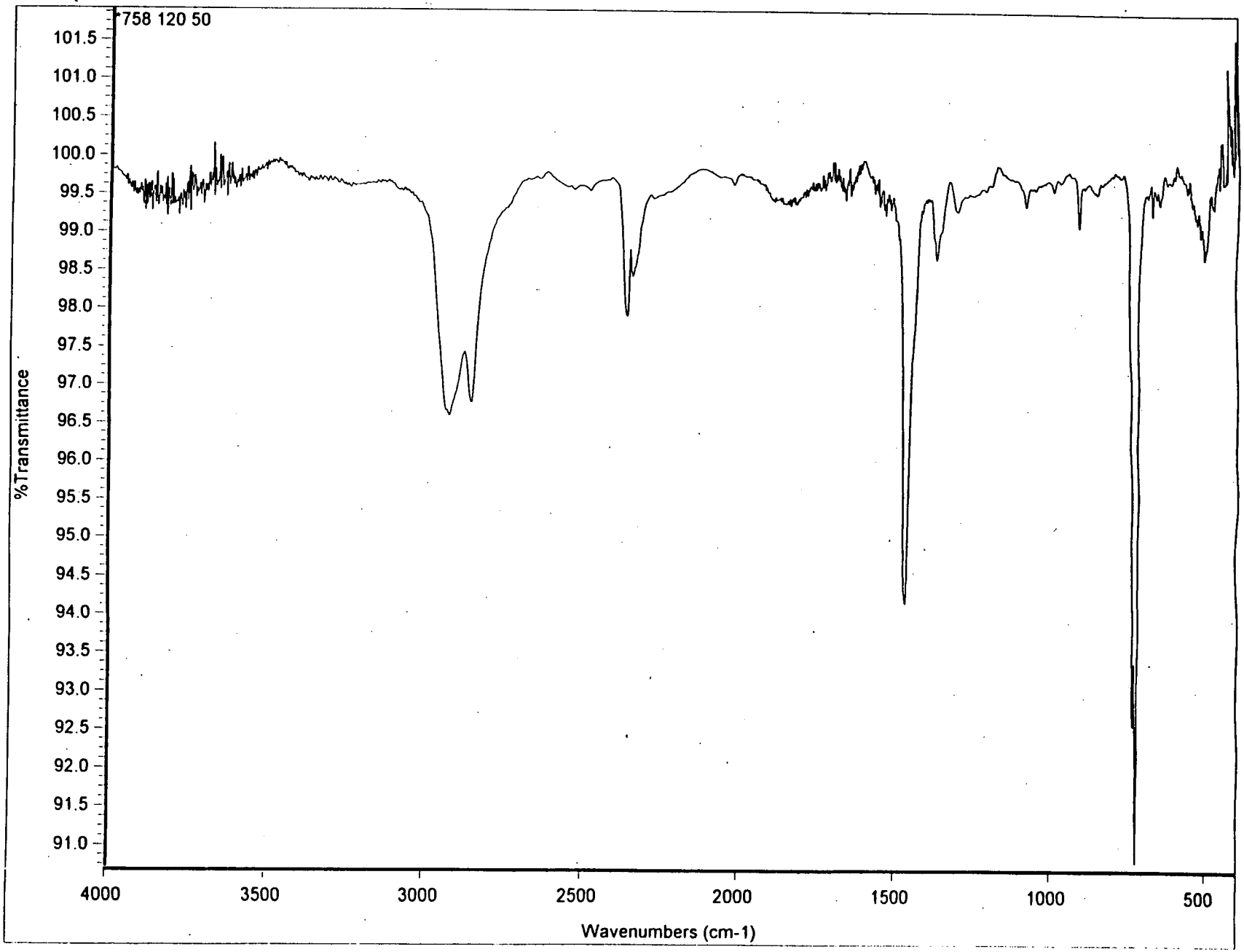

GeoSyntec Consultants

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APPENDIX E

STRESS CRACK RESISTANCE

Part I: Rationale, Results and Discussions, and Conclusions

Part II: Stress-Time Curves

APPENDIX E

STRESS CRACKING RESISTANCE

Environmental Stress Cracking Resistance

Environmental stress cracking resistance of the five geomembranes was assessed by conducting notched constant tensile load (NCTL) tests in accordance with ASTM D 5397. Results are provided below based on a 2,000-hour test duration.

Rationale for Test

In the NCTL test, geomembrane specimens are subjected to constant stress at pre-established percentages of the short-term yield stress of the geomembrane. The time required for the geomembrane specimen to rupture at a specific stress level is measured and recorded. Curves are developed by graphing percent of stress (ordinate) versus rupture time (abscissa). From these curves, the time to rupture at 6.2 MPa (900 psi), which is the industry accepted stress level for specifying environmental stress cracking resistance, and the ductile to brittle transition time, can be assessed. The longer the time to rupture at 6.2 MPa (900 psi), the greater the stress cracking resistance of a material.

Results and Discussion

The test results for the NCTL tests on the five geomembranes are summarized in Table E-1 and complete results are given in Table E-2.

Inspection of Table E-1 reveals that the GSE-SLT and the NSC geomembranes have better stress crack resistance than the GSE-Gundle, Serrot, and Polyflex geomembranes because neither the time to rupture at 6.2 MPa (900 psi) nor the ductile to brittle transition times have been achieved. Furthermore, the GSE-SLT geomembrane appears to have somewhat greater stress cracking resistance than the NSC geomembrane because specimens that have higher stress levels have not yet ruptured,

TABLE E-1

SUMMARY OF NCTL TEST RESULTS

Geomembrane/Resin	Time to Rupture at 6.2 MPa (900 psi)	Estimated Ductile-to-Brittle Transition Time
GSE-SLT/Mobil	(1)	(2)
NSC/Union Carbide	(3)	(4)
GSE-Gundle/Phillips	536 hr	450 hr
Serrot/Solvay	535 hr	526 hr
Polyflex/Phillips	182 hr	50 hr

Notes:
(1) Specimens with <40% of yield stress did not rupture.
(2) Only ductile ruptures were observed.
(3) Specimens with <30% of yield stress did not rupture.
(4) Only ductile ruptures have been observed.

TABLE E-2

NOTCHED CONSTANT TENSILE LOAD DATA

Sample	Yield Stress	Hours to Rupture at Percent of Yield Stress[2]									
		20%	25%	30%	35%	40%	45%	50%	55%	60%	65%
GSE-SLT	2,351 psi	470 psi NR[1]	588 psi NR	705 psi NR	823 psi NR	940 psi 1564[3]	1058 psi 361 hr	1176 psi 244 hr	1293 psi 180 hr	1411 psi 4 hr	1528 psi 0.1 hr
NSC	2,814 psi	563 psi NR	704 psi NR	844 psi 1412 hr	985 psi 109 hr	1126 psi 58 hr	1266 psi 21 hr	1407 psi 3 hr	1548 psi 0.2 hr	1688 psi 0.04 hr	1829 psi 0.01 hr
GSE-Gundle	2,851 psi	570 psi NR	713 psi 805 hr	855 psi 564 hr	998 psi 478 hr	1140 psi 184 hr	1283 psi 56 hr	1426 psi 28 hr	1568 psi 0.7 hr	1711 psi 0.02 hr	1853 psi 0.008 hr
Polyflex	3,086 psi	617 psi 1451 hr	772 psi 393 hr	926 psi 182 hr	1080 psi 81 hr	1234 psi 49 hr	1389 psi 5.1 hr	1343 psi 3 hr	1697 psi 0.1 hr	1852 psi 0.03 hr	2,000 psi 0.004 hr
Serrot	2,600 psi	520 psi NR	650 psi 883 hr	780 psi 468 hr	910 psi 556 hr	1040 psi 155 hr	1170 psi 73 hr	1300 psi 8 hr	1430 psi 8 hr	1360 psi 0.2 hr	1690 psi 0.03 hr

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

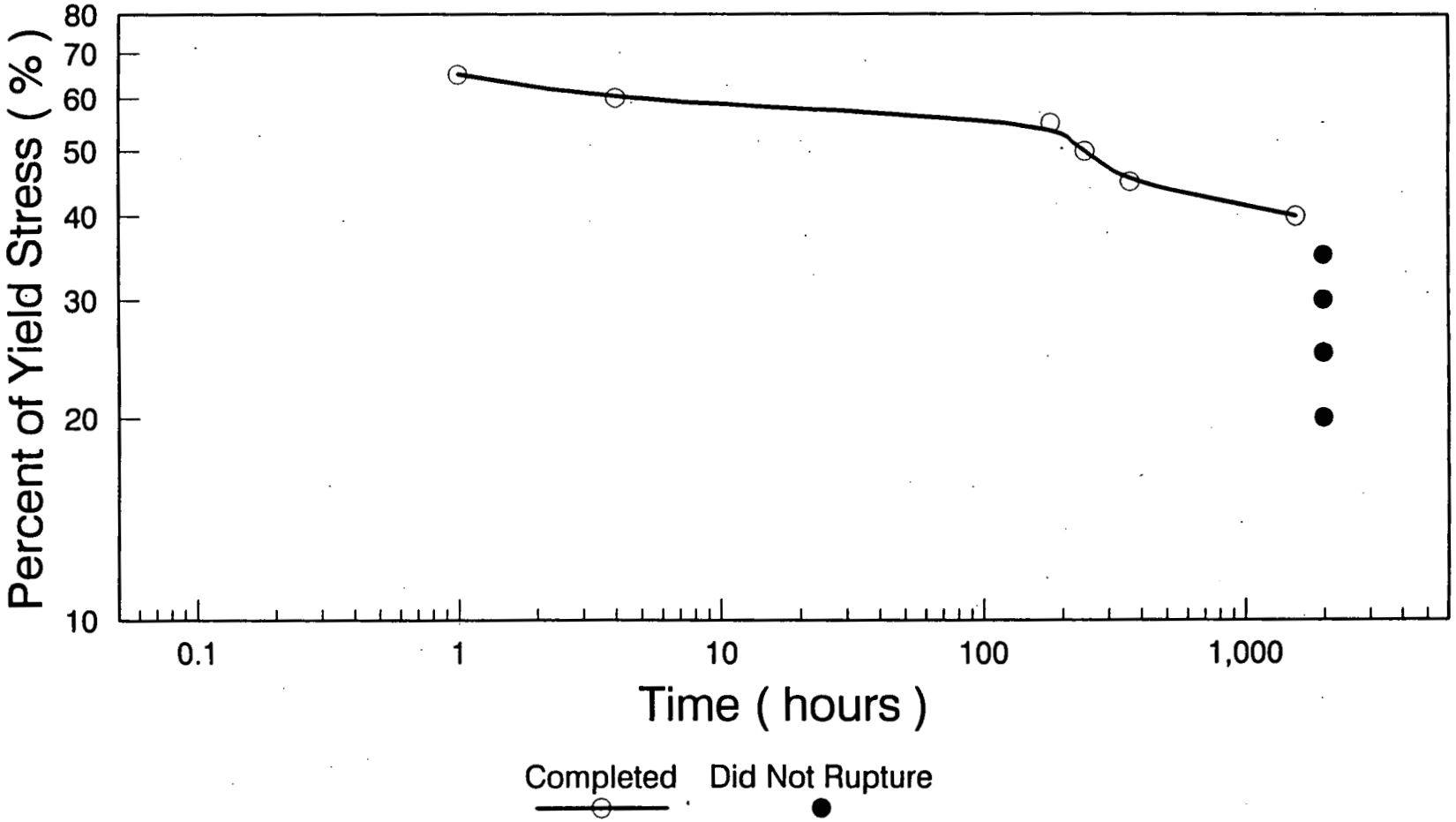
compared to the NSC geomembrane. Specimens having higher stresses tend to rupture in a ductile mode and rupture more quickly than specimens having lower stresses, which take longer to rupture and tend to rupture in a brittle mode. In addition, from Table E-1, the Polyflex geomembrane has values that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

Conclusion

Based on these test results, it is recommended that the specified time-to-rupture for HDPE geomembranes, tested in accordance with ASTM D 5397 at 6.2 MPa (900 psi), be greater than 500 hours. This appears to be an achievable level of performance for four existing HDPE geomembranes, and is likely achievable by other manufacturers if necessary to meet a specification requirement.

NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

Sample: 754 (GSE - SLT)



Yield Stress = 2351psi

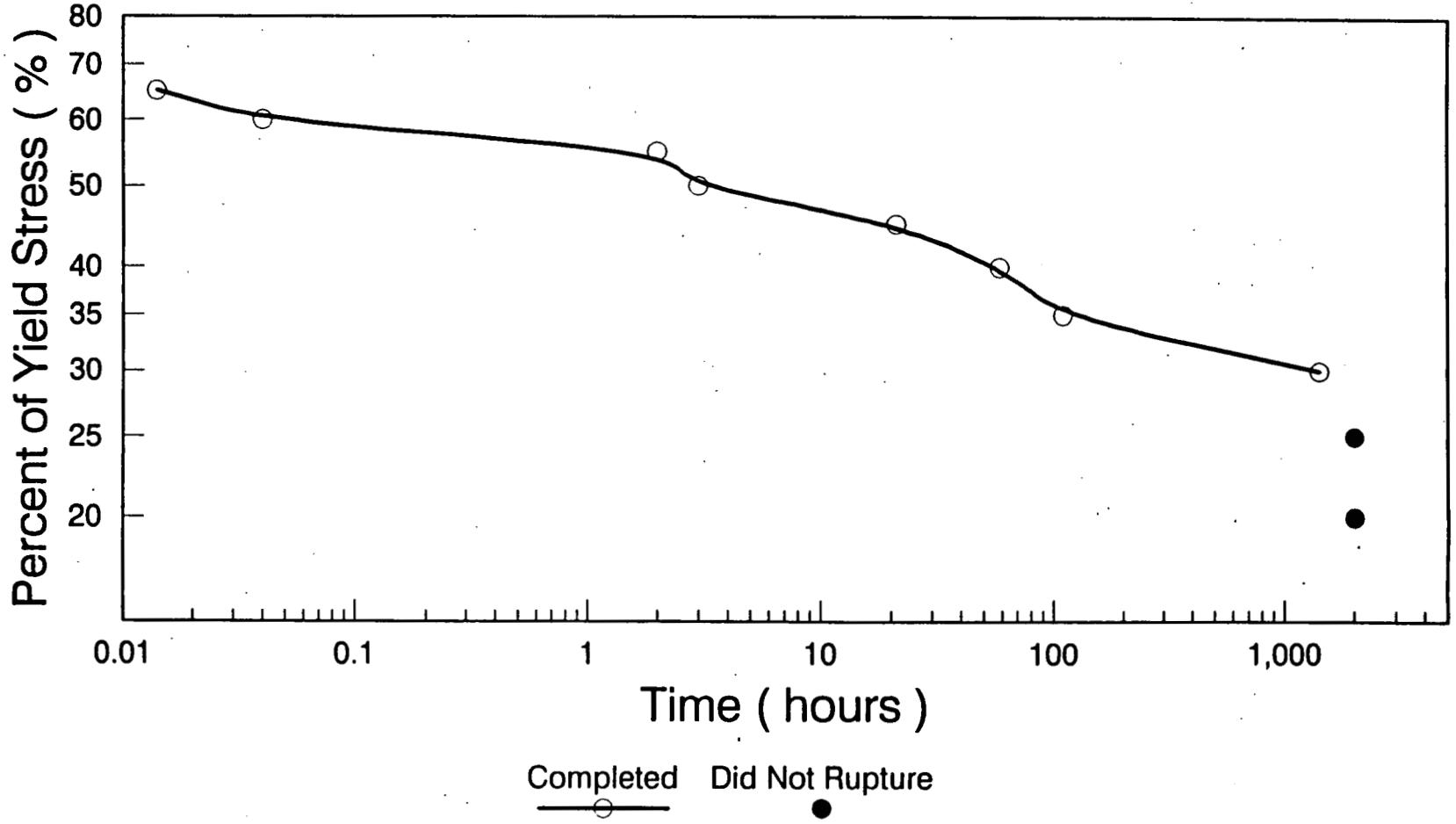
August 12, 1996

000377

827

NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

Sample: 755 (NSC)

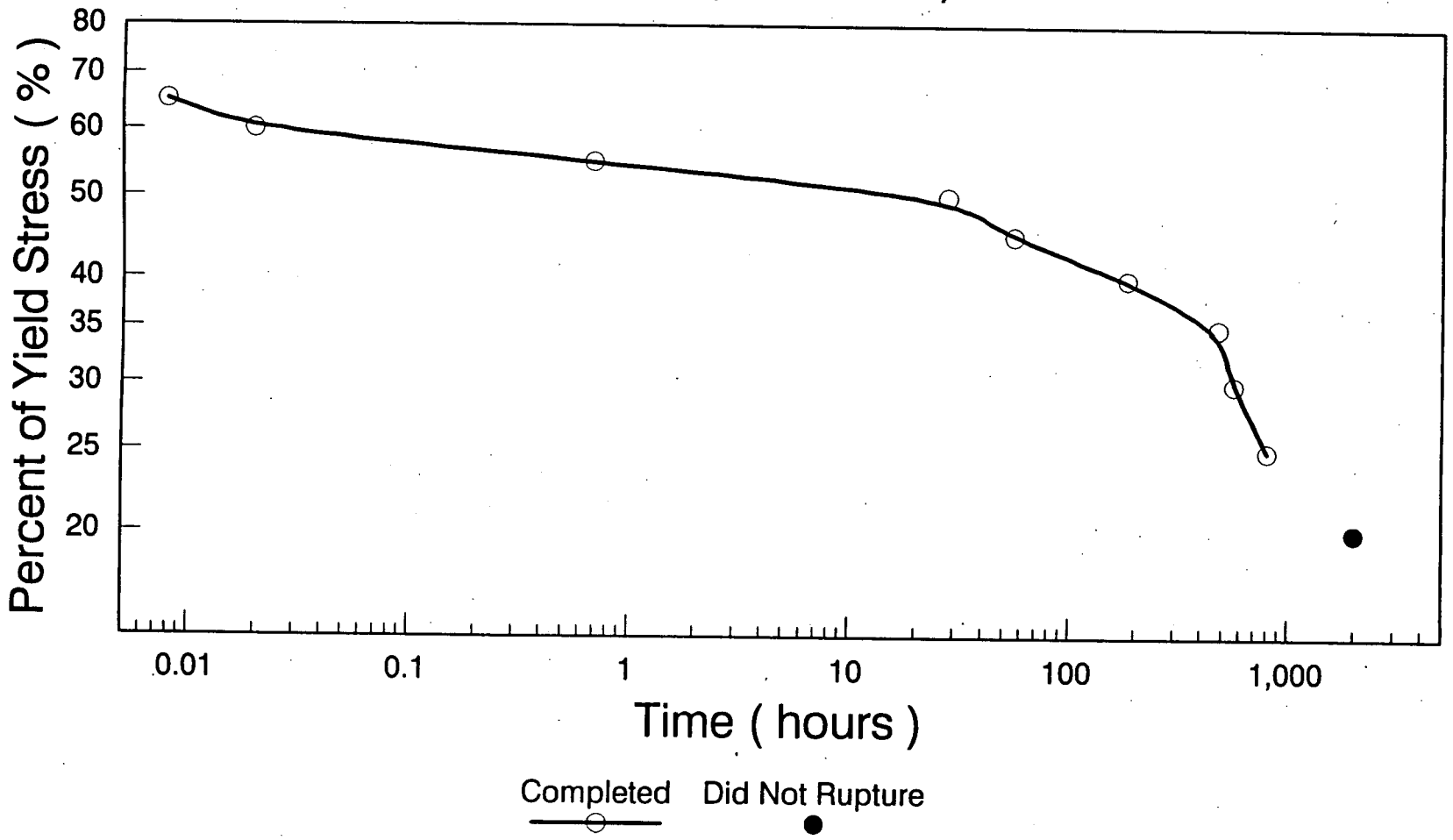


Yield Stress=2814 psi

August 12, 1996

NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

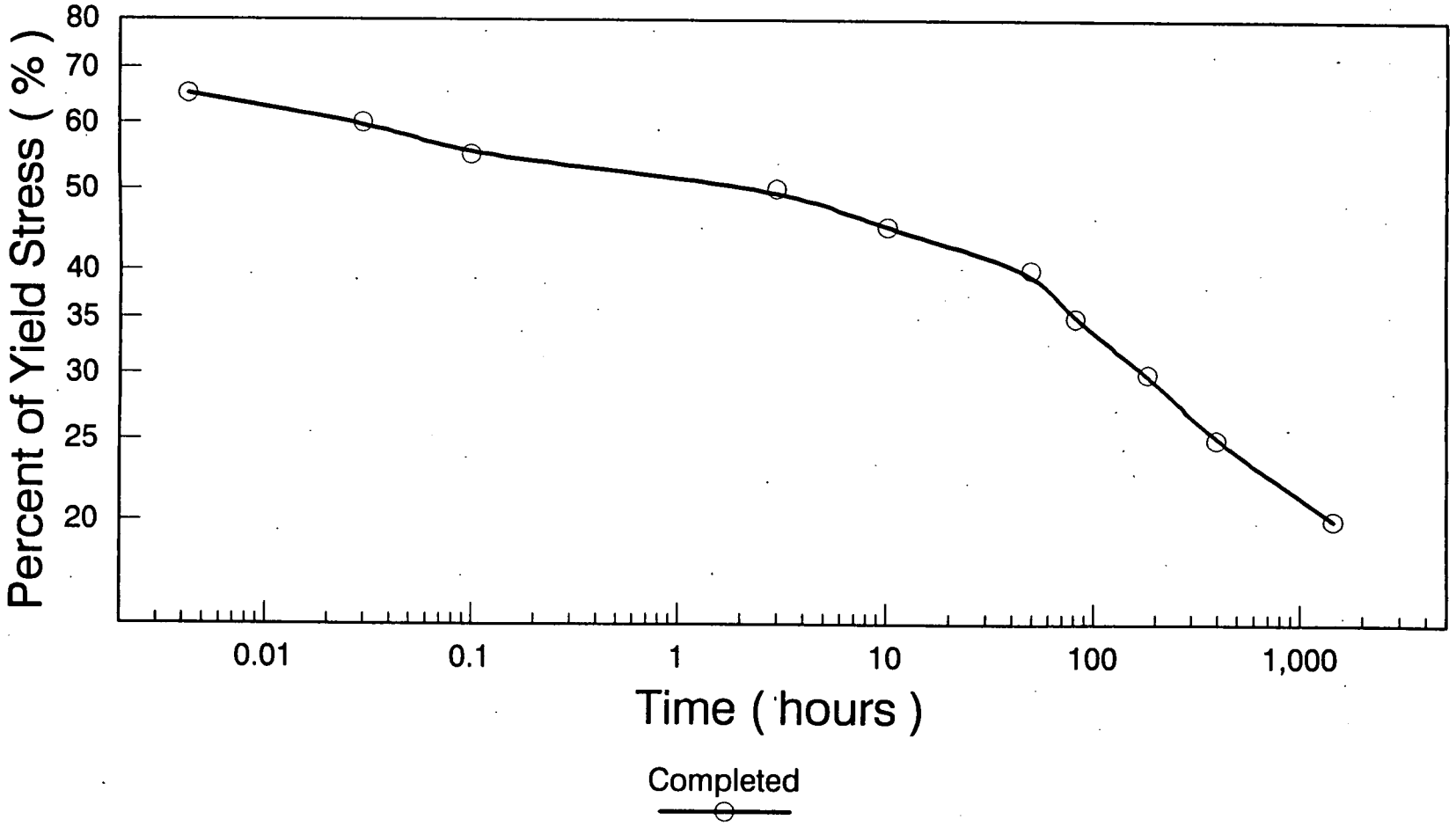
Sample: 756 (GSE - GUNDLE)



Yield Stress=2851 psi
August 12, 1996

NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

Sample: 757 (POLYFLEX)



Yield Stress = 3086 psi

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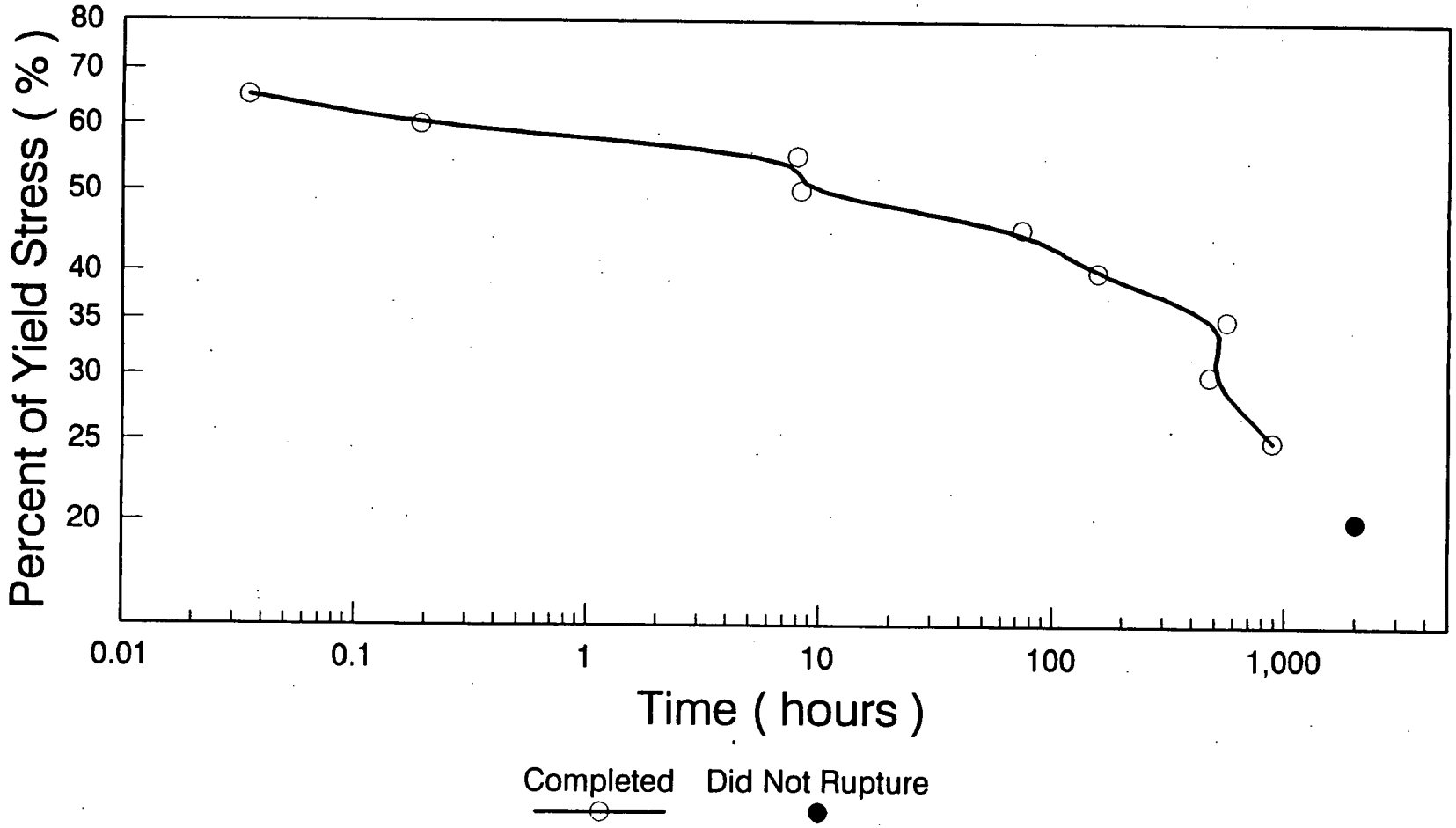
000380

827

NOTCHED CONSTANT TENSILE LOAD TEST RESULTS FOR FERMCO

Sample: 758 (SERROT)



Yield Stress=2600 psi

August 12, 1996

000381

827