



G S E S t u d L i n e r

C o n c r e t e P r o t e c t i o n P r o d u c t s

Greenbrook Chemical Resistance (Pickle Jar) Test Results



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GSE StudLiner Greenbook Chemical Resistance (Pickle Jar) Test Results

GSE StudLiner concrete protection geomembranes are made of a high quality, virgin high density polyethylene (HDPE) which demonstrates excellent chemical resistance. HDPE's superior chemical resistance is what makes GSE StudLiner the lining material of choice for applications with harsh chemical conditions.

A chemical test was performed on GSE StudLiner per the 2006 Greenbook standard Section 211-2: Chemical Resistance Test (Pickle Jar Test). This test is used to determine the physical properties of material specimens used in sewers after exposure to chemical solutions. The main function of this test is to determine if the chemicals will affect the properties of the liner over time. The tables below reflect a summation of the test results.

TENSILE STRENGTH PSI (MPA)						
Chemical Solution	Concentration	Exposed				
		Initial	30 day	60 day	90 day	120 day
Sulphuric Acid (H ₂ SO ₄)	20%	3856	4264	4331	4256	4033
Sodium Hydroxide (NaOH)	5%	3856	3991	4109	4011	4242
Ammonium Hydroxide (NH ₄ OH)	5%	3856	4080	3900	4131	4091
Nitric Acid (HNO ₃)	1%	3856	3822	4231	4118	4164
Ferric Chloride (FeCl ₃)	1%	3856	4371	3929	4162	4300
Sodium Hypochlorite	1%	3856	4009	3707	3378	3720
Soap	0.1%	3856	3913	4020	3833	4138
Detergent (Linear Alkyl Benzyl Sulfonate or LAS)	0.1%	3856	3860	3796	4151	3838
Bacteriological	BOD ≥ 700 ppm	3856	4020	3909	3933	4098

TENSILE BREAK AT ELONGATION (%)						
Chemical Solution	Concentration	Exposed				
		Initial	30 day	60 day	90 day	120 day
Sulphuric Acid (H ₂ SO ₄)	20%	512	547	561	550	578
Sodium Hydroxide (NaOH)	5%	512	528	525	525	612
Ammonium Hydroxide (NH ₄ OH)	5%	512	542	522	519	595
Nitric Acid (HNO ₃)	1%	512	514	555	527	599
Ferric Chloride (FeCl ₃)	1%	512	561	527	534	599
Sodium Hypochlorite	1%	512	511	500	490	536
Soap	0.1%	512	522	523	504	611
Detergent (Linear Alkyl Benzyl Sulfonate or LAS)	0.1%	512	511	496	530	559
Bacteriological	BOD ≥ 700 ppm	512	542	517	505	588

HARDNESS (RATING) AFTER 1 SECOND						
Chemical Solution	Concentration	Exposed				
		Initial	30 day	60 day	90 day	120 day
Sulphuric Acid (H ₂ SO ₄)	20%	61	60	61	61	62
Sodium Hydroxide (NaOH)	5%	61	61	60	61	61
Ammonium Hydroxide (NH ₄ OH)	5%	61	61	61	60	61
Nitric Acid (HNO ₃)	1%	61	61	61	61	61
Ferric Chloride (FeCl ₃)	1%	61	62	60	62	62
Sodium Hypochlorite	1%	61	61	60	62	62
Soap	0.1%	61	60	60	61	60
Detergent (Linear Alkyl Benzyl Sulfonate or LAS)	0.1%	61	61	61	61	61
Bacteriological	BOD ≥ 700 ppm	61	61	63	61	62

HARDNESS (RATING) AFTER 10 SECONDS						
Chemical Solution	Concentration	Exposed				
		Initial	30 day	60 day	90 day	120 day
Sulphuric Acid (H ₂ SO ₄)	20%	58	57	57	54	55
Sodium Hydroxide (NaOH)	5%	58	59	58	56	56
Ammonium Hydroxide (NH ₄ OH)	5%	58	59	56	57	56
Nitric Acid (HNO ₃)	1%	58	58	56	56	56
Ferric Chloride (FeCl ₃)	1%	58	59	56	55	57
Sodium Hypochlorite	1%	58	60	57	59	59
Soap	0.1%	58	57	55	54	56
Detergent (Linear Alkyl Benzyl Sulfonate or LAS)	0.1%	58	59	57	55	57
Bacteriological	BOD ≥ 700 ppm	58	59	58	55	56

WEIGHT CHANGE (%)						
Chemical Solution	Concentration	Exposed				
		Initial	30 day	60 day	90 day	120 day
Sulphuric Acid (H ₂ SO ₄)	20%	0.00	0.17	0.00	0.17	0.00
Sodium Hydroxide (NaOH)	5%	0.00	0.00	-0.34	0.17	0.00
Ammonium Hydroxide (NH ₄ OH)	5%	0.00	0.17	0.17	0.00	-0.17
Nitric Acid (HNO ₃)	1%	0.00	0.17	0.00	0.17	0.00
Ferric Chloride (FeCl ₃)	1%	0.00	0.00	0.00	0.00	0.00
Sodium Hypochlorite	1%	0.00	0.17	-0.42	0.00	-0.35
Soap	0.1%	0.00	0.17	-0.17	0.00	0.17
Detergent (Linear Alkyl Benzyl Sulfonate or LAS)	0.1%	0.00	0.17	0.00	0.17	0.00
Bacteriological	BOD ≥ 700 ppm	0.00	-0.17	0.17	-0.17	0.00

Conclusion: As the test results indicate, GSE StudLiner physical properties are not affected by the chemical constituents listed in the 2006 Greenbook chemical resistance test. These test results make evident that GSE StudLiner is an outstanding material of choice for sewer applications.

TN007 Stud Pickle Jar Test R04/13/06

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South America	GSE Lining Technology Chile S.A.	Santiago, Chile		56.2.595.4200	Fax: 56.2.595.4290
Asia Pacific	GSE Lining Technology Company Limited	Bangkok, Thailand		66.2.937.0091	Fax: 66.2.937.0097
Europe & Africa	GSE Lining Technology GmbH	Hamburg, Germany		49.40.767420	Fax: 49.40.7674234
Middle East	GSE Lining Technology-Egypt	The 6th of October City, Egypt		20.2.828.8888	Fax: 20.2.828.8889



April 13, 2007

Mail To:

Mr. Jimmy Youngblood
GSE Lining Technology, Inc.
19103 Gundle Rd.
Houston, TX 77073

email: jyoungblood@gseworld.com

Dear Mr. Youngblood:

Thank you for consulting TRI/Environmental, Inc. (TRI) for your geosynthetics testing needs. TRI is pleased to submit this preliminary report for laboratory testing.

TRI Job Reference Number:	E2256-04-03
Material(s) Tested:	1 GSE Studliner
Test(s) Requested:	Chemical Resistance (ASTM D 5747, D5322)

If you have any questions or require any additional information, please call us at 1-800-880-8378.

Sincerely,

A handwritten signature in black ink that reads "Jarrett A. Nelson". The signature is written in a cursive, flowing style.

Jarrett A. Nelson
Special Projects Manager
Geosynthetic Services Division



GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 20% SULFURIC ACID @ 55C

Tensile Properties:

Tensile Stress @ Yield (psi)	2522	2578	2422	2578	2267
ASTM D638	2500	2578	2422	2578	2278
Machine Direction	2500	2567	2422	2589	2278
	2433	2544	2400	2578	2278
	2456	2544	2433	2589	2244

Average	2482	2562	2420	2582	2269
STD	37	17	12	6	14
Coefficient of Variation	1	1	1	0	1

% Change		3	-3	4	-9
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Tensile Strength @ Break (psi)	4200	4278	4367	4500	4467
ASTM D638	4189	4356	4389	4022	4278
Machine Direction	3378	4100	4322	4189	4200
	3833	4400	4056	4311	3944
	3678	4189	4522	4256	3278

Average	3856	4264	4331	4256	4033
STD	350	122	171	174	462
Coefficient of Variation	9	3	4	4	11

% Change		11	12	10	5
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Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 20% SULFURIC ACID @ 55C

Tensile Properties:

Elongation @ Yield (%)	19	20	21	23	22
ASTM D638	19	20	21	23	22
Machine Direction	19	22	21	23	22
	19	22	21	23	22
	19	24	21	23	22
Average	19	22	21	23	22
STD	0	2	0	0	0
Coefficient of Variation	0	8	0	0	0
% Change		14	11	21	16
Elongation @ Break (%)	544	549	559	564	628
ASTM D638	541	546	561	541	616
Machine Direction	459	539	560	549	596
	516	554	534	550	564
	500	549	590	545	486
Average	512	547	561	550	578
STD	35	5	20	9	57
Coefficient of Variation	7	1	4	2	10
% Change		7	10	7	13

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Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 20% SULFURIC ACID @ 55C

Indentation Hardness:

Reading @ 1 sec	61	60	60	60	62
ASTM D2240	62	61	62	61	63
(with TYPE D DUROMETER)	61	58	61	61	61
	62	59	61	62	61
	61	60	62	60	62
Average	61	60	61	61	62
STD	1	1	1	1	1
Coefficient of Variation	1	2	1	1	1
% Change		-3	0	-1	1

Indentation Hardness:

Reading @ 10 sec	58	57	55	54	54
ASTM D2240	58	57	57	54	55
(with TYPE D DUROMETER)	57	56	58	54	56
	58	57	57	55	55
	59	57	56	54	54
Average	58	57	57	54	55
STD	1	0	1	0	1
Coefficient of Variation	1	1	2	1	2
% Change		-2	-2	-7	-6

Mass Change:

Mass of 2 inch diameter circle (g) - Pre Immersion	5.78	5.83	5.81	5.89
Mass of 2 inch diameter circle (g) - Post Immersion	5.79	5.83	5.82	5.89
% Change	0.17	0.00	0.17	0.00

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Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 5% SODIUM HYDROXIDE @ 55C

Tensile Properties:

Tensile Stress @ Yield (psi)	2522	2556	2456	2633	2422
ASTM D638	2500	2522	2456	2667	2422
Machine Direction	2500	2544	2433	2656	2400
	2433	2544	2444	2611	2422
	2456	2544	2444	2678	2400

Average	2482	2542	2447	2649	2413
STD	37	12	9	27	12
Coefficient of Variation	1	0	0	1	1

% Change		2	-1	7	-3
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Tensile Strength @ Break (psi)	4200	3489	4500	4089	4244
ASTM D638	4189	4011	3644	4067	4233
Machine Direction	3378	4167	3933	3744	4367
	3833	4233	4356	3989	4067
	3678	4056	4111	4167	4300

Average	3856	3991	4109	4011	4242
STD	350	294	339	162	111
Coefficient of Variation	9	7	8	4	3

% Change		4	7	4	10
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Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 5% SODIUM HYDROXIDE @ 55C

Tensile Properties:

Elongation @ Yield (%)	19	20	21	21	23
ASTM D638	19	22	20	21	23
Machine Direction	19	19	22	21	23
	19	20	22	20	23
	19	21	21	23	23
Average	19	20	21	21	23
STD	0	1	1	1	0
Coefficient of Variation	0	6	4	5	0
% Change		7	12	12	21
Elongation @ Break (%)	544	478	561	529	616
ASTM D638	541	528	488	543	651
Machine Direction	459	544	508	499	603
	516	550	543	519	586
	500	539	525	538	604
Average	512	528	525	525	612
STD	35	29	29	17	24
Coefficient of Variation	7	6	6	3	4
% Change		3	2	3	20

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TABLE OF CHEMICAL RESISTANCE TEST RESULTS
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Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 5% SODIUM HYDROXIDE @ 55C

Indentation Hardness:

Reading @ 1 sec	61	59	60	62	60
ASTM D2240	62	61	60	62	62
(with TYPE D DUROMETER)	61	61	58	61	61
	62	61	59	61	61
	61	61	61	60	61
Average	61	61	60	61	61
STD	1	1	1	1	1
Coefficient of Variation	1	1	2	1	1
% Change		-1	-3	0	-1

Indentation Hardness:

Reading @ 10 sec	58	58	58	55	56
ASTM D2240	58	59	56	56	57
(with TYPE D DUROMETER)	57	59	57	55	56
	58	59	59	57	56
	59	58	58	55	56
Average	58	59	58	56	56
STD	1	1	1	1	0
Coefficient of Variation	1	1	2	2	1
% Change		1	-1	-4	-3

Mass Change:

Mass of 2 inch diameter circle (g) - Pre Immersion	5.76	5.8	5.9	5.84
Mass of 2 inch diameter circle (g) - Post Immersion	5.76	5.78	5.91	5.84
% Change	0.00	-0.34	0.17	0.00

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TABLE OF CHEMICAL RESISTANCE TEST RESULTS
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Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 5% AMMONIUM HYDROXIDE @ 55C

Tensile Properties:

Tensile Stress @ Yield (psi)	2522	2578	2511	2711	2311
ASTM D638	2500	2556	2522	2689	2278
Machine Direction	2500	2567	2511	2700	2289
	2433	2522	2433	2711	2300
	2456	2544	2544	2722	2289

Average	2482	2553	2504	2707	2293
STD	37	21	42	13	13
Coefficient of Variation	1	1	2	0	1

% Change		3	1	9	-8
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Tensile Strength @ Break (psi)	4200	4011	4211	4167	4533
ASTM D638	4189	4267	3100	4067	3800
Machine Direction	3378	4056	3644	4167	4389
	3833	3744	4333	4067	4122
	3678	4322	4211	4189	3611

Average	3856	4080	3900	4131	4091
STD	350	230	521	60	387
Coefficient of Variation	9	6	13	1	9

% Change		6	1	7	6
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Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO 5% AMMONIUM HYDROXIDE @ 55C

Tensile Properties:

Elongation @ Yield (%)	19	20	20	19	23
ASTM D638	19	20	20	19	22
Machine Direction	19	22	20	22	23
	19	22	20	21	23
	19	23	20	21	23
Average	19	21	20	20	23
STD	0	1	0	1	0
Coefficient of Variation	0	6	0	7	2
% Change		13	5	7	20
Elongation @ Break (%)	544	534	564	505	676
ASTM D638	541	559	429	526	561
Machine Direction	459	543	495	534	621
	516	509	564	523	589
	500	565	559	509	525
Average	512	542	522	519	595
STD	35	22	60	12	58
Coefficient of Variation	7	4	11	2	10
% Change		6	2	1	16

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TABLE OF CHEMICAL RESISTANCE TEST RESULTS
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Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO 5% AMMONIUM HYDROXIDE @ 55C

Indentation Hardness:

Reading @ 1 sec	61	62	60	60	62
ASTM D2240	62	61	62	60	61
(with TYPE D DUROMETER)	61	61	61	60	62
	62	62	60	61	61
	61	61	60	61	61
Average	61	61	61	60	61
STD	1	1	1	1	1
Coefficient of Variation	1	1	1	1	1
% Change		0	-1	-2	0

Indentation Hardness:

Reading @ 10 sec	58	59	57	57	56
ASTM D2240	58	60	56	57	56
(with TYPE D DUROMETER)	57	59	55	57	55
	58	59	56	56	56
	59	59	56	58	57
Average	58	59	56	57	56
STD	1	0	1	1	1
Coefficient of Variation	1	1	1	1	1
% Change		2	-3	-2	-3

Mass Change:

Mass of 2 inch diameter circle (g) - Pre Immersion	5.87	5.82	5.89	5.91
Mass of 2 inch diameter circle (g) - Post Immersion	5.88	5.83	5.89	5.90
% Change	0.17	0.17	0.00	-0.17

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TABLE OF CHEMICAL RESISTANCE TEST RESULTS
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Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO 1% NITRIC ACID @ 55C

Tensile Properties:

Tensile Stress @ Yield (psi)	2522	2600	2544	2733	2333
ASTM D638	2500	2533	2533	2689	2344
Machine Direction	2500	2611	2533	2678	2322
	2433	2600	2511	2733	2333
	2456	2567	2478	2678	2289

Average	2482	2582	2520	2702	2324
STD	37	32	27	29	21
Coefficient of Variation	1	1	1	1	1

% Change		4	2	9	-6
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Tensile Strength @ Break (psi)	4200	4189	4211	4100	3911
ASTM D638	4189	4200	4467	4244	4456
Machine Direction	3378	3233	3922	3700	4189
	3833	4267	4067	4289	4389
	3678	3222	4489	4256	3878

Average	3856	3822	4231	4118	4164
STD	350	543	247	245	266
Coefficient of Variation	9	14	6	6	6

% Change		-1	10	7	8
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Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO 1% NITRIC ACID @ 55C

Tensile Properties:

Elongation @ Yield (%)	19	20	20	20	23
ASTM D638	19	20	20	20	23
Machine Direction	19	22	20	20	24
	19	22	20	20	23
	19	22	20	20	21
Average	19	21	20	20	23
STD	0	1	0	0	1
Coefficient of Variation	0	5	0	0	5
% Change		12	5	5	20
Elongation @ Break (%)	544	545	564	526	558
ASTM D638	541	554	563	538	613
Machine Direction	459	458	515	493	624
	516	561	569	536	630
	500	453	566	540	571
Average	512	514	555	527	599
STD	35	54	23	20	33
Coefficient of Variation	7	11	4	4	5
% Change		0	8	3	17

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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 1% NITRIC ACID @ 55C

Indentation Hardness:

Reading @ 1 sec	61	61	61	60	61
ASTM D2240	62	61	61	62	61
(with TYPE D DUROMETER)	61	60	62	62	60
	62	62	61	61	61
	61	61	61	62	61
Average	61	61	61	61	61
STD	1	1	0	1	0
Coefficient of Variation	1	1	1	1	1
% Change		-1	0	0	-1

Indentation Hardness:

Reading @ 10 sec	58	57	55	55	54
ASTM D2240	58	58	55	56	55
(with TYPE D DUROMETER)	57	59	56	55	57
	58	58	57	57	56
	59	58	55	55	56
Average	58	58	56	56	56
STD	1	1	1	1	1
Coefficient of Variation	1	1	2	2	2
% Change		0	-4	-4	-4

Mass Change:

Mass of 2 inch diameter circle (g) - Pre Immersion	5.89	5.79	5.84	5.87
Mass of 2 inch diameter circle (g) - Post Immersion	5.90	5.79	5.85	5.87
% Change	0.17	0.00	0.17	0.00

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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 1% FERRIC CHLORIDE @ 55C

Tensile Properties:

Tensile Stress @ Yield (psi)	2522	2556	2489	2644	2378
ASTM D638	2500	2533	2467	2622	2411
Machine Direction	2500	2522	2467	2611	2456
	2433	2578	2556	2667	2444
	2456	2567	2467	2656	2422

Average	2482	2551	2489	2640	2422
STD	37	23	38	23	30
Coefficient of Variation	1	1	2	1	1

% Change		3	0	6	-2
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Tensile Strength @ Break (psi)	4200	4433	4189	4389	4156
ASTM D638	4189	4222	3722	4022	4078
Machine Direction	3378	4656	3789	3900	4556
	3833	4178	4178	4378	4500
	3678	4367	3767	4122	4211

Average	3856	4371	3929	4162	4300
STD	350	190	234	217	214
Coefficient of Variation	9	4	6	5	5

% Change		13	2	8	12
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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO 1% FERRIC CHLORIDE @ 55C

Tensile Properties:

Elongation @ Yield (%)	19	22	20	19	22
ASTM D638	19	23	20	19	21
Machine Direction	19	23	20	19	21
	19	22	20	19	21
	19	22	20	19	21
Average	19	22	20	19	21
STD	0	1	0	0	0
Coefficient of Variation	0	2	0	0	2
% Change		18	5	0	12
Elongation @ Break (%)	544	563	526	558	598
ASTM D638	541	553	516	520	541
Machine Direction	459	584	526	510	643
	516	546	553	549	629
	500	561	515	531	585
Average	512	561	527	534	599
STD	35	14	15	20	40
Coefficient of Variation	7	3	3	4	7
% Change		10	3	4	17

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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO 1% FERRIC CHLORIDE @ 55C

Indentation Hardness:

Reading @ 1 sec	61	61	59	63	61
ASTM D2240	62	62	61	62	62
(with TYPE D DUROMETER)	61	61	61	61	62
	62	62	60	61	63
	61	63	61	62	61
Average	61	62	60	62	62
STD	1	1	1	1	1
Coefficient of Variation	1	1	1	1	1
% Change		1	-2	1	1

Indentation Hardness:

Reading @ 10 sec	58	58	55	54	57
ASTM D2240	58	60	56	55	57
(with TYPE D DUROMETER)	57	59	55	57	58
	58	58	57	56	57
	59	59	55	55	58
Average	58	59	56	55	57
STD	1	1	1	1	1
Coefficient of Variation	1	1	2	2	1
% Change		1	-4	-4	-1

Mass Change:

Mass of 2 inch diameter circle (g) - Pre Immersion	5.94	5.81	5.86	5.89
Mass of 2 inch diameter circle (g) - Post Immersion	5.94	5.81	5.86	5.89
% Change	0.00	0.00	0.00	0.00

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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 0.1% SOAP @ 55C

Tensile Properties:

Tensile Stress @ Yield (psi)	2522	2533	2444	2578	2289
ASTM D638	2500	2533	2378	2533	2311
Machine Direction	2500	2522	2500	2567	2311
	2433	2578	2511	2544	2289
	2456	2522	2489	2544	2278

Average	2482	2538	2464	2553	2296
STD	37	23	55	18	15
Coefficient of Variation	1	1	2	1	1

% Change		2	-1	3	-8
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Tensile Strength @ Break (psi)	4200	3556	3989	3622	4322
ASTM D638	4189	4200	4333	4022	3700
Machine Direction	3378	4344	3711	3767	4400
	3833	3567	4033	3544	4244
	3678	3900	4033	4211	4022

Average	3856	3913	4020	3833	4138
STD	350	359	221	279	282
Coefficient of Variation	9	9	5	7	7

% Change		1	4	-1	7
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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO 0.1% SOAP @ 55C

Tensile Properties:

Elongation @ Yield (%)	19	23	22	19	24
ASTM D638	19	23	22	19	24
Machine Direction	19	23	22	19	24
	19	23	22	20	24
	19	23	22	20	24
Average	19	23	22	19	24
STD	0	0	0	1	0
Coefficient of Variation	0	0	0	3	0
% Change		21	16	2	26
Elongation @ Break (%)	544	489	523	480	646
ASTM D638	541	543	545	528	538
Machine Direction	459	563	498	499	609
	516	489	521	475	639
	500	526	526	538	621
Average	512	522	523	504	611
STD	35	33	17	28	43
Coefficient of Variation	7	6	3	6	7
% Change		2	2	-2	19

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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO 0.1% SOAP @ 55C

Indentation Hardness:

Reading @ 1 sec	61	60	59	61	61
ASTM D2240	62	59	60	60	61
(with TYPE D DUROMETER)	61	60	59	59	59
	62	60	60	62	60
	61	60	61	61	60
Average	61	60	60	61	60
STD	1	0	1	1	1
Coefficient of Variation	1	1	1	2	1
% Change		-3	-3	-1	-2

Indentation Hardness:

Reading @ 10 sec	58	55	56	53	57
ASTM D2240	58	58	55	54	57
(with TYPE D DUROMETER)	57	58	55	53	56
	58	57	56	54	56
	59	58	55	54	55
Average	58	57	55	54	56
STD	1	1	1	1	1
Coefficient of Variation	1	2	1	1	1
% Change		-1	-4	-8	-3

Mass Change:

Mass of 2 inch diameter circle (g) - Pre Immersion	5.76	5.86	5.84	5.81
Mass of 2 inch diameter circle (g) - Post Immersion	5.77	5.85	5.84	5.82
% Change	0.17	-0.17	0.00	0.17

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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO 0.1% DETERGENT (LAS) @ 55C

Tensile Properties:

Tensile Stress @ Yield (psi)	2522	2489	2533	2689	2300
ASTM D638	2500	2467	2522	2689	2289
Machine Direction	2500	2522	2511	2700	2300
	2433	2544	2500	2733	2289
	2456	2456	2489	2700	2278

Average	2482	2496	2511	2702	2291
STD	37	37	18	18	9
Coefficient of Variation	1	1	1	1	0

% Change		1	1	9	-8
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Tensile Strength @ Break (psi)	4200	3711	3967	4011	4311
ASTM D638	4189	3744	4278	4444	4178
Machine Direction	3378	4456	3489	4389	3978
	3833	3967	3344	3989	3067
	3678	3422	3900	3922	3656

Average	3856	3860	3796	4151	3838
STD	350	385	378	245	497
Coefficient of Variation	9	10	10	6	13

% Change		0	-2	8	0
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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO 0.1% DETERGENT (LAS) @ 55C

Tensile Properties:

Elongation @ Yield (%)	19	22	20	21	24
ASTM D638	19	22	20	21	22
Machine Direction	19	22	20	21	23
	19	21	20	21	23
	19	23	21	21	24
Average	19	22	20	21	23
STD	0	1	0	0	1
Coefficient of Variation	0	3	2	0	4
% Change		16	6	11	22
Elongation @ Break (%)	544	498	510	521	641
ASTM D638	541	509	548	548	584
Machine Direction	459	548	463	548	564
	516	523	444	521	468
	500	478	514	510	539
Average	512	511	496	530	559
STD	35	26	42	17	64
Coefficient of Variation	7	5	8	3	11
% Change		0	-3	3	9

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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO 0.1% DETERGENT (LAS) @ 55C

Indentation Hardness:

Reading @ 1 sec	61	60	61	61	62
ASTM D2240	62	60	60	59	60
(with TYPE D DUROMETER)	61	61	62	62	62
	62	61	59	62	60
	61	61	62	61	61
Average	61	61	61	61	61
STD	1	1	1	1	1
Coefficient of Variation	1	1	2	2	2
% Change		-1	-1	-1	-1

Indentation Hardness:

Reading @ 10 sec	58	61	56	55	56
ASTM D2240	58	59	57	55	58
(with TYPE D DUROMETER)	57	60	57	54	57
	58	59	57	55	57
	59	58	56	54	56
Average	58	59	57	55	57
STD	1	1	1	1	1
Coefficient of Variation	1	2	1	1	1
% Change		2	-2	-6	-2

Mass Change:

Mass of 2 inch diameter circle (g) - Pre Immersion	5.88	5.79	5.75	5.78
Mass of 2 inch diameter circle (g) - Post Immersion	5.89	5.79	5.76	5.78
% Change	0.17	0.00	0.17	0.00

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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO BACTERIOLOGICAL WITH BOD > 700 mg/L @ 55C

Tensile Properties:

Tensile Stress @ Yield (psi)	2522	2600	2500	2711	2300
ASTM D638	2500	2556	2500	2733	2289
Machine Direction	2500	2589	2489	2700	2300
	2433	2600	2433	2711	2278
	2456	2589	2400	2722	2300

Average	2482	2587	2464	2716	2293
STD	37	18	45	13	10
Coefficient of Variation	1	1	2	0	0

% Change		4	-1	9	-8
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Tensile Strength @ Break (psi)	4200	4411	4489	3400	4278
ASTM D638	4189	3811	4289	4200	4122
Machine Direction	3378	3922	3711	3811	3522
	3833	4011	3778	4289	4167
	3678	3944	3278	3967	4400

Average	3856	4020	3909	3933	4098
STD	350	230	484	353	339
Coefficient of Variation	9	6	12	9	8

% Change		4	1	2	6
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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
-----------------	----------	---------------	---------------	---------------	----------------

GEOMEMBRANE: STUDLINER EXPOSED TO BACTERIOLOGICAL WITH BOD > 700 mg/L @ 55C

Tensile Properties:

Elongation @ Yield (%)	19	22	21	21	24
ASTM D638	19	22	21	21	24
Machine Direction	19	22	21	21	24
	19	22	21	21	24
	19	22	20	21	24
Average	19	22	21	21	24
STD	0	0	0	0	0
Coefficient of Variation	0	0	2	0	0
% Change		16	9	11	26
Elongation @ Break (%)	544	573	574	460	600
ASTM D638	541	526	548	531	609
Machine Direction	459	524	504	499	511
	516	540	506	530	603
	500	549	451	506	616
Average	512	542	517	505	588
STD	35	20	47	29	43
Coefficient of Variation	7	4	9	6	7
% Change		6	1	-1	15

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TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

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Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO BACTERIOLOGICAL WITH BOD > 700 mg/L @ 55C

Indentation Hardness:

Reading @ 1 sec	61	61	62	60	62
ASTM D2240	62	60	61	62	62
(with TYPE D DUROMETER)	61	60	64	62	61
	62	61	63	62	61
	61	61	63	61	62
Average	61	61	63	61	62
STD	1	1	1	1	1
Coefficient of Variation	1	1	2	1	1
% Change		-1	2	0	0

Indentation Hardness:

Reading @ 10 sec	58	59	57	55	57
ASTM D2240	58	59	59	55	57
(with TYPE D DUROMETER)	57	60	58	54	56
	58	58	57	55	56
	59	59	59	54	55
Average	58	59	58	55	56
STD	1	1	1	1	1
Coefficient of Variation	1	1	2	1	1
% Change		2	0	-6	-3

Mass Change:

Mass of 2 inch diameter circle (g) - Pre Immersion	5.82	5.86	5.82	5.88
Mass of 2 inch diameter circle (g) - Post Immersion	5.81	5.87	5.81	5.88
% Change	-0.17	0.17	-0.17	0.00

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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

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Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 1% SODIUM HYPOCHLORITE (HYPOCHLORIDE) @ 55C

Tensile Properties:

Tensile Stress @ Yield (psi)	2522	2556	2489	2467	2444
ASTM D638	2500	2533	2489	2422	2422
Machine Direction	2500	2544	2433	2478	2344
	2433	2578	2478	2478	2500
	2456	2544	2478	2411	2433

Average	2482	2551	2473	2451	2429
STD	37	17	23	32	56
Coefficient of Variation	1	1	1	1	2

% Change		3	0	-1	-2
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Tensile Strength @ Break (psi)	4200	3711	4144	2789	3911
ASTM D638	4189	4156	3522	3700	4156
Machine Direction	3378	3922	3411	3589	3344
	3833	4111	3922	3700	3633
	3678	4144	3533	3111	3556

Average	3856	4009	3707	3378	3720
STD	350	191	312	409	317
Coefficient of Variation	9	5	8	12	9

% Change		4	-4	-12	-4
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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 1% SODIUM HYPOCHLORITE (HYPOCHLORIDE) @ 55C

Tensile Properties:

Elongation @ Yield (%)	19	23	23	22	23
ASTM D638	19	24	25	22	23
Machine Direction	19	23	23	22	24
	19	23	23	22	23
	19	23	23	22	23
Average	19	23	23	22	23
STD	0	0	1	0	0
Coefficient of Variation	0	2	4	0	2
% Change		22	23	16	22
Elongation @ Break (%)	544	476	548	401	528
ASTM D638	541	535	491	564	584
Machine Direction	459	500	455	509	496
	516	518	529	519	528
	500	526	476	458	544
Average	512	511	500	490	536
STD	35	23	38	62	32
Coefficient of Variation	7	5	8	13	6
% Change		0	-2	-4	5

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GEOMEMBRANE TEST RESULTS
TABLE OF CHEMICAL RESISTANCE TEST RESULTS
 TRI Client: GSE Lining Technology, Inc.

Report Date: April 2007

Exposure Time and Temperature

Test Parameters	Baseline	30 Day 55C	60 Day 55C	90 Day 55C	120 Day 55C
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GEOMEMBRANE: STUDLINER EXPOSED TO 1% SODIUM HYPOCHLORITE (HYPOCHLORIDE) @ 55C

Indentation Hardness:

Reading @ 1 sec	61	61	62	63	62
ASTM D2240	62	61	61	63	61
(with TYPE D DUROMETER)	61	59	61	61	62
	62	62	59	62	62
	61	62	59	62	61
Average	61	61	60	62	62
STD	1	1	1	1	1
Coefficient of Variation	1	2	2	1	1
% Change		-1	-2	1	0

Indentation Hardness:

Reading @ 10 sec	58	60	56	60	60
ASTM D2240	58	59	57	60	59
(with TYPE D DUROMETER)	57	61	56	58	58
	58	59	58	59	58
	59	60	56	58	60
Average	58	60	57	59	59
STD	1	1	1	1	1
Coefficient of Variation	1	1	2	2	2
% Change		3	-2	2	2

Mass Change:

Mass of 2 inch diameter circle (g) - Pre Immersion	5.83	4.77	4.73	5.79
Mass of 2 inch diameter circle (g) - Post Immersion	5.84	4.75	4.73	5.77
% Change	0.17	-0.42	0.00	-0.35

The testing herein is based upon accepted industry practice as well as the test method listed.
 Test results reported herein do not apply to samples other than those tested.
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