The GSI Newsletter/Report

Geosynthetic Institute

Vol. 35, No. 2 **June, 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)

We appreciate the time and effort that the GSI Board of Advisors spends each quarter to review and advise the Geosynthetic Institute on business matters. There input is valuable and greatly appreciated. Listed below, by term, are the current members of the BOA.

2021-2023 Board of Advisors

Term Ends 2021

- Burrill (Bo) McCoy - Waste Management Inc.
  (Owners and Operators)
  e-mail: bmccoy2@wm.com
- David Andrews – Propex
  (Geotextiles and Geogrids)
  e-mail: David.Andrews@propexglobal.com
- Sam Allen – TRI Environmental Inc.
  (At-Large)
  e-mail: Sallen@tri-env.com

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
  (Consultants and Testing Labs)
  email: tsoong@cticompanies.com
- Nathan Ivy
  (Geomembranes and GCL's)
  Nivy@agruamerica.com
- Mathieu Cornellier
  (International - 2)
  e-mail: mcornellier@solmax.com

GSI has been having virtual quarterly meetings with the Board of Advisors throughout 2021 via Zoom. The 2nd quarter meeting was held on Wednesday, June 30, 2021 with 5 members in attendance and minutes distributed via email.

In addition, an Annual meeting for GSI members will be in December. This annual meeting is open to all GSI members. The date for the annual 2021 meeting will be announced on December 15 at 11:00 am eastern time USA.

NEW 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) or Grace Hsuan (hsuanyg@drexel.edu) for details and/or discussions.

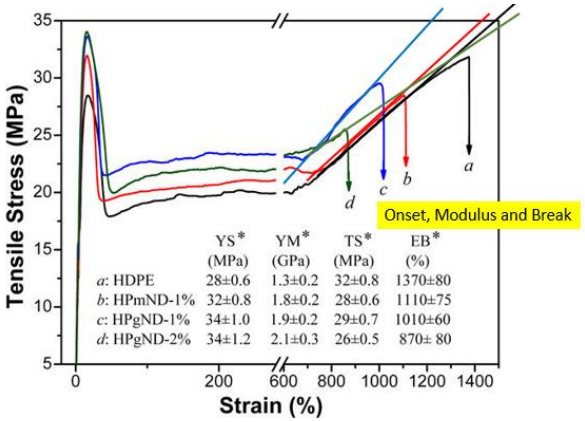
1. **Field Exposed Lifetime of Geogrids Used at the Facing of Landfill Berms** - The facing of mechanically stabilized earth landfill berms (and other walls and slopes as well) often uses a wrap-around configuration leaving the geogrid exposed to the atmosphere. A project being conducted by George Koerner 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.
2. **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 halflife 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 GeoAmericas 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.
3. **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 exactly 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. Time will tell!
4. **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.
5. **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 started high, but over time they are now down to eight and lower. George has published a paper in this regard.
6. **Slow Pressurization of HDPE Geomembranes in Axi-Symmetric Testing* - The** ASTM D5716 method of testing geomembranes in a 3-D axi-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.
7. **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)
8. **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.

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. If you would like to participate in this round robin effort or have an opinion about this work, we would greatly appreciate hearing from you.

9. 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.



10. Anchored Geosynthetics

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 goesynthetics.

11. The Quest for a better Extrusion Welding Technique

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
We tested the following;

1. ASTM D3895 STD. OIT results prepared form cross sectioning of specimens every 2mm
2. ASTM D3895 STD. OIT results prepared form removing only the skin of the specimens every 2mm
3. ASTM D792 density results for good and bad extrusion seams
4. ASTM D1238 MFI results for good and bad extrusion seams
5. ASTM D4218 CB Content results for good and bad extrusion seams

It is very humbling to admit that 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.

12. Wicking Geotextiles

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:

1. Observational
2. LED camera and
3. 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.

13. Heat Resistant 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?

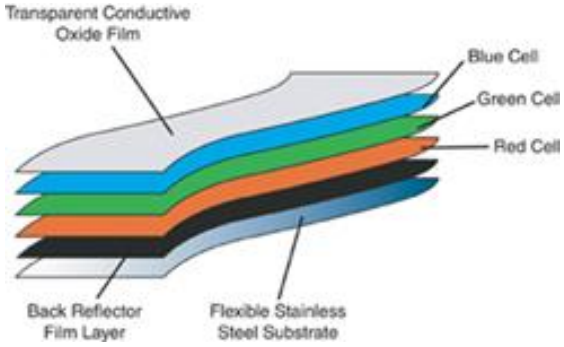
Their plan was to use a TPO (PP) geomembrane and protect it with only a 1" thick fiber expansion insulation board. The field trial was as follows:

1. Install a 10 oz/sy NW-NP geotextile over the existing subgrade near the asphalt.
2. Install 30 mil TPO PP GM over the Geotextile
3. Attach an array of five (5) thermocouples to the Geomembrane for evaluation of heat absorption and disapasion.
4. Install the 1" thick fiber board (attached) over the GM/thermo-couples
5. 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 affect on the geomembrane. In the course of about 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.

14. Durability of Multi Component Geomembranes

Gone are the days when geomembranes were only constructed as one thick monolithic layer. 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.



Progress within GII (Information)

GSI Website

Our GSI Home Page is accessed as follows:

www.geosynthetic-institute.org

In collaboration with the International Geosynthetics Society (IGS), Geosynthetica and Geosynthetic News Alerts (GNA), links to their websites are now on GSI's website. These links offer important news and information regarding the latest developments relating to geosynthetics. Check it out!

The website has been revised and is being maintained with the help of GSI staff. 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**
- **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)**

Worldwide Database of Guidelines/Regulations for Applications using Geosynthetic Barriers

This user-friendly database will provide quick access for anyone looking for worldwide geosynthetic barrier guidelines/regulations. On November 25, 2020 we started the database with 12 categories, although we know there are additional applications. The 12 categories are:

Landfills, Hydraulic Engineering, Mining, Coal Ash, Railways, Road Construction, Groundwater Protection, Soil Encapsulation, Waterproofing, Tank Farms, Storage Ponds and Storm Water Retention.

As of March 1, 2020, we have received input from 13 countries. They are: Austria, Australia, China, Europe, France, Germany, Netherlands, New Zealand, Norway, South Africa, Switzerland, United Kingdom and U.S.A. The total number of regulations that have been uploaded so far is 64.

To date, many countries are not represented in this database and our goal is to continue to expand both the

number of countries participating and the number of categories.

We are requesting your assistance in this endeavor. Because we need worldwide participation, we ask that you please forward this information to your international contacts so that we can include as many countries as possible. Your Information should be added onto the form under this link:

https://friedhelm-fischer.de/geosynthetics-used-as-barriers-worldwide-guidance/

Progress within GEI (Education)

Testing Innovation Fellowship Program

We are pleased to announce the launch of a new student fellowship program aimed at transitioning geosynthetic-related research to ASTM standards and increasing student engagement in our professional organizations. The fellowship program will be jointly supported by the Geosynthetic Institute (GSI), the North American Chapter of the International Geosynthetic Society (IGS), and ASTM International. This Testing Innovation Consortium will be giving awards of $500 per student. The intention is to support five (5) students annually. The ASTM D35 committee on geosynthetics task group will initiate and guide the students on their research and development of new standards.

"GSI Fellowships for Graduate Students"

Eleven (11) students were selected for the 2020-2021 GSI Fellowship awards. In the past 5 years of the fellowship awards, the number of new fellowships awarded has ranged from 9-18 ($45,000-$90,000). For this year's fellowships (2021-2022), we will be continuing the fellowship awards at $5000 per recipient. We are hoping to attract more and better proposals relating to geosynthetic research this year. More emphasis will be placed on International outreach as to attract worldwide participation in the fellowship program. GSI was disappointed last year to have no proposals from International Universities, especially because we know there is important research in the geotechnical fields underway. We intend to rectify this through advertising and reaching out to our International contacts.

Proposals for this year's fellowships are due to us by August 23, 2021 and recipients will be announced in September. More information, including past recipients (starting in 2008) can be found at https://geosynthetic-institute.org/gsifellows.htm.

Please contact Jamie if you have any questions about the fellowship program or would like additional information.

Jamie R. Koerner
Office Manager
jamie@geosynthetic-institute.org.

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 June 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.

- 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)
  Cora Queja -- (714) 520-9631
  cqueja@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 (13 tests)
Melissa Medlin -- (706) 693-2226
m.medlin@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 Geosynthetics, LLC - Houston, TX (28 tests)
Daniel Vasquez
Dvasquez@solmax.com

38[C] - CTT Group SAGEOS (120 tests)
Liette Courchesne -- (450) 771-4608
lcourchesne@gcttg.com

40[B] - Solmax Geosynthetics, LLC - Kingstree, SC (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)
Grant Murphy -- (615) 847-7299
grantmurphy@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 International Inc. - Canada (21 tests)
Claude Cormier -- (450) 929-1234
ccormier@solmax.com

53[B] - Polytex Autofagasta (18 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 (13 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)
Victoria Shoupe -- (912) 375-6180
Victoria.shoupe@PFSfabrics.com

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

60[B] - TDM Geosintéticos S.A**.** (19 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 Geosynthetics Sdn. Bhd. - Malaysia (16 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
btloffice@btraindia.com

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

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

69[B] - Solmax Geosynthetics Co., Ltd. - 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@pgaperu.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)
Ping Wang 86-512-6283-1396
Pwang@tri-env.com

80[B] - Texel Technical Materials (11 tests)
Eric Trudel (418) 387-4801
etrudel@lydall.com

81[B] - Solmax Geosynthetics GmbH - Germany (18 tests)
Evelin 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] - International Packaging Products (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@pgaperu.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 - 91-972-739-6658
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 (19 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)
jenny.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)
Gabriel Martin - 971-564-33-1271
gmartin@atarfil.com

100[B] - Atarfil Geomembranes USA (12 tests)
Gabriel Martin - 971-564-33-1271
gmartin@atarfil.com

101[B] - Solmax Geosynthetics LLC - Spearfish (7 tests)
Chuck Taylor - 605-642-8531
ctaylor@solmax.com

102[B] - SKAPS Industries (11 tests)
Sadhvi Arora 706-336-7000
sadhvi.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[B] - 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

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

Semi-Annual GAI-LAP Meeting

The semi-annual GAI-LAP meeting was held virtually via zoom just before ASTM D35 committee week on June 8th 2021. The meeting had 84 attendees during the live stream and the recording has been requested at least 35 times. The attendance of these virtual meetings is far eclipsing the in-person events. The discussion at the one-hour meeting started with a brief introduction and then the background of the GAI-LAP program was presented. The program started in 1995, making this our 26th year of operation with the program. We accredit only geosynthetic labs and model the program after ISO 17025. On-site audits are conducted every five years and proficiency tests are done every year, with a goal of the coefficient of variation less than five for each test conducted. The demographics of the current 87 GAI-LAP labs are as follows:

24 Independent labs
52 Manufacturer QC labs
5 Centers (Research and Government)
6 Proficiency test (PT) only labs

These labs are located in 24 different countries. Recently, there has been an increased interest in the program internationally, particularly from Australia. There are 263 possible tests for accreditation (204 ASTM and 57 ISO consensus standards). The number of accredited tests per lab varies greatly, ranging from 2 up to 144, with an average of 27.

Proficiency testing is still the hallmark of GAI-LAP where 6128 proficiency tests were conducted this year.

- 37 first submittal outliers (> +/- 2 std. dev.) which represents 0.7% of total tests.
- 26 different laboratories
- Results of proficiency tests are shard anonymously after all CARs are closed with root causes identified

Results of the proficiency tests were shared at the meeting and also distributed electronically via e-mail. Congratulations to the GAI-LAP members on a job well done.

The GAI-LAP program would not function without samples to test. We would like to thank the following organizations for their generous contribution of geosynthetics for laboratory testing:

AGRU, SOLMAX, Owens Corning, Propex, TenCate, Mineral Tech (CETCO), Huesker, ADS Maccaferri, Waste Management, AWD, GeoMatrix, Tensar, EPI and ACF.

As usual, we had a lively discussion at the GAI-LAP meeting regarding the conflict resolution (CR) cases addressed by the GAI-LAP during the past six months. Fourteen (14) of them are summarized below.

1. **ASTM D4595 - WWT of Geotextile**
   Modulus calculation is heavily dependent on preload. Section 10.4 of the method states that if you are not a manufacturer and do not know the UTS of the material, you need to run an extra precursor trail to determine it. This Matters! You will not be able to execute the toe correction without the proper preload.

2. **ASTM D6637 - WWT of Geogrid**
   Cutting the outer ribs on the multi rod specimen for procedure "B" is important. It is detailed in the method and shown in Figure 1 (below) clearly. Also, the gauge length and grip separation are not the same for some geogrids. This fact will influence strain (elongation) calculations.

3. **ASTM D5397 - NCTL Stress Crack**
   In a search to find alternative surfactants to IGEPAL CA-630, it has become apparent that different surfactants influence the stress cracking behavior of HDPE in different manners. Several countries are having difficulty obtaining IGEPAL CA-630. Unfortunately, a relationship has not yet been determined between alternative surfactants and failure times. GSI is actively engaged in this effort. It has also been determined that Igepal CA-630 ages and looses some potency over time.

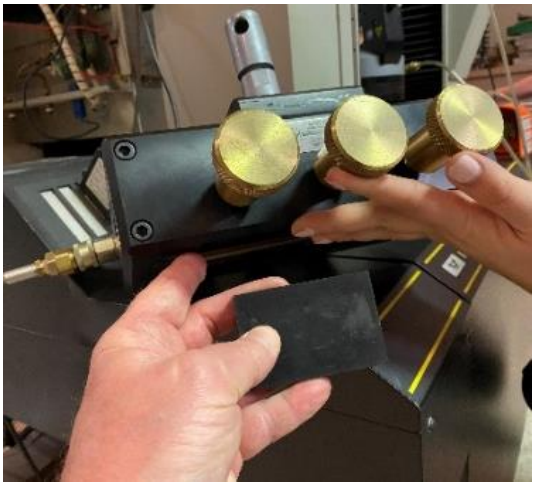
4. **ASTM D6364 - Compressive Behavior**
   For relatively week materials in compression, the suggested preload of 20 kpa (2.9 psi) may be too much. This is particularly the case for HP-TRM. Such materials are also sensitive to the nature of the platten surface, whether it is flat, polished or painted. All of these influence the test result regardless of the procedure A, B or C.

5. **ASTM D 5199 - Thickness of Geomembrane**
   There was quite an uproar about the definition of "smooth" geomembrane. To our knowledge, there is no ASTM nor ISO definition to define the difference between smooth and textured geomembranes. Geomembrane surfaces embody a complex series of peaks and troughs of varying heights, depths and spacing. To quantify surface roughness, one needs to know the vertical deviation of the "real" surface from its ideal form. If the deviations are great, the surface is rough, if they are small, the surface is smooth. Knowing the surface roughness is imperative in slope design. In the age of mirror, smooth matter, faille, and embossed surface finishes all considering themselves "smooth", customers are wondering when a geomembrane is considered "textured". We offered a suggestion of 10mil (0.25mm) per ASTM D5994 as a starting point for discussion. However, this suggestion did not resonate well with either party involved with the conflict resolution.

6. **ASTM D4533 - Trapezoidal Tear**
   A reoccurring debate involving the trapezoidal tear method has centered around the upper grip for the test. The method clearly states that the grips need to be parallel, flat and the faces 51mm by at least 76mm. The method does not state that the upper grip should or could have a universal joint or swivel. Use of a swivel results in the upper grip rotating

during the test as the tear propagates across the tested specimen.

If no universal is used, the tear strength results appear to trend lower. GAI-LAP recommends the use of a universal joint or swivel during the test and it should be noted on the report. It does affect the results.



7. ASTM D5321 - Direct Shear

An irate owner contacted GSI screaming that a GAI-LAP accredited lab produced a bad set of direct shear results for a fat clay (CH) against smooth HDPE. After reviewing the data, we found nothing wrong with the report. In short, the clay was unconsolidated and undrained (…fast at 1mm/min (0.04in/mm). It was also placed saturated and run at about 90% of standard proctor. I told the owner that they were lucky to get a peak friction angle of 8 and a residual of 6 degrees. This led to a discussion about the value of the Appendix 1 checklist, located in the standard, and the value of a post test photo of the interface.

8. ASTM D4218 - Carbon Black Content

In the age of multi component geomembranes (specifically black geomembrane with a white reflecting titanium dioxide surface), one cannot determine the carbon black content using a muffle furnace. One needs to separate the black and white layers from one another and conduct the determination on only the black layer.

9. ASTM D3895, 5885 and D8117 - OIT by DSE Testing

Fingerprinting of multicomponent geomembranes can be problematic. The make-up of any geosynthetic will be influenced by its formulation, manufacture, and fabrication. Gone are the days when a manufacturer or "converter" loads the hopper of an extruder with a base resin and a masterbatch (consisting of a carrier resin and an additive package) and extrudes a geomembrane.

Most materials are blends of several different compounds. In addition, there could be textured, special performance layers such as EVAL-EVOH vapor barrier inclusions, tie layers, different colors, reinforcement, conductive layers, etc. The purpose for the differing configurations or layers is to either enhance the properties, change the appearance, or increase benefit/cost. The possibilities are endless and the client has a large range of options.

With all this manufacturing advancement, the task of fingerprinting all types, particularly multilayered geomembranes, for conformance to specifications has become a challenge. One can no longer take a cross section of the material and perform a test and know that the result is repetitive of the material in question. Furthermore, when incubating the geomembrane in tests like stress cracking, UV exposure, or oven aging, there must be consideration for specimen orientation as well as knowing the side for exposure.

Prior to commissioning any testing of these multilayered geomembranes, there needs to be an open and frank discussion of what should be tested, how coupons are exposed, and how specimens should be prepared prior to testing. One needs to be clear that the homogenization and the plaquing process as a precursor to OIT testing. The technique chosen will significantly influence results. Also of note, ASTM D3895 and D8117 are similar, but not the same. The first is controlled by D20 and the latter by D35.

10. ASTM D4766 - Asperity Height

This conflict resolution was nasty… In short, an owner and a manufacturer were arguing over 1 mil (0.025 mm) on a spray applied textured HDPE geomembrane. What I think was going on is that the owner had never seen spray applied textured HDPE

and did not like it. He did not like the variability of asperity height or consistency across the roll width. In the end, the discussion centered around the search technique in section 9.4 of the test method and obtaining repetitive specimens from the roll. After much testing, the material was accepted.

This concept of effective contact area can be seen in the picture below:

11. ASTM D5891 - Fluid Loss of GCL infill

It was discovered that the nature of water used in this test matters significantly to the results. It was also noted that one needs to clean and "rinse" the apparatus between uses. One needs to use ASTM D1193 Type I, II or III distilled deionized water for this test in preparing the slurry for the filter press. It this high purity water is not used; ions may react with the clay and throw off the results. Soap residue can also adversely affect the test results.

12. ASTM D5323 - 2% Secant Modulus

One needs to determine the load of a ASTM D6693 Type IV dog bone shaped specimen at precisely 0.66mm of deflection for this test to determine the 2% Secant Modulus. There is some debate of the preload allowed on the skewer and if a toe correction should be used. GAI-LAP suggested that no artifact compression be allowed on the specified and that the actual thickness of each specimen be used in each calculation.

13. ASTM D4716 - Transmissivity

It comes as no surprise to anyone who runs this test that the test involves creep of the drainage cross section. This creep can come in the form of the following:

1) Tension creep of GT in intestacies of the GN
2) Compression creep of GN or spacer
3) Consolidation of soil above or below the GC

The standard method states that the "minimum" seating time may be more than 15 minutes if the load is not stable. For the particular cross section in question, the seating time needed to be extended to 30 minutes before equilibrium was reached.

14. ASTM D5818 - Radial Transmissivity

This one was a tricky situation. The calculations of normal pressure and gradient are both based on the drainage path testing for this method. Unfortunately, equipment for this test is not standardized and the lab did not factor in the effective drainage path length (L= 150-25mm) versus the radius of the platen (K=150). Once this was corrected, we were all in agreement.

The meeting concluded with open discussion, identification of the calendar of events and deliverables from GAI-LAP. The next GAI-LAP annual meeting will be held on Thursday, January 29, 2022 in conjunction with ASTM D-35 in Houston, Texas, USA. It is always a pleasure working with the GAI-LAP labs. They work hard and provide a valuable service to our industry. We appreciate their participation and urge them to contact us accordingly with questions and concerns. GSI takes pride in servicing the program to the best of our ability.

- George R. Koerner

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 Fifteenth (15) 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.

Throughout 2020-2021, TRI has hosted several virtual QA/QC in field installation courses, which have kept the program running throughout the COVID pandemic.

Special thanks to Sam Allen, Jeffrey Kuhn, Abigail Beck and Mark Sieracke for teaching the course.

Inspector Certification Test Results
2006 – 2021

Year	Geosynthetic Materials		Compacted Clay Liners		Commentary
	No. of people taking exam	No. of people failing exam	No. of people taking exam	No. of people failing exam	No. of people failing both exams
2006	141	5 (3%)	128	12 (9%)	2
2007	82	11 (13%)	73	12 (16%)	7
2008	95	25 (26%)	89	20 (22%)	13
2009	36	7 (19%)	36	2 (5%)	2
2010	59	12 (20%)	54	7 (13%)	5
2011	54	6 (11%)	53	3 (6%)	1
2012	34	5 (15%)	28	3 (11%)	3
2013	32	4 (12%)	30	1 (3%)	1
2014	45	1 (3%)	42	3 (7%)	0
2015	56	6 (11%)	51	6 (12%)	1
2016	36	3 (10%)	35	5 (18%)	0
2017	78	5 (6%)	66	3 (4%)	1
2018	53	5 (10%)	51	1 (3%)	0
2019	114	20 (18%)	119	15 (13%)	11
2020	100	14 (14%)	92	10 (11%)	7
2021	36	11 (32%)	29	5(17%)	5
TOTAL (to date)	1051	140 (13%)	976	108 (11%)	61 (5%)

There are currently 513 practicing certified inspectors, 417 inspectors (2016-2021) and 96 inspectors (2006-2015) who have renewed to keep certification current.

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.
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 for additional details:

jamie@geosynthetic-institute.org

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
2017-2021	GSI On-Line Course	0	0
TOTAL		24	0

Program #3 - Geosynthetic Designer Certification

The "Geosynthetic Designer Certification Program (GDCP)" is also available. Please go to www.geosynthetic-institute.org/gdcpintro.pdf for the requisite details.

Included on the website is an introduction (rationale behind the program was given in a 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 meet the following:

- 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 Dr. Hsieh was recently elected President of the Chinese Geosynthetics Association. Our congratulations for this achievement. In addition, we joyfully inform you that the 7th Asian Regional Conference on Geosynthetics (GeoAsia7) will be held on November 22-26, 2021 at the Taipei International Conference Center (TICC), Taipei, Taiwan. The main theme of GeoAsia7 is **Hazard's Risk Management, Innovation, and Sustainability**. GeoAsia7 is organized by the Chinese Taipei Chapter of the International Geosynthetics Society. Dr. Hsieh is Chairman of the GeoAsia7 Organizing Committee. He invites you to participate in the event. Please visit the conference website (http://www.geoasia7.org/) for more details.

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). It completely parallels GSI in that it has specific units for research, education, information, accreditation and certification. The Director is Dr. Chiwan Wayne Hsieh who is a Professor in the Department of Civil Engineering and Dean of the R & D Office. GSI-Taiwan has a Taiwanese consortium of geogrid/geotextile manufacturers who work toward producing quality products according to the draft GRI geogrid specifications and the associated test methods. As such, GSI-Taiwan is a GAI-LAP accredited laboratory for 59 geosynthetic test methods. Dr. Hsieh has 10 students working on geosynthetic-related projects and is extremely active nationally and internationally.

GSI-India was formed in 2015 under the direction of Dr. A.K. Mukhopadhyay, who retired in 2020. Under the current leadership of the director, Dr. T.V. Sreekumar, GSI-India provides a much-needed service to the geosynthetic industry in India. The hosting organization is the Bombay Textile Research Association (BTRA), and is world known for its excellence in textile R & D. It 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. GSI welcomes its newest member, Concrete Canvas Ltd. Concrete Canvas was incorporated in 2005 and had its start by developing the Shelter concept, then in 2015 they launched CC Hydro. We are pleased to have them as a member. The current GSI member organizations and their contact members are listed below:

U.S. Environmental Protection Agency
David A. Carson [BOA]
Federal Highway Administration
Silas Nichols/Daniel Alzamora
Golder Associates Inc.
Frank Adams/Paul Whitty/Linda Grover
Tensar International Corporation
Mark H. Wayne/Joseph Cavanaugh/Doug Brown
TenCate Geosynthetics
John Henderson/John Lostumbo/Chris Lawson
CETCO
Dave Chiet/Michael Donovan/Jim Olsta
Huesker, Inc.
Flavio Montez/Andreas Elsing/Lilma Schimmel
NAUE GmbH & Co. KG
Kent von Maubeuge [BOA]
Propex Operating Company LLC
Drew Loizeaux/David Andrews [BOA]
Berry Global Inc.
Keith Misukanis
TRI/Environmental Inc.
Sam R. Allen [BOA] /C. Joel Sprague
U. S. Army Corps of Engineers
Kevin Pavlik/Richard DePasquale
Chevron Phillips Chemical Co.
Ashish Sukhadia/Vergil Rhodes [BOA]
Solmax Géosynthétiques
Jacques Cote/Simon Gilbert St-Pierre/Catrin Tarnowski
Jimmy Youngblood/Matthieu Cornellier [BOA]
CARPI, Inc.
Alberto M. Scuero/John A. Wilkes
Civil & Environmental Consultants, Inc.
Tony Eith
Agru America, Inc.
Nathan Ivy [BOA] /Markus Haager
INHA (GSI-Korea)
H.-Y. Jeon
Waste Management Inc.
Greg Cekander/Burrill (Bo) McCoy [BOA]
NPUST (GSI-Taiwan)
Chiwan Wayne Hsieh
GeoComp/GeoTesting Express
W. Allen Marr/Gary T. Torosian
ATARFIL
Emilio Carreras Torres/Tamara Jurado Corrasco
Republic Services Inc.
Joe Benco/ Mike Beaudoin/Dave Vladic
InterGEO Services Co.
Şükrü Akçay/Archie Filshill
Raven Industries, Inc.
Clint Boerhave/Stacy Coffin/Greg Anderson
CTI and Associates, Inc.
Te-Yang Soong [BOA] /Kevin Foye
Advanced Earth Sciences, Inc.
Kris Khilnani/Suji Somasundaram
Carlisle Syntec, Inc.
Paul Markel/Brinda Mehta
EPI, The Liner Co.
Daniel S. Rohe/Paul Livingston
Weaver Consultants Group, Inc.
Mark Sieracke? Jeff Blum
Aquatan (Pty) Ltd.
Piet Meyer/ Sanet van der Merwe
Jones Edmunds, Inc.
George Reinhart/Tobin McKnight
Afitex-Texel
Pascal Saunier/Stephan Fourmont/Jocelyne Grenier
EVAL Americas (Kuraray)
Edgar Chow
BTRA (GSI-India)
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Maccaferri
Moreno Scotto /Sachin Mandavkar
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Riva Nortje
Ardaman & Assoc.
Mohamad Al-Hawaree/Thomas S. Ingra/Deborah Scott
American Wick Drain
Scott Morris/Craig Phelps/Seth Marlow
INOVA Geosynthetics/AERO Aggregates
Archie Filshill/Theresa Loux
Owens Corning Science & Technology LLC
Steve Thaxton/Clive Mills/Jason Woodall
SKAPS Industries
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Virginia Department of Environmental Quality
Donald Brunson
Massachusetts Department of Environmental Protection
Tom Adamczyk
Dept. of Water Affairs of South Africa
Kelvin Legge
Pennsylvania Department of Transportation
Beverly Miller

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- Activities within GAI (Accreditation)
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- The GSI Affiliate Institutes
- GSI's Member Organizations