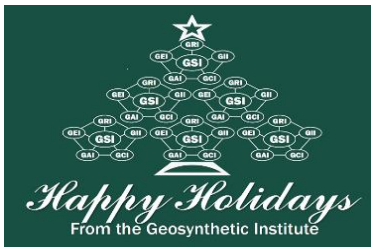
The GSI Newsletter/Report



Wishing you a Healthy and Prosperous 2022

Vol. 35, No. 4 **December, 2021**

This quarterly newsletter, now in its 35th year, presents the activities of GSI and its related institutes to all who are interested. It is available on the institute's home page at www.geosynthetic-institute.org. It also serves as a quarterly report to its member organizations. Details are available by contacting George R. Koerner or Jamie Koerner at phone (610) 522-8440; or e-mail at gsigeokoerner@gmail.com or Jamie@geosynthetic-institute.org.

Activities of GSI's Officers and Board of Advisors (BOA)

Results of the most recent voting for three positions on the Board of Advisors (BOA) resulted in Burrill (Bo) McCoy to continue to represent the Owner and Operator members, Sam Allen, representing the At-Large group and Rene Laprade to represent the Geotextile and Geogrid members. Burrill McCoy replaced John Workman mid-term in 2020 and will now serve on the BOA through the end of 2024. We welcome new Board of Advisor (BOA) Rene Laprade and look forward to working with him for the next 3 years.

2022-2024 Board of Advisors

Term Ends 2022

- Kent von Maubeuge – NAUE GmbH & Co. KG (International-1)
  email: kvmaubeuge@naue.com
- Vergil Rhodes – C.P. Chemical (Resin and Additives Group)
  email: RhodeVH@cpchem.com
- David Carson – U.S. EPA (Agencies)
  email: carson.david@epa.gov

Term Ends 2023

- Te-Yang Soong - CTI Co. (Consultants and Testing Labs)
  email: tsoong@cticompanies.com
- Nathan Ivy - AGRU America (Geomembranes and GCL's)
- Mathieu Cornellier - Solmax (International - 2)
  e-mail: mcornellier@solmax.com

Term Ends 2024

- Burrill (Bo) McCoy - Waste Management Inc. (Owners and Operators)
  e-mail: bmccoy2@wm.com
- Rene Laprade - Tencate Geosynthetics (Geotextiles and Geogrids)
  e-mail: r.laprade@tencategeo.com
- Sam Allen – TRI Environmental Inc. (At-Large)
  e-mail: Sallen@tri-env.com

GSI has continued to have virtual quarterly meetings with the Board of Advisors throughout 2021 via Zoom. We are anticipating that by mid- 2022, conferences and live meetings will resume. While virtual meetings have certainly been productive and a necessity during COVID, there is no comparison (in our opinion) to in-person meetings. We are looking forward to traveling once again in 2022. Our fourth quarter BOA meeting was held on December 22, 2021. We thank the BOA for sharing their time and talent to fulfill the GSI mission.

IN THIS ISSUE

Overview of GRI Projects (Research)

The following projects are all funded by GSI membership dues unless specifically noted. Most are long-term projects for which we are well positioned to accomplish. *Those projects marked with an asterisk have written papers available; please ask and we will send them accordingly.* Contact George Koerner (gsigeokoerner@gmail.com), Grace Hsuan (hsuanyg@drexel.edu) for details and/or discussions.

1. Durability of Geosynthetics

Field Exposed Lifetime of Geogrids Used at the Facing of Landfill Berms - The facing of mechanically stabilized earth landfill berms (and other walls and slopes as well) often uses a wraparound configuration leaving the geogrid exposed to the atmosphere. A project being conducted by George Koerner is presently investigating the behavior of two different geogrids and two erosion control materials at a local landfill over time. These four materials are also being exposed on the roof of the GSI carport. A 50-year time frame is envisioned! The long-term behavior will eventually be compared to our UV laboratory predicted database.

Laboratory Exposed Lifetime of Geomembranes* - GSI is using three UV fluorescent devices to estimate the projected exposed lifetime of six different types of geomembranes. They are HDPE, LLDPE, fPP, EPDM and PVC (N.A. and European). They are being incubated at 60, 70, and 80°C until half-life of strength and elongation are measured. The goal is lifetime prediction. Incubation times are now over 60,000 light hours (8.2 years) and several are not yet complete. They will probably take as long as 90,000 light hours (~ 12.3 years). The information up to this point in time was made available to the public on April 6, 2016 at the GenAmerica's Conference in Orlando, Florida. It has been republished in the International Geosynthetics Journal. A copy is available. It is now also being offered as a 90 min. webinar.

HDPE Geomembrane Lifetime as a Function of Thickness - This often-encountered question is being evaluated at elevated temperature exposure at in a QUV weathering device per ASTM D7238. Formulations are the same and only the sample thicknesses vary. These thicknesses are 2.76, 2.44, 1.58, 1.08, 0.77, and 0.48 mm. Parameters being evaluated in this decades long study are change in thickness and presence of crazing or cracking. The research will alter how we design landfill covers.

Laboratory Exposed Lifetime of PVC (European) Geomembranes - We have been evaluating five different European formulations for nine years using three dedicated UV-fluorescent devices and the results are very impressive. The study is being conducted for CARPI Tech, a GSI member organization. The project also allows us to distinguish between PVC geomembranes manufactured in North America versus Europe. The differences are in the type of plasticizers used in the formulations as well as thicknesses. The program will end this year but may be extended with new formulations.

2. GSI wall, pH and durability of PET GGs

pH Between Masonry Block Wall Units* - George Koerner has been measuring the pH between three types of masonry blocks for over eight years to monitor the values. Concern here is over PET geogrids which are known to be sensitive to very high alkalinity environments. Indeed, the values - 3 - started high, but over time they are now down to eight and lower. George has published a paper in this regard

3. Creep axisymmetric behavior of HDPE and LLDGE GM's

Slow Pressurization of HDPE Geomembranes in Multi-Axial Symmetric Testing* - The ASTM D5716 method of testing geomembranes in a 3-D multi-axial symmetric mode uses a pressure rate of 6.9 kPa/min (1.0 psi/min). While such a rate is appropriate for most geomembrane types, it is very fast for HDPE which is semi-crystalline and cannot readily stress relax so as to accommodate the applied pressure. To investigate slower rates, we have initiated a project with rates as low as 6.9 kPa/month (1.0 psi/month)! The last test, begun in 2017, is at a rate of 6.9 kPa/six months (1.0 psi/six months) and it will take an estimated five years to conclude. Recently, yield was observed in the deformed geomembrane but air pressure is still sustained. A preliminary paper was presented at Geosynthetics '15 in Portland.

4. Long term filtration tests

GSI has ongoing projects to investigate geotextile filters in various, transportation and geotechnical applications. Such experiments model migration of soil fines into aggregate base layers as well and filtering fluids from coal combustion residuals (CCRs) over time. Over the year we have used hundreds of ASTM D1987 permeameters to quantify the performance of

separation and filtration layers over time. We look for a response of piping, clogging or equilibrium with respect to design flows.

5. Leakage through holes in geomembranes

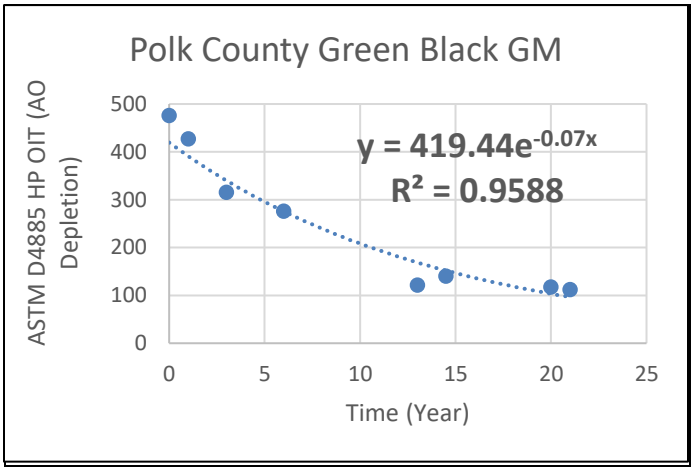
This work involves a large-scale test method intended to determine the leakage through imperfections in a geomembrane under a given hydrostatic or hydrostatic/soil pressure head. It can be used as a performance test to simulate field conditions where the geomembrane is physically breached. A geomembrane test specimen of approximately 0.5m diameter on a subgrade within a high-pressure test vessel. Upon adequate sealing of the geomembrane around the perimeter and closing of the upper portion of the vessel, a hydrostatic and/or soil pressure can be applied to the specimen by a control panel system attached to pressure vessel cell. The leakage through any imperfection in the geomembrane can be monitored at differential pressures by a flow measurement system attached to both the influent line (headwater above the geomembrane) and the effluent line (tailwater below the geomembrane). It is a commeasure device but versatile. One can even access leakage through geomembrane imperfections with wrinkles or folds.

The targeted hydrostatic pressure applied to the test specimen should simulate the equivalent of the design pressure, which will be applied to the geomembrane to determine if the design value can be sustained. A wide variety of subgrade conditions are capable of being assessed. For example, different soil conditions, different subgrade placement conditions, effect of sharp objects, effect of a geotextile protection layer, wrinkles, folds, waves, etc. are all possible options. Obviously, each of these field situations can have punctures, holes, tears or cracks in the geomembrane. Some of the more common scenarios will be addressed.

6. Multicomponent geomembranes & service life projection (Polk County)

The days when geomembranes were only constructed as one thick monolithic layer are gone. They currently can be made of different colors, conductivity, diffusion characteristics etc. Testing the performance of said multicomponent geomembranes are more involved than conventional materials. Geomembranes with layers need to be separated or the composite need to be challenged as a single unit after homogenization. GSI is actively testing the performance of such multicomponent geomembranes after oven or UV exposure. In addition, we are developing new fingerprinting tests for their analysis before and after exposure.

Regarding this effort, we have come across a site of opportunity in Polk County Landfill. Jones Edmunds group out of Florida asked us to collaborate with them on the evaluation of the exposed geomembrane cover (EGM) as it ages over time. The following graph gives you a taste of some of the data being generated from this site and the gems that are involved with this collaboration.



Exposed GM received from Polk Co. Landfill

7. GS survivability in ultra-light weight aggregate **(ULWA)**

Several large-scale laboratory tests were conducted on multi geosynthetic specimens to assess damage effects from ultra-light weight foamed glass aggregates versus ASSHTO #57 stone.
When geotextile or geogrid design strengths are needed for geosynthetics used in reinforcement applications, one needs to define the Long-Term Design Allowable strength, or LTDA. This value is utilized in design, and is arrived at by first determining the ultimate wide strip tensile strength (by either ASTM D4595 or D6637) and then reducing this value to an

allowable one by the applying partial factors of safety as in the following equation:

$$T_{all} = T_{ult}\left(\frac{1}{FS_{cr}} \times FS_{id} \times FS_{cd}\right)$$

where: T_{all} = long term design allowable load (lb./in. or lb./ft.)

T_{ult} = Ultimate wide strip tensile strength (lb./in. or lb./ft.)
FS_{cr} = Partial Factor of Safety for creep potential
FS_{id} = Partial Factor of Safety for installation damage
FS_{cd} = Partial Factor of Safety for degradation potential

In regard to the Partial Factor of Safety for installation damage, we have a very good handle on how reinforcement geosynthetics behave with conventional soil and aggregate. Installation damage FS_{id} is the loss of strength properties resulting from the act of installation. In some situations, where aggressive backfill and heavy equipment are used in construction, the resultant loss of strength can be significant. Cases have been reported where only 30% of the original strength properties remain after installation (AASHTO Task Force 27). Although this high loss level is unusual, it points out the need to address installation conditions.

It should be clearly pointed out that the range of FS_{id} = Partial Factor of Safety for installation damage is usually 1.1 to 1.6 for convention materials installed in AASHTO #57 stone with moderate ground pressure equipment. The design engineer can control several variables which impact installation survivability conditions. This includes the choice of backfill and installation equipment. Specifications requiring sand backfill will reduce the installation damage significantly. However, this option does reduce drainability and strength of the fill. Furthermore, light ground pressure equipment and greater lift thickness will reduce installation stresses. Unfortunately, neither is possible when a 90-95% requirement of Standard Proctor (ASTM D698) is desired for the fill.
Relatively new to the USA market are AeroAggregates. These Ultra-Lightweight Foamed Glass Aggregates are produced from 100% post-consumer recycled glass. The aggregates have a highly frictional surface that are combined with low unit weight, inertness, high permeability, and insulating properties. As such these foamed glass aggregates are ideal as lightweight backfill used in conjunction with geosynthetic reinforcing elements.

As you can see by the enclosed pictures, GSI conducted installation survivability tests with AeroAggregates' ultra-light-weight foam glass aggregate recently. Test specimens were cut from geotextile and geogrid samples exposed according to ASTM D5818 "Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics." The exposure and retrieval were conducted at AeroAggregates' plant in Eddystone, PA and then tested back at GSI.

The following test methods were performed on the retrieved and as received materials:

- ASTM D4595 Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
- ASTM D6637 Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method

Installation damage reduction factors were obtained for the following geosynthetics.

- Two NPNW Geotextiles of different mass/unit area
- Woven slit film Geotextile
- UX Geogrid punched and drawn
- BX Geogrid punched and drawn
- BX strap and welded Geogrid

Very favorable results were realized compared to AASHTO #57 stone. This can be attributed to the nature of the Ultra-Lightweight Foamed Glass Aggregate and the placement technique of the material. The manufacturer of UL-FGA recommends that one protects geosynthetics before, during, and after installation. UL-FGA should be placed in the following manner to assure this outcome.

- The area to be filled shall not have any standing water (including ice) in it prior to placement of the UL-FGA.

- Construction equipment, other than for placement and compaction, should avoid operating on the exposed UL-FGA. If construction sequencing necessitates trafficking on the UL-FGA layer, minimize construction traffic to the least extent possible.

- For compaction using tracked equipment, foamed glass aggregate shall be placed in uncompacted lift thicknesses of 24 inches and compaction shall be performed with a tracked excavator or dozer with ground pressures between 625 - 1,025 psf. Compaction using tracked equipment shall be completed by placing the initial lift thickness, and then raising the blade or bucket and tracking over the layer for a total of four (4) full passes. One (1) full

pass is defined as a minimum of 100% coverage of the tracks passing over the top of the lift.

- For areas not accessible by tracked equipment (e.g., around structures and utilities or within 4 feet of the MSE wall face) or to compact thinner lifts, foamed glass aggregate shall be placed in maximum uncompacted lifts of 12 inches and compacted with a plate compactor weighing between 110 and 220 lbs. Compaction shall be completed by making a minimum of four (4) full passes with the plate compactor.

AeroAggregates Eddystone Plant

Retrieving GS on Plater after Survivability Test

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UX GG looks in Good Shape

ASTM D6637 Testing at GSI

8. Wicking Geotextiles (capillary action)

GSI has developed a new test method used to determine the wicking capability within geosynthetics. The method is applicable to all geosynthetics and is used to determine a rate of capillary wicking. The method covers the measurement of liquid transport on a specimen of known cross section as it is exposed to Distilled Deionized Deaired (DDD) water at a known temperature and pressure. The rate of capillary wicking is a flow measurement which is the characterization of fluid flow in individual pore space conduits in the absence of hydraulic head. It is monitored by tracking the location of a moving wetting front meniscus as a function of time. Understanding liquid transport through nanoscale confinements of geosynthetic materials is critical in a variety of practical application, including energy conversion/storage, fluid transport, phase change thermal management, biological and chemical separations, and drainage of pore water pressure. This method can be applicable to hydrophobic or hydrophilic channels and experimentally measured by one of the following three methods:

- Observational
- LED camera and
- Measuring the changes in resistance

Given the limitations of any one or the measurement techniques, it might be necessary or useful to use different techniques for various geosynthetics.

9. Elevated temperatures on geomembranes

The USA Corps of Engineers approached us with an interesting challenge for a geomembrane. The question: Can you pave over it with hot mix asphalt and still have it functioning as a moisture barrier? Their plan was to use a TPO (PP) geomembrane and protect it with only a 1” thick fiber expansion insulation board. The field trial was as follows:

- Install a 10 oz/sy NW-NP geotextile over the existing subgrade near the asphalt.
- Install 30 mil TPO PP GM over the Geotextile
- Attach an array of five (5) thermocouples to the Geomembrane for evaluation of heat absorption and dissipation.
- Install the 1” thick fiber board (attached) over the GM/thermo-couples
- Pave a 4-inch lift of hot mix asphalt over the fiber board and compact it with a vibratory steel wheel roller.

Everyone present at the field trial was shocked at the results. The 300°F ready mix asphalt had little to no

effect on the geomembrane. During an hour, most of the heat dissipated upwards and left the geomembrane

in near pristine condition. By the end of the trial, we were experimenting with asphalt directly on the Geomembrane

10. Anchorage and connection strength of HP-TRMS

GSI is working on new anchorage and connection strength tests applicable to geosynthetics. This new test method has applicability to exposed geomembrane covers, closure turf, HP-TRMs, GCLs, Wind Defender, GCCM's etc. We now have two test rigs: (1. field anchor and 2. lab connections) at the institute and are experimenting with several products. We currently have seven (7) different anchor systems and five different geosynthetics being tested. As you can see from the photos below, we have both the field and lab testing systems up and operational. It is heavy work, but yielding very practical results that have direct field applicability which are needed for design with exposed geosynthetics.

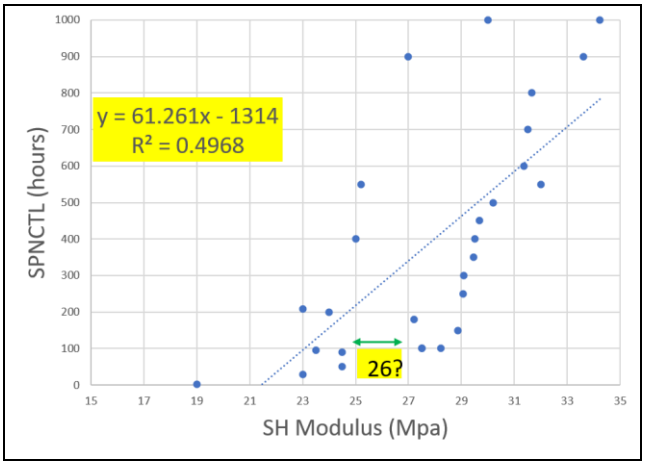
11. Stress cracking with respect to strain hardening Modulus & update to GRI GM13

Improved stress cracking resistance in high density polyethylene (HDPE) geomembranes has been a quest of our industry for many years. We have been working in this area since the mid 1980's. GRI GM13 standard specification for HDPE geomembranes has moved the stress crack requirement from 200 to 300 and finally to 500 hours over the last thirty years. It is interesting to note that some HDPE geomembrane formulations have a considerable higher value. (i.e. greater than 1,000 Hours). Igepal CO 630 is referenced in stress crack test methods as the reagent. Unfortunately, it has now been listed as a priority pollutant under the REACH directive and is no longer available for laboratory use in several countries. Obviously, our industry is searching for an equivalent surfactant. As such, GSI has been tasked with finding a replacement for the surfactant used in several stress cracking tests. We know that there are hundreds of commercially available surfactants to choose from. Unfortunately, all have unique characteristics that will affect stress cracking in HDPE differently. We are currently evaluating Solvey's Rhodasurf and Dow's Tergitol as alternatives to Igepal CA-630. Thank you, TRI, SAGEOS, Naue, Solmax, SKZ, Layfield and Agru for participating in the round robin the result to date appears in the following table. I= Igepal and T = Tergitol

GM	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 6	Lab 1	Lab 2	Lab 3	Lab 4	Lab 6
#		I	I	I	I	I	T	T	T	T	T
71	1	2	2	2	2	3	2	3	1	1	1
72	141	192	144	139	152	139	508	315	278	267	524
73	>800	>1000	>1000	-	>2130	>500	>800	>500	372	334	325
74	554	525	565	488	624	629	>800	267	400	>500	>500
75	>800	>1000	492	316	1856	470	>800	230			

In addition to changing the surfactant, we would also like to increase the bath temperature from 50 to 65 degrees Celsius so that we can shorten the test time. We have initiated a round robin test program with several geomembranes to verify equivalency.

Strain Harding Modulus It has been hypothesized that strain hardening modulus determined from ASTM D6693, dog bone tensile testing can be used as an alternative to ASTM D5397 SPNCTL testing for determining the stress crack resistance of HDPE geomembranes. Stress crack resistance of HDPE has always been a major consideration with material field performance. As HDPE formulations continue to improve, their SPNCTL result has increased past 1,000 hours. This long test time is difficult for quality control and for making business decision on a routine basis from SPC data. We are hoping Strain hardening behavior of HDPE geomembranes will be a good predictor of stress crack performance. We are testing ten materials from which we know both field and conventional (ASTM D5397) lab results. Strain hardening modulus determination has been used with success in the pipe industry. It is hoped that we will soon be writing a new test method for transferring this technology for evaluating the stress crack susceptibility of HDPE geomembranes. As you can see by the graphical result below, the relationship does not look promising to date. We look forward to collaborating with researchers at Queens University to see if we can improve this correlation.



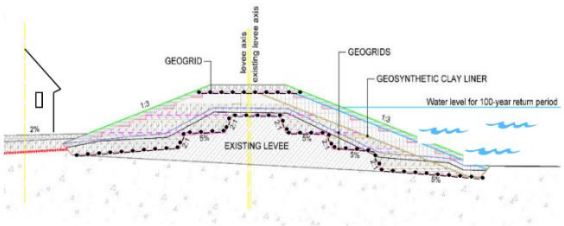
GRI GM13 standard specification for HDPE geomembranes continues to evolve. The geomembrane task group within GSI put forth the following suggestions for improvement of the standard.

- Change OIT criteria to minimum average values not “percent retained” values for both Standard and HP OIT.
- State that all OIT values should be generated from specimens taken from 10 mil plaqued samples made from homogenized material via a two-roll mill.
- Delete the “or” and change it to “and” in reference to three OIT durability criteria.
- Change the surfactant and increase the temperature for ASTM D5397 Appendix SPNCTL.
- Expose geomembrane sheet to ASTM D1204 conditions prior to specimen preparation in advance of ASTM D5397 testing to remove residual stress.
- Add a strain hardening modulus criteria to the specification.
- Add a rigorous (0, 30, 60, 90 & 120 days in bleach or caustic soda) liquid immersion durability challenge to the specification

After much discussion and development work none of these initiatives were promulgated into the specification.

12. Seepage induced by geosynthetic in fine grained soils

We have been asked if a geosynthetic reinforced levee, slope or embankment will induce a seepage path (adjacent to and around the geosynthetic layer(s)). As you can see by the graphic below, geosynthetics such as geogrids, high performance turf reinforcement mats and geotextiles are increasingly being used in this application to fortify such structures which are experiencing increased pressure from extreme weather events.



Location of Geogrid in Levee Heightening

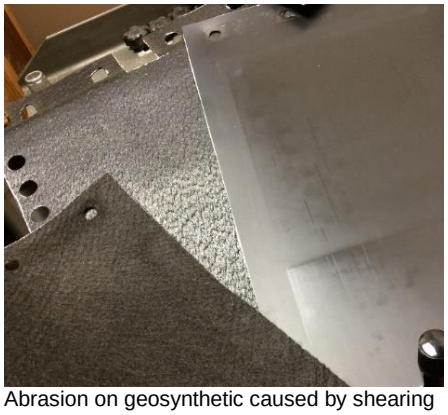
GSI is currently conducting multiple transmissivity tests to specifically challenge such scenarios and back up this laboratory testing with a handful of project case histories. Long term ASTM D4716 transmissivity tests and ASTM D5084 Flux tests are being conducted at the institute with a multitude of geosynthetic and different soils. We are running the experiment firstly with a silty clay with variable gradients normal pressures. We anticipate that this work will lead to standard test methods to quantify this phenomenon.

Dissecting FLUX specimen post test

Sample Preparation of Geogrid in Transmissivity Unit

13. High normal pressure direct shear

Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear has been standardized in ASTM D 5321. The method has seen fantastic international exposure and yields repeatable results that are readily used in the design of landfill liner side slopes. As waste containment systems have become large and higher, the normal pressures for these tests have increased to 2,000 kPa (300 psi) and greater. Running such a test presents challenges to laboratories regarding clamping(front), gripping (sides) and high friction (bottom) of the geosynthetic components to force the failure at the midplane of the apparatus during interface shear testing and not conducting a wide width tensile test where the geosynthetic specimens exit the box. We have been asked by Duke Energy to write guidance on such high normal pressure direct shear testing and work with the task group in ASTM D35 to implement it into the ASTM method.



Abrasion on geosynthetic caused by shearing

Skid marks on clay as a result of textured GM

14. Improved extrusion welding

It has often been discussed that fillet extrusion welds are the Achilles heel of any geomembrane liner project. This type of seam is labor intensive but a necessary evil on any project due to details like “T” seams, destructive seam test repairs, appurtenances, pipe boots etc. Knowing that you cannot always make fusion welds and in a quest to improve the state of the practice, AQUATAN of South Africa, has come up with an approach of rapidly quenching the fillet bead after it exists the gun with a cold damp cloth. They have been using this technique for decades. It is anticipated that this rapid cooling creates more amorphous rather than crystalline regions in the weld bead making the seam more ductile rather than brittle. In the Spring of 2021, AQUATAN approached GSI to see if GSI would be interested in testing fillet extrusion seams from a surface impoundment that they lined 30 years ago (with this quenching technique) and another contractor lined the adjacent surface impoundment 28 years ago with conventional fillet extrusion welding. The 30-year-old seams are still in good condition where the 28-year-old seams are in a deteriorated state. Questions are, is it the polymer from which the geomembrane is made different (one inferior to the other) or can this difference in performance be a result of the seaming methods.

In typical GSI fashion, we designed an experiment and started testing the two options in hopes of determining if quenching works, as you can see by the below table, we tested the following.

- ASTM D792 density results for good and bad extrusion seams
- ASTM D4218 CB Content results for good and bad extrusion seams It is very humbling to admit that
- ASTM D1238 MFI results for good and bad extrusion seams
- ASTM D3895 STD. OIT results prepared form cross sectioning of specimens every 2mm

Unfortunately, we were unable to paint a clear picture of improvement with the technique of quick quenching the extrudate seam just after it exits the gun. To us, this technique makes sense from both a practical and theoretical standpoint. Unfortunately, the analytical methods available at GSI’s fingerprinting lab are not sophisticated enough to pick up the phenomenon.

#	Sample ID	Density	CBC	MFI	STD. OIT
		(g/cc)	(%)	g/10 min.	(min)
1	2R1	0.953	2.51	0.026	54
2	6R5	0.951	2.49	0.028	50
3	4R3	0.958	2.35	0.042	20
4	1, 8-5 mm Top	0.952	2.50	0.039	24
5	1, 5-2 mm Top	0.953	2.64	0.041	26
6	1, 2-0 mm Top	0.956	2.51	0.049	29
10	1, Center seam	0.956	2.44	0.051	34
7	1, 0-2 mm Bottom	0.955	2.38	0.052	28
8	1, 2-5 mm Bottom	0.957	2.54	0.051	27
9	1, 5-8 mm Bottom	0.953	2.53	0.049	26
11	5, 8-5 mm Bottom	0.952	2.56	0.059	27
12	5, 5-2 mm Bottom	0.949	2.41	0.052	26

13	5, 2-0 mm Bottom	0.948	2.39	0.050	21
14	5, Center seam	0.951	2.51	0.046	31
15	5, 0-2 mm Top	0.952	2.53	0.044	30
16	5, 2-5 mm Top	0.950	2.62	0.049	32
17	5, 5-8 mm Top	0.949	2.71	0.052	29
18	3, 8-5 mm Bottom	0.952	2.53	0.041	24
19	3, 5-2 mm Bottom	0.952	2.27	0.046	23
20	3, 2-0 mm Bottom	0.951	2.51	0.047	20
21	3, Center seam	0.952	2.39	0.043	16
22	3, 0-2 mm Top	0.953	2.52	0.048	15
23	3, 2-5 mm Top	0.954	2.51	0.046	14
24	3, 5-8 mm Top	0.955	2.43	0.044	14

15. Concrete Canvas (GCCM) Testing per ASTM D8364

GCCMs contain geosynthetic and cementitious materials, both of which possess very different physical mechanical, hydraulic and durability properties. GCCMs are unlike most geosynthetics as their properties change on hydration from flexible to rigid. Both the uncured and cured properties need to be reported to understand the GCCM capabilities in both deployment and in-service conditions.

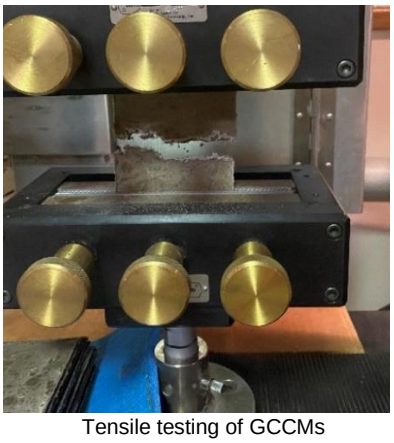
In March of 2021, ASTM International D35 Geosynthetics published ASTM D8364/D8364M-21: 'Standard Specification for Geosynthetic Cementitious Composite Mat (GCCM) Materials'. This was a leap forward for the technology and provides clearly defined instructions on properties and intention for use and performance of three classes of GCCM's.

GSI has a lot of experience with manufactures quality control specification. Upon implication of this new specification there are nuisances uncovered with it. We have been asked to kick the tires of this specification and refine it if possible. It is our intent to test several classes of GCCMs and find any loopholes in it from the perspective of continuous improvement.

Installation of GCCM as a canal lining

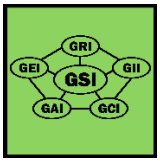
Close up photo of GCCM

Mass per Unit Area and thickness flexural testing



Tensile testing of GCCMs

Progress within GII (Information)



GSI has updated it's LinkedIn page… Check it out!

https://linkedin.com/company/geosynthetic-institute.org

Our GSI Home Page is accessed as follows:

www.geosynthetic-institute.org

Everyone (members and nonmembers) can access the open part, which has the following menu:

Newsletter
Prospectus
Specifications
White Papers
Bookstore
Keyword Search
Members Only
Research
Certification
Information
Education
Accreditation
Personnel
Contacts
Upcoming Webinars

To go further one needs a members-only password. Your contact person (names beneath member company) must obtain a password from Jamie Koerner. Jamie can be reached by e-mail at Jamie@geosynthetic-institute.org. When you get into this section, the following information is then available.

- **GRI Test Methods (all)**
- **GRI Reports**
- **GRI Technical Papers (419 Citations)**
- **Notes of GSI Meetings**
- **Links to the GSs World**
- **Keyword Search for Generic Papers**
- **Example Problems**
- **Frequently Asked Questions (FAQs)**

The Keywords Section contains about 35,000 citations which is the vast (~ 90%) majority of the geosynthetics literature published in English. It is updated as each published paper is received. Citation retrieval is quite easy provided that you have a specific topic, or area, in mind. This is the section of the website that we (and others we are told) use the most in our daily activities.

GRI Reports

To date, we have 48 GRI Reports available to members and associate members. These reports vary in length from 30 to 200 pages. They are in the password protected section of our home page at www.geosynthetic-institute.org/member/reports.html.

Progress within GEI (Education)

"GSI Fellowships for Graduate Students"

The Geosynthetic Board of Advisors (BOA) have reviewed the 2021-2022 proposals and the recipients for this year's GSI fellowships have been chosen. Our website has additional details such as research topics, advisor names and pictures (new this year) of all twenty (20) GSI fellowship recipients. This information can be found at:

www.geosynthetic-institute.org/gsifellows.htm

Twenty (20) students were selected for the 2021-2022 GSI Fellowship awards. Each recipient received a $5,000 fellowship. We were happy to see fellowship proposals from international universities once again this year. Overall, nine (9) fellowships (45%) were awarded to universities outside of the USA and eleven (11) were given to students attending universities located in the USA. The names of 2021-2022 GSI Fellowship recipients, along with their affiliated university is listed below:

Mahmoud Ali	Queens University, Canada
Florian Christ	Ruhr University, Germany
Po-Chung Chuang	NPUST, Taiwan
Mostafa Ebrahimi	Southern Illinois University Edwardsville, USA
Bahia El Rafai	Institute of tech. Sligo, Ireland
Sara Fayek	Missouri University of S&T, USA
Li He	University of Mass-Amherst, USA
Mian Huang	University of Victoria, Canada
Wei Huang	Rutgers University, USA
Jung Geun Hwang	Columbia University, USA
Hao Liu	University of Kansas, USA
Tavakoli Mehjhardi	RWTH Aachen University, Germany
Miyurudarshi Piyathilake	Colorado State University, USA
Hamid Rostami	Sothern Illinois University Edwardsville, USA
Pitak Ruttithivaphanich	University of South Carolina, USA
Matheus Cardoso Santos	Federal University of Sao Carlos, Brazil
Sankaranarayanan Subramanian	University of Texas at Austin, USA
Thandar Swe	Technische Hochschule Georg Agricola, Germany
Mohen Zafari	Queens University, Canada
Md. Wasif Zaman	University of Kansas, USA

Please contact Jamie if you have any questions about the fellowship program or would like additional information. Jamie@geosynthetic-institute.org

Robert and Mitchell Landreth "Steward of the Environment" Award

The Robert and Mitchell Landreth "Steward of the Environment" award has been established this year. It is in honor of Robert Landreth (1939-2021) and his wife Mitchell. The award is bestowed by the Geosynthetic Institute (GSI) in recognition of "distinguished engineering achievement" by a young faculty member, graduate student, or post doctorate working with Geosynthetics. Only one such award is given annually by GSI.

Robert E. Landreth rose to the rank of Captain in the US Department of Public Health. As the research director at the U. S. Environmental Protection Agency (EPA) he advocated for research funding which made it possible to spearhead efforts in geosynthetics during the 1980 and 90's. The pioneering research which transpired changed regulations and the way that waste is managed throughout the world. Landreth's guidance, determination and hard work are a testament to the very best of our nation's public servants. His critical leadership role at the US EPA changed the world for the better and he will not be forgotten.

This year's award recipient is Dr. Joseph Scalia IV. He is an Assistant Professor in the Civil and Environmental Engineering Department in the Walter Scott, Jr. College of Engineering at Colorado State University. Joe specializes in geoenvironmental and geotechnical engineering. His research and teaching centers on the convergences of soil mechanics with contaminant hydrology, geology, environmental engineering, hydrology, mechanical engineering, and hydraulics. Prior to joining CSU, Scalia was a Senior Associate at Exponent (formerly Failure Analysis Associates) in the Environmental and Earth Sciences Practice in Bellevue, Washington, and Natick, Massachusetts. Scalia received his BS in Civil and Environmental Engineering from Bucknell University, and his MS and PhD in Geological Engineering from the University of Wisconsin-Madison. Visit http://geosynthetic-insitute/gsilandreth.htm to learn more about the award and Dr. Joseph Scalia.

Robert and Mitchell Landreth

2021 Award Recipient Dr. Joseph Scalia IV

Testing Innovation Fellowship Program

We are pleased to announce the new fellowship program transitioning geosynthetics-related research to ASTM International standards. This new program is jointly supported by the Geosynthetic Institute (GSI), the North American chapter of the International Geosynthetic Society (IGS-NA), and ASTM's Committee D35 on Geosynthetics. Fellows are awarded $500 per year for up to a three-year period. Up to five fellows can be supported concurrently in any given year. This year, three recipients were awarded the Testing Innovation Fellowship. They are as follows:

Han Wang

MD Wasif Zama

Mahmoud Ali

Recipient - Han Wang
University of Illinois Urbana-Champaign

Ms. Wang is working on a test standard involving "Effectiveness of Geosynthetics in Aggregate Stabilization - Evaluation using Bender Element Sensor Technology". Her advisor is Dr. Erol Tutumluer.

Recipient - Md Wasif Zaman
University of Kansas

Mr. Zaman's topic for a test standard is "Measurement of Water Contact Angle on Geotextiles to Evaluate It's Wettability Using ASTM 7334". His advisor is Dr. Jie Han.

Recipient - Mahmoud Ali
Queens University

Mr. Ali has chosen "New Method to Predict HDPE Geomembrane ESCR Value" for his test method. His advisor is Dr. Kerry Rowe.

Our congratulations go out to all the Testing Innovation Fellowship Award winners!

New webinar schedule for 2022

GSI Webinars (90 minutes long)

11:30 AM – 1:00 PM (Eastern Time Zone)
Registration at
www.geosynthetic-institute.org/webinar.htm
1.5 Professional Development Hours

GSI Members Cost - $200
(unlimited number of attendees for GSI Members)
Nonmembers Cost - $250

Date	GSI No.	Title
1/12/2022	W5	Geosynthetics in Hydraulic Applications
2/09/2022	W6	Geosynthetics in Heap Leach Mining
3/16/2022	W7	Geosynthetics in Agriculture/Aquaculture
4/20/2022	W9	Behavior of 20 Landfill Failures
5/11/2022	W12	Landfill Covers: Past-Present-Emerging
6/08/2022	W14	Lifetime Predictions of Geosynthetics
7/20/2022	W17	Geosynthetics in Erosion Control
8/10/2022	W20	Geosynthetic Drainage Materials
9/07/2022	W26	Applications and Design of Geotextile Tubes
10/12/2022	W27	Stability Design of Landfill Cover Soils
11/09/2022	W29	QA/QC of Geosynthetics
12/07/2022	W34	Geosynthetics in Roadways

Webinar Wednesdays

GSI's mission statement begins with the goal to "develop and transfer knowledge". The primary way we accomplish this is through research, that leads to publishing papers, reports, standards and articles for industry journals. Courses and webinars are an integral part of promoting our mission statement. That said, the number of online Courses and especially webinars have grown in popularity over the past 1 ½ years due to limitations placed on holding in-person courses and conferences. The popularity of free webinars and the plethora of webinar topics available on Geosynthetics influenced our decision to scale back GSI Webinar Wednesdays from weekly to monthly. Below is the webinar recap for 2021 referencing the number of portals:

#	DATE	TITLE	# Portals
1	1/13/21	Durability and Aging of Geosynthetics	17
2	2/10/21	MSE Wall Inspection	14
3	3/2/21 - 3/4/21	(ASCE) Reinforced MSE Walls	54
4	3/10/21	Landfill Covers – Past, Present and Emerging	15
5	4/14/21	Geosynthetic Drainage Material	16
6	5/4/21	Geosynthetics in Roads & Transportation – Propex Mexico	25
7	5/12/21	Testing of Geosynthetics	14
8	6/9/21	Geosynthetics in Roadways	7
9	6/15/21	Geosynthetics Durability ACIGS	270
10	6/21/21	(IGS) CQA Uncertainty in GSI Testing	340
11	7/14/21	Geosynthetics in Hydraulic Applications	7
12	8/11/21	Geosynthetics in Heap Leach Mining	15
13	9/8/21	Lifetime Predictions of Geosynthetics	12
14	10/13/21	(ASCE) Embankments and slopes	35
15	10/27/21	IGS EGC and Anchored Geomembranes	100
16	11/10/21	Geotextile Filters	16
17	12/8/21	Coal Combustion Residuals	8
TOTAL			**969**

Courses

We have abandoned our in-house, one-day, courses (which have been given for the past 30-years) and are presently delivering two of them in six segments over three consecutive days, one each morning and then afternoon. They are the following:

1. Quality Assurance/Quality Control of Geosynthetic in Waste Containment Facilities (Recordings are available)

2. Construction Inspection of Mechanically Stabilized Earth (MSE) Walls, Berms and Slopes (Recordings are available)

The third and newest of GSI courses is an On-Line "Designing with Geosynthetics (DwG)" course. Please go to www.geosynthetic-institute.org/courses.htm and scroll down to Course #3. Here you will see the requisite details. The course itself is completely synchronized with the 6th Edition of the DwG textbook. It consists of 1540 slides with ~ 18 hours of voice over; about one minute for each slide.

Contact Jamie Koerner at jamie@geosynthetic-institute.org if you want information and details.

Activities within GAI (Accreditation)

The Geosynthetic Accreditation Institute's (GAI) current mission is focused on a Laboratory Accreditation Program (LAP) for geosynthetic test methods. George Koerner is in charge of the program. The GAI-LAP was developed for accrediting geosynthetic testing laboratories on a test-by-test basis. GAI-LAP suggests that laboratories use ISO 17025 as their quality system model. In addition, the program uses the GSI lab as the reference test lab and operates as an ISO 17011 enterprise. *It should be emphasized that our GSI lab does not conduct outside commercial testing.* It should also be made clear that GAI-LAP does not profess to offer ISO certification, nor does it "certify" laboratory results. GAI-LAP provides accreditation to laboratories showing compliance with equipment training and documentation for specific standard ASTM or ISO test methods. In addition, GAI-LAP verifies that an effective quality system exists at accredited laboratories by way of proficiency testing. There have been significant additions to the number of GAI-LAP tests. Presently, there are 263 GAI-LAP test methods available for accreditation. Please consult our home page for a current listing.
As of December 2021, the following laboratories are accredited by the GAI-LAP for the number of test methods listed in parenthesis. Contact personnel, telephone numbers and e-mails are also listed. **Three (3) new labs have been added during 2021 4th quarter (#109-111).**

1[A] - TRI/Environmental Inc. (155 tests)
Jarrett Nelson -- (512) 263-2101
jnelson@tri-env.com

3[A] - Golder Associates (43 tests)
Henry Mock -- (770) 492-8280
Henry_Mock@golder.com

4[C] - Geosynthetic Institute (108 tests)
George Koerner -- (610) 522-8440
gsigeokoerner@gmail.com

8[B] - Propex Operating Co., Ringgold (18 tests)
Todd Nichols -- 438-553-3757
todd.nichols@propexglobal.com

9[B] - Lumite (17 tests)
Rebecca Kurek -- (770) 869-1787
rkurek@lumiteco.com

13[A] - Precision Geosynthetic Labs (TRI Env.) (84 tests)
Chad Blackwell -- (714) 520-9631
cblackwell@tri-env.com

14[A] - Geotechnics (55 tests)
J. P. Kline -- (412) 823-7600
JPkline@geotechnics.net

20[A] - GeoTesting Express, MA (59 tests)
Barbara Sanchez-- (978) 635-0424
bsanchez@geotesting.com

22[B] - CETCO Hoffman Estates (11 tests)
Minerals Technologies Inc.
Barbara Gebka – (847) 851-1904
Barbara.gebka@mineralstech.com

24[B] - CETCO Lovell (12 tests)
Minerals Technologies Inc.
Stuart Yates -- (307) 548-6521
stuart.yates@mineralstech.com

25[B] - Ten Cate, Pendergrass (12 tests)
Darrell Scoggins -- (706) 693-2226
d.scoggins@tencategeo.com

26[B] - Agru America Inc. (24 tests)
Maria Coffey -- (843) 546-0600
mcoffey@AgruAmerica.com

29[e] - FITI Testing and Research Institute (79 tests)
Hang Won-Cho -- 82-2-3299-8071
hwcho@fitiglobal.com

31[D] - NYS Dept. of Transportation (7 tests)
Tom Burnett -- (518) 485-5707
tburnett@dot.ny.gov

34[B] - Solmax (GSE) - Houston, TX USA (28 tests)
Lana Hickman
Lhickman@solmax.com

38[C] - CTT Group SAGEOS (120 tests)
Oliver Vermeersch -- (450) 771-4608
overmeersch@gcttg.com

40[B] - Solmax (GSE) - Kingstree, SC USA (20 tests)
Thomas Harrelson -- (843) 382-4603
tharrelson@solmax.com

41[A] - SGI Testing Service, LLC (19 tests)
Zehong Yuan -- (770) 931-8222
ZYuan@sgilab.com

42[C] - NPUST (GSI-Taiwan) (71 tests)
Chiwan Wayne Hsieh -- 011-886-8-7740468
CWH@mail.npust.edu.tw

43[A] - Ardaman & Associates (22 tests)
George DeStefano -- (407) 855-3860
gdestafano@ardaman.com

44[B] - Berry Global Inc. (9 tests)
Julie Solarz -- (615) 847-7299
juliesolarz@berryglobal.com

45[B] - Ten Cate Geosynthetics Malaysia SDN Bhd. (29 tests)
Boon Kean Tan -- (603) 519 28576
BK.tan@tencategeo.com

46[B] - TAG Environmental Inc. (13 tests)
Ryan Ackerman -- (705) 725-1938
ryan_ackerman@tagenv.com

49[B] - Engepol Geossinteticos (16 tests)
Patricia Ferreira -- (55) 51 3303-3901
patricia@engepol.com

50[B] - ADS, Inc. Hamilton (7 tests)
Justin Elder -- (513) 896-2065
justin.elder@ads-pipe.com

51[B] - SOLMAX - Canada (21 tests)
Claude Cormier -- (450) 929-1234
ccormier@solmax.com

53[B] - Polytex Autofagasta (17 tests)
Mario Contreras Cardenas -- 011 55-288-3308
mcontreras@polytex.cl

55[B] - Atarfil Geomembranes (21 tests)
Gabriel Martin Sevilla -- 34 958 439 200
gmartin@atarfil.com

56[B] - Polytex Santiago (14 tests)
Luedy Utria Caicedo -- 011 56-2-677-1000
Lutria@polytex.cl

57[B] - Ten Cate Cornelia (22 tests)
Randy Johnson -- (706) 778-9794
r.johnson@tencategeo.com

58[B] - Propex Furnishing Solutions - Hazlehurst (10 tests)
Nicholas Miller -- (912) 375-6180
Nicholas.miller@propexglobal.com

59[B] - Firestone (9 Tests)
Janie Simpson -- (864) 439-5641
SimpsonJanie@firestonebp.com

60[B] - TDM Geosintéticos S.A**.** (20 tests)
Roberto Diaz -- 051-1-6300330
rdiaz@tdmgeosinteticos.com.pe

61[B] - Raven Industries (24 tests)
Clint Boerhave -- (605) 335-0288
Clint.Boerhave@ravenind.com

62[B] - SOLMAX - Selangor - Malaysia (18 tests)
Pei Ching Teoh -- (450) 929-1234
pcteoh@solmax.com

63[A] - TRI-SC Labs (12 tests)
Jay Sprague -- (864) 346-3107
Jesprague@tri-env.com

64[B] - Agru America (NV) (13 tests)
Ryan Steele -- (775) 835-8282
RSteele@AgruAmerica.com

65[C] - Bombay Textile Research Assoc. (BTRA) (23 tests)
Riyaz Shaikh (0) 022-25003651
btra@vsnl.com

66[B] - Rowad International Geosynthetics Co. Ltd (13 tests)
Saleh Al-Qubaisi -- +966-3-812-1360
A.alqubaisi@rowadplastic.com

68[B] - Shawmut Corporation (4 tests)
Stacy Chadwell -- (336) 229-5576
schadwell@shawmutcorporation.com

69[B] - Solmax (GSE) - Rayong - Thailand (16 tests)
Siriporn Chayaporenlert – 66-386-36758
siripornc@solmax.com

70[A] - RSA Geo Lab LLC (48 tests)
Rasheed Ahmed – (908) 964-0786
geolab13@yahoo.com

71[B] - Plasticos Agricolas y Geomembranas S.A.C. (24 tests)
Manuel Constantino Olivares Espinoza –
073-511814-511829
calidad@pqaperu.com

72[B] - Tensar Corp. GA 8 tests)
Lynn Cassidy-Potts (770) 968-3255
lcassidy@tensarcorp.com

73[B] - Gai Loi JSE (10 tests)
Paul Wong 84-650-362-5825
paul905677@gmail.com

74[B] - Agru America Inc. (9 tests)
Mark Lockliear - (843) 221-4121
mlockliear@agruamerica.com

75[B] - GeoMatrix S.A.S. (42 tests)
Javier Diaz Cipagauta (571) 424-9999
jdiaz@geomatrix.com.co

76[B] - Tehmco (Chile) (15 tests)
Rodrigo Campoy 56-22-580-2852
rcampoym41@gmail.com

78[B] - PQA Mexico (16 tests)
Cesar Agusto Arcila (669) 954-8202
directorcalidad@payg.mx

79[A] - TRI Geosynthetic Testing and Services (32 tests)
Chad Blackwell 86-512-6283-1396
c.blackwell@tri-env.com

80[B] - Texel Technical Materials (11 tests)
André Parent (418) 387-4801
andre.parent@lydall.com

81[B] - Solmax (GSE) - Rechlin - Germany (18 tests)
Evelyn Kroeger 49-40-767420
ekroeger@solmax.com

83[B] - Solmax Geosynthetics S.A.E. (13 tests)
Ahmed Abdel Tawab - 202-2-828-8888
atawab@solmax.com

84[B] - Owens Corning (14 tests)
Ashutosh Dixit - 1-778-945-2888
Ashutosh.dixit@owenscorning.com

85[B] - PAG Tacna (17 tests)
Manuel Constantino Olivares Espinoza –
073-511814-511829
calidad@pqaperu.com

86[B] - BOSTD China (29 tests)
Zheng Hong - 86-532-8780-6917
zhenghong@bostd.com

87[B] - Willacoochee Industrial (18 tests)
Miranda Adams - 912-534-5757
miranda@winfabusa.com

88[B] - Geosynthetic Testing Services Pvt. Ltd. (16 tests)
Ravi Kant - 02717-250019
rkant@gts-pl.com

89[B] - Megaplast India Pvt. Ltd. (13 tests)
Tatwadarsi Tripathy - 91-937404-4620
geo.sqc@megaplast.in

90[B] - Techfab (India) Industries Ltd. - Daman (10 tests)
Anant Kanoi - 91-22-2287-6224
anant@techfabindia.com
Anant Kandi - anant@techfabindia.com

91[B] - Techfab (India) Industries Ltd. - Rakholi (3 tests)
Rajendra Chavan - 91-982-593-9922
geogrid.qualitylab@techfabindia.com

92[B] - Techfab (India) Industries Ltd. - Khadoli (2 tests)
Navir Kumar - 91-22-229-76224
woven.qualitylab@techfabindia.com

93[B] - Garware Technical FIbres (21 tests)
Rajendra K. Ghadge - 0-932-601-8083
rghadge@garwarefibres.com

95[B] - Mexichem Colombia (Pavco) (8 tests)
Jenny Colmenares Chavez - 57-1-782-5100 (ext. 1534)
jjenny.colmenares@wavin.com

96[B] - Tensar China (8 tests)
Zhu Shaolian - 603-6148-3276
zsl@tensar.com.cn

97[A] - TUV SUD PSB Singapore (17 tests)
CHA Ming Yang - 65-6885-1514
ming-yang.CHA@tuv-sud.psb.sg

98[B] - NeoPlastic Filmes e Embalagens Plasticas Ltda. (7 tests)
Daniel Meucci - 55 (11) 4443-1000
daniel.meucci@sapphireoffice.com.br
Nathalia Santos
nathalia.santos@neoplastic.com.br

99[B] - Atarfil Middle East (16 tests)
Mohammad Hneine - 971-564-33-1271
mhneine@atarfil.com

100[B] - Atarfil Geomembranes USA (12 tests)
Alejandro Carreras - 757-263-4057
acarreras@atarfil.com

101[B] - Solmax (GSE) - Spearfish, SD USA (7 tests)
Chuck Taylor - 605-642-8531
ctaylor@solmax.com

102[B] - SKAPS Industries (11 tests)
Sadhi Arora - 706-336-7000
sadhi.Arora@skaps.com

103[B] - STRATA Geosystems Pvt. Ltd. (6 tests)
C. V. Kanade - 91-22-4063-5100
cv.kanade@strataindia.com

104[A] - Advanced Terra Testing (32 tests)
William Raush - 303-232-8308
wraush@terratesting.com

105 [B] - Pavco Wavin - Peru (6 tests)
Nestor Sifuentes Boggio - 51 990 277 136
nestor.sifuentes@wavin.com

106 [C] - Auburn University-Erosion & Sediment Control Testing Facility (1 test)
Michael Perez - 334-844-6267
Mike.perez@auburn.edu

107 [A] - TRI Australasia PTY LTD (38 tests)
Warren Hornsey - +617-5535 7227
Whornsey@tri-env.com.au

108 [B] - Solmax Geosynthetic Co. Ltd. Suzhou (13 tests)
Tony Xia - 86512-66667-6100
Txia@solmax.com

109 [B] - Hock Technology Co. Ltd. (13 tests)
Song Binghong - 186-7873-9722
Binghong.Song@sdhock.com

110 [C] - Geofabrics Australia Pty. Ltd. - GRID
Ryan Hackney - 61-42-781-0392
r.hackney@geofabrics.com.au

111 [B] - Huesker Inc. - Shelby
Jamie Honeycutt - 704-406-8308
jhoneycutt@huesker.com

[A]Third Party Independent [C]Institute
[B]Manufacturers QC [D]Government

If anyone desires more information on the GAI-LAP program, its test methods, the associated laboratories, etc., please go to our website www.geosynthetic-institute.org/gai/lab.htm or contact George Koerner.

Activities within GCI (Certification)

GSI presently has three separate inspector certification programs. One (begun in 2006) is focused on QA/QC of field inspection of waste containment geosynthetics and compacted clay liners. The second (begun in 2011) is focused on MSE Wall, Berm and Slope field inspection. The third on Geosynthetic Designer Certification began on September 1, 2016. See our website at www.geosynthetic-institute.org under "certification" for a description and information on all three of them. They are similar in that a perspective candidate must…

- Be recommended by a superior or professional engineer who knows, and can attest to, at least six months of acceptable experience performing professional services within the specific application area.
- Submit a completed application and be approved by the Geosynthetic Certification Institute to take the exam.
- Must successfully pass a written examination (70% of the questions is the passing grade) proctored by GCI or a GCI designated organization and graded by the Geosynthetic Certification Institute to become a certified inspector or engineer.
- Must pay a one-time fee which covers a five-year period upon completion of the above items. The fee is $500 for five-years of certification. It is renewable if so desired.

Program #1 - Inspection of Liner Systems for Waste Containment Facilities

This program, now in its sixteenth (16) year, has been recommended, and in some cases required, by solid waste owners, state regulators, and design consultants for proper QA/QC in field installation of both geosynthetic materials and compacted clay liners. The statistics to date are listed below. We would like to thank TRI Environmental Inc. for their significant contribution to the success of this certification program. Their promotional strategies and in-house QA/QC course have generated renewed interest in the program. Special thanks to Sam Allen, Jeffrey Kuhn, Abigail Beck and Mark Sieracke for teaching the course.

Inspector Certification Test Results
2006 – 2021

There are currently 523 practicing certified inspectors, 415 inspectors (2017-2021) and 108 inspectors (2006-2016) who have renewed to keep certification current. A recap of the Inspector Certification Program is below:

Year	Geosynthetic Materials		Compacted Clay Liners	
	No. of people taking exam	No. of people failing exam	No. of people taking exam	No. of people failing exam
2006	141	5 (3%)	128	12 (9%)
2007	82	11 (13%)	73	12 (16%)
2008	95	25 (26%)	89	20 (22%)
2009	36	7 (19%)	36	2 (5%)
2010	59	12 (20%)	54	7 (13%)
2011	54	6 (11%)	53	3 (6%)
2012	34	5 (15%)	28	3 (11%)
2013	32	4 (12%)	30	1 (3%)
2014	45	1 (3%)	42	3 (7%)
2015	56	6 (11%)	51	6 (12%)
2016	36	3 (10%)	35	5 (18%)
2017	78	5 (6%)	66	3 (4%)
2018	53	5 (10%)	51	1 (3%)
2019	114	20 (18%)	119	15(13%)
2020	100	14 (14%)	92	10 (11%)
2021	70	14(20%)	61	8 (13%)
Total	**1085**	**143 (13%)**	**1008**	**111 (11%)**

GSI has a pre-recorded "QA/QC of geosynthetics in waste containment facilities" course that can be purchased by anyone wanting to take the course online (accommodates your schedule) in preparation for the GCI-ICP certification exams. More information can be found at:

www.geosynthetic-institute.org/courses.htm

Please contact Jamie Koerner if you are in need of a proctor to administer the GCI-ICP exams or have any questions regarding the program.

jamie@geosynthetic-institute.org

Program #2 - Inspection of MSE Walls, Berms and Slopes

While a field inspector cannot require proper design or direct a contractor how to build a wall, flaws can be identified for possible design modification or mitigation action. Furthermore, and at minimum, construction practices can be observed and corrected if inadequate or improper.

The official launch of this inspection program was on December 1, 2011 with a course and the examination afterward. A somewhat revised course on November 29, 2012 was presented. Presently, the corresponding course for this certification program has been transferred into a series of six presentations over a consecutive three-day period. The live on-line course has not been scheduled, however, recordings are available. Contact Jamie Koerner at jamie@geosynthetic-institute.org for details and arrangements.

The status of the program is shown in the following table. Here it can be seen that this particular GSI certification has been less than anticipated even though we have 340 similar MSE wall failures. We only received one renewal during 2020 and have had no new inspectors. There are several factors that are impacting the MSE Wall Inspector Certification Program. The biggest impact is that there are other organizations who offer wall inspection services and have been doing so for many years. In addition, there are apps available for structural inspection of retaining walls. Lastly, the National Concrete Masonry Association provides inspection guidelines for retaining walls. All these factors are impacting the success of the MSE Wall Inspectors Certification Program.

Inspector Certification Test Results for
MSE Walls and Berms Inspectors
2011 – 2021

Year	Course Location	MSE Wall And Berms	
		No. of People Taking the Exam	No. of People Failing the Exam
2011	GSI Course	7	0
2012	GSI Course	6	0
2013	GSI Course	2	0
2014	GSI Course	3	0
2015	GSI Course	4	0
2016	GSI On-Line Course	2	2
2017-21	GSI On-Line Course	0	0
TOTAL		24	0

Program #3 - Geosynthetic Designer Certification

The "Geosynthetic Designer Certification Program (GDCP)" is also now available. Please go to www.geosynthetic-institute.org/gdcpintro.pdf for the requisite details. Included are introduction (rationale behind the program was given in a recent GSI Column called "We're Losing the Battle"), disclaimer, requirements, application, reference material, sample questions, proctor manual and proctor application. In the *requirements section* you will see that the applicant must;

- be a graduate of an accredited engineering program,
- have six-months geosynthetic designer experience,
- complete the application form,
- pay the $500 fee for 5-years certification, and
- take a 45-question examination with ≥ 70% passing.

The *examination* itself is subdivided into 15-sections, each consisting of five questions. A candidate must answer any 3 questions in each section, making a total of 45 questions to be answered. Most of the questions are numeric, as is geosynthetic design practice in general. Unlike our other certification examination questions, however, this examination is of an open-book, open-notes format and does require a calculator so as to "crunch the numbers".
Lastly, please spread-the-word within your organization and to others as well. We sincerely hope that one, or all three, of the above programs will be beneficial in upgrading the technical base of geosynthetic design and installation so as to properly utilize all of our geosynthetic materials in all of their many applications. All three programs are on-going and if you have questions and/or comments please contact us accordingly.

Jamie Koerner jamie@geosynthetic-institute.org

The GSI Affiliated Institutes

It has long been realized that the information generated within the GSI group should have a timely outlet to all countries, and in all languages. To this end, GSI has created affiliated institutes in three countries (Korea, Taiwan and India), and potentially others in the future. These affiliated institutes are full members of GSI and are empowered to translate and use all available information so as to create similar institutes and activities in their respective countries.

GSI-Korea was formed on February 9, 1998 as a collaborative effort between FITI Testing and Research Institute (a quasi-government organization) and INHA University (through its Geosynthetics Research Laboratory). It is presently held entirely within INHA University.

INHA University is located in Incheon and the geosynthetics laboratory is led by Professor Han-Yong Jeon. Dr. Jeon has 10-students working on geosynthetic-related projects and is extremely active both nationally and internationally. His active participation at conferences worldwide is very admirable. He has provided research and development in many geosynthetic subjects including geotextiles, geomembranes, geocells, additives for GCLs, recycled plastics for improved formulations, etc.

GSI-Taiwan was formed on August 18, 2000 and is wholly contained within the National Pingtung University of Science and Technology in Nei Pu, Pingtung (southern Taiwan). The Director is Dr. Chiwan Wayne Hsieh who is a Professor in the Department of Civil Engineering and Dean of the R & D Office. We inform you that the 7th Asian Regional Conference on Geosynthetics (GeoAsia7) & IGS First Young Engineers Conference will be held on October 31- November 4, 2022 at the Taipei International Conference Center (TICC), Taipei, Taiwan. GeoAsia7 is organized by the Chinese Taipei Chapter of the International Geosynthetics Society and Dr. Hsieh is Chairman of the GeoAsia7 Organizing Committee. Information about the conference can be found at http://www.geoasia7.org

GSI-India under the direction of Dr. T.V. Sreekumar was formed in 2015. The hosting organization is the Bombay Textile Research Association (BTRA) which is a premier textile research institute providing testing, research, training and consultancy services. BTRA is located in Mumbai, India and is accredited as per ISO 17025. The Geosynthetic test lab is also GAI-LAP accredited. Testing at BTRA is performed as per the latest EDANA, ASTM, INDA, AATCC, ISO, EN and AASHTO international standards. BTRA is known for its excellence in textile R & D and is currently branching out into all forms of geosynthetics with a fantastic R & D laboratory.

GSI Member Organizations

We sincerely thank all of our sponsoring organizations for their continued support. Without members, GSI could not exist. The current GSI member organizations and their contact members are listed below.

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In The Next Issue

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- Overview of GRI (Research) Projects
- Progress within GII (Information)
- Progress within GEI (Education)
- Activities within GAI (Accreditation)
- Activities within GCI (Certification)
- The GSI Affiliate Institutes
- GSI's Member Organizations