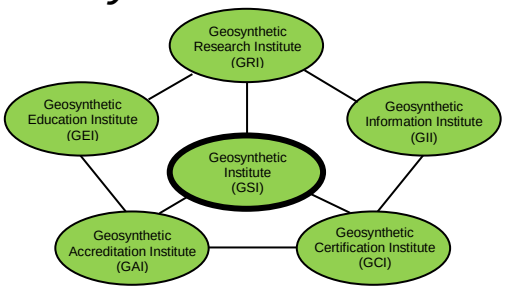
The GSI Newsletter/Report

Geosynthetic Institute



Vol. 33, No. 1 **March, 2019**

This quarterly newsletter, now in its 33rd 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 Marilyn Ashley at phone (610) 522-8440; fax (610) 522-8441 or e-mail at gsigeokoerner@gmail.com or mvashley@verizon.net.

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

1. GSI's Annual Meeting followed by its Board of Advisors (BOA) Meeting were held in Houston, Texas during the Geosynthetics '19 Conference. Both were well attended and our appreciation is extended to all. A writeup of the annual meeting is contained herein in the GII section and the presented slides are on our website as well.
2. Dr. Mark Wayne of Tensar International was awarded a plaque in appreciation of his six-year service to the BOA. It was acknowledged by all.
3. The annual GeoMEast Conference will be again in Cairo, Egypt on November 10-14, 2019. This ever-growing event will contain the 3rd Koerner Lecture presented by Chiado (Yuli) Doulala-Rigby, Chief Civil Engineer of Tensar International… for details see www.geomeast.org.
4. Dr. Barry Christopher is presenting his Koerner Honorary Lecture on behalf of GMA at a number of conferences this year and next.
5. Jamie Koerner (Special Projects Manager) has surveyed the 50 U.S. State Departments of Transportation focusing on Highway Pavement Design Methods currently in use. The results are published as White Paper #40.
6. The GSI Board of Advisors for 2919-2021 is as follows:

Term Ends 2019

- Kent von Maubeuge - NAUE GmbH & Co. KG (International-1)
  e-mail: kvmaubeuge@naue.com
- A. K. Mukhopadhyay – BTRA & GSI-India (Agencies)
  e-mail: btra@vsnl.com/btradirector@gmail.com
- Ashish Sukhadia – Chevron Phillips (Resin and Additives)
  e-mail: sukhaam@cpchem.com

Term Ends 2020

- Tony Eith - CEC Consultants, Inc. (Consultants and Testing Labs)
  e-mail: teith@cecinc.com
- Jimmy Youngblood - GSE Environmental (Geomembranes and GCL's)
  e-mail: jyoungblood@gseworld.com
- Moreno Scotto - Maccaferri (International - 2)
  e-mail: moreno.scotto@gmail.com

IN THIS ISSUE

Term Ends 2021

- John Workman - Waste Management Inc.
  (Owners and Operators)
  e-mail: jworkman@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

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) or Bob Koerner (rmk27@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 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.). 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 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 being offered as a 90 min. webinar.
3. **HDPE Geomembrane Lifetime as a Function of Thickness** - This often-encountered question is being evaluated by exposure at 80°C 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.
5. **Cable Tied Geonet Evaluations** - A study has just been completed on plastic cable ties used to connect the overlapped ends and edges of geonets and geospacers. The new GRI Test Standard is available www.geosynthetic-institute.org/member/gn/gn3.pdf as well as the technical paper which was published at the IGS Conference in Seoul, Korea in September, 2018.
6. **Retaining Wall Failure Evaluations* -** We have past GRI Reports 38, 39, and 40 addressing mechanical stabilized earth (MSE) walls using geosynthetic reinforcement which document 82-failures. Our data base has grown to 141, then 171, then 320 and now 340! *Readers, we have a very serious situation in this regard!* The failures are either excessive deformation or actual collapses. We have presented one-day courses on this topic along with inspector training and development insofar as a field inspectors certification program; see the certification section of this Newsletter/Report. An updated paper on 320 case histories has just been published in the Journal of Geotextiles and Geomembranes. Lastly, an ongoing GSI webinar is also available.
7. **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.
8. **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. A preliminary paper was presented at Geosynthetics '15 in Portland.

9. **PVD Strengthening of Soft Foundation Soils*** - A recent project, conducted over the past summer, addresses the use of PVDs for drainage (as customary) plus tensile reinforcement (never recognized to date). An experimental device was developed and used to assess three different PVDs. This data was then used with the ReSSA soil stability code on an old foundation soil failure that did not have PVDs. The FS-values increased 4% and could go higher with closer spacing or stronger PVDs. A journal paper is available.
10. **Geotextile Intrusion into Geonet and Geospacer Drainage Cores -** A series of in-plane flow tests on geonet drainage composites has resulted in the flow rate results for the geonet by itself, the geocomposite with different weights of needle-punched nonwoven geotextiles, and composites with a heat-bonded nonwoven geotextile. The decrease in flow rates of the composites are large when testing boundaries use rubber surfaces. Since this simulates in-situ soil conditions it is significant. A paper has been accepted by the Geotechnical Testing Journal of ASTM. It also includes a generic specification and is available.
11. **Seams of Reinforced Geomembranes** - There are now five scrim reinforced geomembranes available and the properties are listed in our GRI Specifications. To compliment these sheet products a set of shear and peel tests are have been evaluated. A new specification designated GRI-GM19(b) has been developed… GRI-GM19(a) is presently solely for homogeneous geomembranes. A review of the GRI-GM30 specification is underway and it will be modified to reflect new manufacturing of scrim reinforced coated polyethylene geomembranes (≥ 0.75 mm, or 30 mils)/barriers (< 75 mm, or 30 mils).
12. **Generic Specifications** - A major continuing effort is ongoing with respect to the development and updating of GRI's generic geosynthetic specifications. The current status of these specifications is as follows. Incidentally, all 18 are currently presently copyrighted.

Completed and Available on our Website
GM13 – HDPE Geomembranes
GM17 – LLDPE Geomembranes
GM18 – fPP and fPP-R Geomembranes
GM19a – Geomembrane Seams-Homogeneous
GM19b – Geomembrane Seams-Fabric Reinforced
GM21 – EPDM and EPDM-R Geomembranes
GM22 – Scrim Reinforced PE Barriers
GM25 – LLDPE-R Geomembranes
GM28 – CSPE-R Geomembranes
GM30 – Coated Tape PE Barriers (under revision)
GCL3 – Geosynthetic Clay Liners
GS15 – Geocells using HDPE Strips
GT10 – Geotextile Tubes
GT12 (a and b) – Geotextile Cushions
GT13 (a and b) – Geotextile Separators
GN4 – Geonets and Geonet Composites
GC14 – Turf Reinforcement Mats
GC16 – Prefabricated Vertical Drains
GS19 – Geospacers and Geospacer Composites

Working; Available Upon Request
GGXX – Bidirectional Geogrids (tabled)
GGXX – Unidirectional Geogrids (tabled)

The complete set of formalized specifications are available to everyone (members and nonmembers) on the open section of our Home Page. Please download and use them accordingly. There is also a brief tutorial accompanying each specification. Also note that this is where the latest modification will always be available. They are updated/modified on an as-required basis. Lastly, test methods of our most used specifications (HDPE, GCL, etc.) are also described on You Tube.

13. **Guides and Practices** - GSI also develops standard guides and practices and these are also available free on our website. There are 12 guides and 6 practices. They are modified on a regular basis and the latest version is updated regularly.
14. **Test Methods** - Since 1987 when we published our first test method on geogrid junction strength until the present, we have developed 72 test methods which are still current.

10 - geotextile	6 - GCL
5 - geogrid	15 - geocomposite
2 - geonet	12 - geosynthetics
22 - geomembrane	

Additionally, 31 have been co-opted by ASTM and we have depreciated our version. Incidentally, our test methods are for members only and are in the password protected portion of our website. We are delighted to report that ASTM has given the David Suits Award to GSI for our cooperation in sharing these GRI standards. We will continue to distribute our test methods in this manner, but specifications, guides and practices are available free as mentioned previously.

15. **Other GRI Standards** - There are several GRI Standards in various forms of preparation. These include the following:
    - A practice on field seaming inspection emphasizing the electrical leak location system (ELLS).

- Three standards on GCL joining so as to prevent/monitor panel separation.
- A practice explaining the use of MARV for geotextiles
- A transverse rib bending test for homogeneous geogrids
- Several field installation guides are being developed in cooperation with geosynthetic installer personnel

Progress within GII (Information)

Our GSI Home Page is accessed as follows:

<<http://www.geosynthetic-institute.org>>

It has been revised and is being maintained through the fine efforts of Marilyn Ashley. Everyone (members and nonmembers) can access the open part, which has the following menu:

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

To go further one needs a members-only password. Your contact person (see the last section of this Newsletter/Report if you do not know who it is) must obtain a password from Marilyn Ashley. Marilyn can be reached by e-mail at mvashley@verizon.net. 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)**

The Keywords Section contains about 35,000 citations which is the 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.

Important Note: This keyword search is now available to everyone. It is on the open section of our website, however, there is a charge to non-GSI members, (www.geosynthetic-institute.org/keywordpay.html). The duplicate information is in the password protected section and is free for GSI members.

In addition to the information provided in our home page as just mentioned, Jamie Koerner (Special Projects Manager) performs various surveys on pertinent topics in geosynthetics. The latest surveys by Jamie Koerner were on the status of geosynthetic use by U.S. State Departments of Transportation, (White Paper #39) and on their pavement design methods (White Paper #40). Also, if you have topics in need of the current status via a survey please advise accordingly.

Geosynthetics '19 Conference Activities

Over four hundred geotechnical professionals came together to write, peer review, publish and present the latest research and case studies on geosynthetics in Houston, Texas on February ninth through the thirteenth. There was nearly a thousand people attending the event as a whole from around the world. This was an opportunity to be part of one of the industry's hallmark events and have some fun Texas-style. The conference was supported by IFAI and IGS North America under auspices of IGS. As you can see by the following list, GSI was heavily involved with this conference;

1. Paper: "Veneer Instability of a Frozen Geomembrane-to-Geotextile Interface" by Maxwell R. Koerner, George R. Koerner and Robert M. Koerner
2. Paper: "Geomembrane Bubble Management at a Dredged Spoil Disposal Impoundment" by George R. Koerner and Robert M. Koerner
3. Panelist: Session on ply adhesion, Chaired by Rick Thiel of RT LLC
4. Panelist: GS Specifications, Chaired by Jennifer Nicks of FHWA
5. Panelist: Session on Environmental Containment System Design Service Life and Risk Factors, Chaired by Chris Richgels of AGRU America
6. Convener: GSI Annual and BOA meetings February 12th, 2019
7. Attendee: Biannual Robert Koerner lecture sponsored by GMA given by Dr. Barry Christopher of BC LLC.
8. Attendee: Meeting of Associations at Geosynthetics 2019 representing GSI
9. Attendee: Meeting of Geosynthetics Magazine advisors
10. Participant: GeoGAMES never new geosynthetic could be so much fun! Thanks Chris Quirk and Kent von Maubeuge for the support.

Recap of GSI Annual Meeting

Dr. Mark Wayne, Ph.D., P.E., of the **Tensar International Corp** received an award of appreciation

for his six years of service on GSI's Board of Advisors. This award is given to an individual who distinguish themself in the geosynthetic field with service on GSI's BOA. We greatly appreciate Mark's help and guidance on internal matters at the institute over the past years. We admire his positive attitude and continued support of our efforts to advance the industry; see photo below.

Mark Wayne and Geo K.

Before the annual meeting we were visited by a true geosynthetic legend, Fred Struve (formerly with Gundle/GSE/Solmax) stopped in and had us all smiling with fond memories and antidotes about geosynthetic's past. Fred is a rock star of the industry and has mentored many of us through the travails of manufacturing and fabrication of geosynthetic from polymers. He has the innate talent of knowing the limits of materials and machines. It was fantastic to see him before the meeting and I think many in the room didn't want the meeting to start so that we could just sit about and chat. We thank Fred for stopping by and making our day. As you can see by the picture below, he looks great and is as sharp as ever.

Connie Wong (Solmax GSE Houston) Mauricio Ossa (Solmax GSE Houston from GSE Chile) Ed Zimmel (Skaps) Catrin Tarnowski (Solmax GSE Germany) Vergil Rhodes (CP Chem) Fred Struve Geosynthetic's Mentor (formerly Gundle GSE) and Rick Thiel of RT LLC

Dr. Barry Christopher accepted the honor of being a Robert M. Koerner Award winner and lecturer from GMA in Houston. He delivered the second lecture in the series on "Lessons learned with Geosynthetics over the last 40 years." He will repeat his lecture at ASCE's GeoCongress in Philadelphia at the end of March; see photo below.

Fred Chuck (Huesker and GMA President) Barry Christopher and Geo K.

Progress within GEI (Education)

GRI Reports

To date, we have 46 GRI Reports available to members and associate members. These reports vary in length from 30 to 200 pages. They are on the password protected section of our home page at www.geosynthetic-institute.org/member/reports.html. Most of them are also available in hard copy. Our most recent report is:

- #46 - Utilizing PVDs to Provide Shear Strength to Saturated Fine-Grained Foundation Soils

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
Nonmembers Cost - $250;
GSI and GMA Member Cost - $200

Commentary on Webinars: Never in Bob K's long career has he "reached out" to so many people than when giving these webinars. For the single cost of $250 or $200 a feed is delivered over Adobe Connect to the requested site. This can be transmitted anywhere, e.g., office, conference room, hotel room, auditorium or even sent to additional offices and sites. For example, NY-DEC had the feed going into their Albany auditorium and then into the 13-regions of New York State. Clearly, hundreds of participants were involved! *Dear readers we feel that on-line distance learning, aka, webinars, is the way to communicate information to masses of people in an inexpensive and time efficient manner. Indeed, the future of distance learning is here!* The 2019 schedule of GSI Webinars (19 of them) is as follows:

Date	GSI No.	Title
January 10	W-18	Pond Liner Design and Performance
January 24	W-20	Geosynthetic Drainage Materials: Applications, Design, Installation and Performance
February 6	W-1	A Data Base and Analysis of 320 Failed MSE Walls With Geosynthetic Reinforcement
February 20	W-2	MSE Wall Back Drainage Design
March 6	W-3	MSE Wall Remediation and Monitoring
March 20	W-4	MSE Wall Inspection
April 10	W-23	Geosynthetic Filters: Concerns and Issues
April 24	W-5	Geosynthetics in Hydraulic Applications
May 8	W-9	Behavior and Analysis of Twenty Solid Waste (Landfill) Failures
May 22	W-14	Lifetime Predictions of Covered and Exposed Geosynthetics
June 12	W-26	Applications and Design of Geotextile Tubes
July 17	W-17	Geosynthetics in Erosion Control
August 14	W-16	Sand Drains-to-Wick Drains-to-Sand-Columns (Including a Major Failure Case History)
September 11	W-21	A Brief Overview of Geosynthetics and Their Major Applications
October 9	W-15	In-Situ Stabilization of Soil Slopes Using Nailed (or Anchored) Geosynthetics
October 23	W-27	Stability Design of Landfill Cover Soils
November 13	W-24	Disposal of Coal Combustion Residuals
November 27	W-25	Soil Consolidation by Wick Drains, aka PVDs
December 11	W-22	Geosynthetic Reinforced MSE Walls; Overview, Failures and Items for Improvement

Courses

We are now abandoning our in-house, one-day, courses (which have been given for the past 30-years) and 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
   (scheduled for June 4-5-6, 2019 and December 3-4-5, 2019)
2. Construction Inspection of Mechanically Stabilized Earth (MSE) Walls, Berms and Slopes
   (currently not scheduled)

The third and newest of GSI courses is an On-Line "Designing With Geosynthetics (DwG)" course. Please go to http://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 jrkoerner@verizon.net if you want information and details.

GSI Fellowships

GSI, with the guidance of the its Board of Advisors, has made their fellowship award selections for the 2018-'19 academic year. The program recognizes and supports outstanding students from around the world studying geosynthetics. The GSI fellowship program for this year continues to include candidates pursuing a master's degree, as well as a doctoral degree. The amount awarded to each fellowship recipient is $5000. The fourteen recipients for the 2018-'19 GSI Fellowship awards are as follows:

	Recipient	University	Advisor	Topic
1-18	Alsharabaili, Alaa	U. of South Carolina	Charles Pierce	Strain hardening method to evaluate the crack resistance of virgin and aged geomembranes
2-18	Faterna, Nuzhath	Syracuse U.	Shobha Bhatia	Role of geotextiles in dewatering tests
3-18	Goudarzi, Anahita	Texas A&M	Jean-Louis Briaud	Experimental and numerical simulation of geosynthetic reinforcement soil interaction
4-18	Hanumasagar, Sangy	Georgia Tech	David Frost	Experimental and numerical evaluation of lateral confinement of aggregates in geogrid stabilized flexible pavements
5-18	McCafferty, Conor	Drexel U.	Grace Hsuan	Numerical modeling to simulate dewatering process of GT tubes filled with fine-grained slurries
6-18	Norris, Anna	Colorado State U.	Joseph Scalia	Indicator parameter test development for screening the hydraulic compatibility of enhanced bentonites
7-18	Rahmaninezhad, Seyed	U. of Kansas	Jie Han	Bearing capacity and deformation of GS walls with flexible facing subjected to footing loads
8-18	Ryoo, Sung	U. of Maryland	Ahmet Aydilek	Hydraulic compatibility of GT compost systems in landfill covers
9-18	Sheikh, Bahman	Penn State	Tong Qiu	Breakwater design guidelines for GT tube applications
10-18	Thabo, Mosta	National Pingtung U.	Wayne Hsieh	Effects of grass and rolled erosion control products at different growth stages on the Manning's coefficient in channel flow
11-18	Ullah, Saad	George Mason U.	Burak Tanyu	Experimental methodology to evaluate long-term performance of GT to minimize the migration of soft clay into highway base courses
12-18	Wang, Dongfang	U. of Mass Amherst	Guoping Zhang	Improvement of GCLs with super hydrophobic hybrid organic-inorganic polymeric powder
13-18	Wright, Jason	U. of Georgia	Sonny Kim	Utilization of accelerated pavement layers due to use of GS materials
14-18	Xia, Xiaolong	Missouri U.	Xiong Zhang	Photogrammetric method to measure 3D full field displacement of GS during the tensile test

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 252 GAI-LAP test methods available for accreditation. Please consult our home page for a current listing.

As of June, 2018, 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 (17 tests)
Todd Nichols -- 438-553-3757
todd.nichols@propexglobal.com

9[B] - Lumite (16 tests)
Rebecca Kurek -- (770) 869-1187
rkurek@lumiteco.com

13[A] - Precision Geosynthetic Labs (TRI Env.) (87 tests)
Cora Queja -- (714) 520-9631
cqueja@tri-env.com

14[A] - Geotechnics (50 tests)
J. P. Kline -- (412) 823-7600
JPkline@geotechnics.net

20[A] - GeoTesting Express, MA (60 tests)
Gary Torosian -- (978) 635-0424
gtt@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 (10 tests)
Minerals Technologies Inc.
Stuart Yates -- (307) 548-6521
stuart.yates@mineralstech.com

25[B] - Ten Cate, Pendergrass (13 tests)
Darrell Scoggins -- (706) 693-2226
d.scoggins@tencategeo.com

26[B] - Agru America Inc. (27 tests)
Maria Coffey -- (843) 546-0600
mcoffey@AgruAmerica.com

29[e] - FITI Testing and Research Institute (80 tests)
Dong Whan Kim -- 82-2-3299-8071
dwKim@fitiglobal.com

31[D] - NYS Dept. of Transportation (9 tests)
Tom Burnett -- (518) 485-5707
tburnett@dot.ny.gov

34[B] - Solmax/GSE - Houston (29 tests)
Lana Hickman
Lhickman@solmax.com

38[C] - CTT Group (123 tests)
Eric Blond -- (450) 771-4608
eblond@GCTTG.com

40[B] - Solmax GSE (14 tests)
Thomas Harrelson -- (843) 382-4603
tharrelson@gseworld.com

41[A] - SGI Testing Service, LLC (18 tests)
Zehong Yuan -- (770) 931-8222
ZYuan@sgilab.com

42[C] - NPUST (GSI-Taiwan) (70 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] - Fiberweb, a Berry Global Inc. Co. (9 tests)
Devin Clem -- (615) 847-7299
devinclem@berryglobal.com

45[B] - Ten Cate Geosynthetics Malaysia SDN Bhd. (24 tests)
Boon Kean Tan -- (603) 519 28576
BK.tan@tencase.com

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

49[B] - Engepol Geossinteticos (15 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 GSE (22 tests)
Claude Cormier -- (450) 929-1234
ccormier@solmax.com

53[B] - Polytex Autofagasta (19 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)
Melissa Medlin -- (706) 778-9794
m.medlin@tencategeo.com

58[B] - Propex Operating Co.Hazelhurst (10 tests)
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59[B] - Firestone (8 Tests)
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60[B] - TDM Geosintéticos S.A. (17 tests)
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61[B] - Raven Industries (18 tests)
Clint Boerhave -- (605) 335-0288
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62[B] - Solmax GSE (14 tests)
Pei Ching Teoh -- (450) 929-1234
pcteoh@solmax.com

63[A] - TRI-SE Labs (4 tests)

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64[B] - Agru America (NV) (14 tests)
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65[C] - Bombay Textile Research Assoc. (BTRA) (23 tests)
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66[B] - Rowad International Geosynthetics Co. Ltd (13 tests)
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68[B] - Glen Raven Technical Fabrics LLC (4 tests)
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69[B] - GSE Lining Technology Co. (13 tests)
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70[A] - RSA Geo Lab LLC (47 tests)
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71[B] - Plasticos Agricolas y Geomembranas S.A.C. (24 tests)
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72[B] - Tensar Corp. GA (4 tests)
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73[B] - Gai Loi JSE (10 tests)
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74[B] - Agru America Inc. (9 tests)
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mlockliear@agruamerica.com

75[B] - GeoMatrix S.A.S. (29 tests)
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76[B] - Tehmco (Chile) (15 tests)
Rodrigo Campoy 56-22-580-2852
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78[B] - PQA Mexico (15 tests)
Cesar Agusto Arcila (669) 954-8202
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79[A] - TRI Geosynthetic Testing and Services (32 tests)
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81[B] - Solmax GSE (18 tests)
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ekroeger@solmax.com

83[B] - Solmax GSE (13 tests)
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84[B] - Owens Corning (14 tests)
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85[B] - PAG Tacna (15 tests)
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86[B] - BOSTD China (29 tests)
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87[B] - Willacoochee Industrial (19 tests)
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88[B] - Geosynthetic Testing Services Pvt. Ltd. (16 tests)
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89[B] - Megaplast India Pvt. Ltd. (13 tests)
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90[B] - Techfab (India) Industries Ltd. - Daman (10 tests)
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92[B] - Techfab (India) Industries Ltd. - Khadoli (2 tests)
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93[B] - Garware Technical FIbres (18 tests)
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94[B] - Al Hoty Stanger Laboratory (2 tests)
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95[B] - Mexichem Colombia (Pavco) (8 tests)
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96[B] - Tensar China (6 tests)
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97[A] - TUV SUD PSB Singapore (16 tests)
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[A]Third Party Independent [C]Institute
[B]Manufacturers QC [D]Government

If anyone desires more information on the GAI-LAP, its test methods, the associated laboratories, etc., a directory is published in December of each year. It is available on GSI's home page at http://www.geosynthetic-institute.org/gai/intro.pdf.

The Geosynthetic Institutes (GSI) Proficiency Testing Program (PTP) is a statistical quality assurance mechanism that enables laboratories to evaluate and improve performance, as well as maintain and fulfill mandatory accreditation requirements. GSI PTP started in 1995. It is modeled after the requirements of ISO/IEC 17043 "Conformity assessment -- General requirements for proficiency testing." The program is conducted only on geosynthetic tests and generally follows on the following schedule;

- January 30th, proficiency samples sent out to labs
- April 15th, proficiency results due
- April 30th, calculation of database due date
- May 1st, invoices out. The fee for this service is $1,500 USD plus shipping and handling of the samples. It should be noted that the fee is the same regardless of the number of tests requested.
- May 15th, retest due with CAR and route cause identification, if necessary
- June 30th, database is shared anonymously with all participants

This program is typically conducted in conjunction with the GAI-LAP. However, the GSI-PTP can be administered independently and is gaining popularity in Europe as a stand-alone program. Over two hundred test methods are covered under the program. A "List of

Proficiency Test Methods" in the GSI PTP can be found on the previously referenced website.

George R. Koerner
Director

Semi-Annual GAI-LAP Meeting

The semi-annual GAI-LAP meeting was held in Houston, Texas in conjunction with ASTM D35 on Thursday, January 31st at the Hyatt Hotel. As you can see by the picture below the meeting was very well attended with twenty-two people in the room. The meeting was held at 8:00 AM in the morning before the ASTM Task Group meetings began. We should point out that a virtual repeat meeting was also held as a webinar on Thursday, February 7th and seventeen open portals were observed. In addition, four groups requested the webcast recording. We are grateful that ASTM allowed us the venue in Houston. I also want to thank all that attended for their time, interest and interaction. This is by far the largest audience to be involved with a GAI-LAP meeting. We are grateful for the participation and hope it stirs a robust conversation about geosynthetic laboratory quality.

BACK ROW: Boyd Ramsey (BR Inc.), Melisa Medlin (TenCate), Nelay Patel (SKAPS), Joel Sprague (TRI), Marshall Sossman (Propex), Rebecca Kurek (Lumite), Vergil Rhodes (CP Chem), Gary Torosian (GTX GeoComp), Ryan Collins (Halliburton) and Eli Cuelho (TRI)
FRONT ROW: Nathan Ivy (AGRU), Mauricio Ossa (Solmax-GSE), Clint Boerhave (Raven), Sam Allen (TRI), Joseph Newkirk (Raven), Jarrett Nelson (TRI), Bill Kennedy (TAG Environmental) and Rich Lacey (TRI-Environmental)
Not Pictured: Katerina Koperna (ASTM D-35 Staff Manager), Zehong Yuan (SGI Testing Services) and George Koerner (GSI)

The discussion at the one-hour meeting was as follows. A brief introduction and background of the GAI-LAP program was discussed. Please note that we are in our 24th year of operations. The program started in 1995. We accredit only geosynthetic labs and model the program after ISO 17025. On-site audits are conducted every five years and proficiency tests every year with a goal of the coefficient of variation less than five for each test conducted. The demographics of the current GAI-LAP labs are summarized as follows: 28 independent labs, 54 manufacturer QC labs and 6 centers (research or government) for 88 total. Forty-six of these labs are GSI members and 39 are international labs from 21 different countries. It appears that this program is getting traction internationally. There are 257 possible tests for accreditation (199 ASTM and 58 ISO consensus standards). The number of accredited tests per lab varies greatly; e.g., 2 min., 27 average 144 max. There has been a rapid rise of new test methods. New tests added appear to be outside the ASTM D35 arena. The international arm of testing is very strong. We particularly see this in South America, Europe, the Middle East and Asia.

Proficiency testing is still the hallmark of GAI-LAP. Of the 4405 proficiency test results submitted this year, only 37 first submittals were outliers representing 0.8% of the total. All outliers were resolved. Results of the proficiency tests were shared at the meeting and also distributed electronic via e-mail and CD. Congratulations to the GAI-LAP members on a job well done. Several other certification and accreditation programs around the world are now requiring proficiency test data per ISO 17025. All GAI-LAP labs easily comply with this requirement. The GAI-LAP proficiency test program would not function without samples to test. In this regard, we would like to thank the following organizations for their generous contribution of geosynthetics to this cause.

- Propex Inc. for geotextiles and erosion control material
- Solmax-GSE for PE geomembranes
- EPI for PVC geomembranes
- Tensar for geogrids
- CETCO for GCLs
- ADS Inc. for plastic pipe
- AWD for geocomposites
- AWD for geocomposites
- ACF Inc. for a bunch of GeoStuff year after year (we appreciated your continued friendship and generosity)

It should be clearly stated that GSI's Proficiency testing program (PTP) started in 1995. It is modeled after the requirements of ISO/IEC 17043:2010 "Conformity assessment -- General requirements for proficiency testing." The PTP is a statistical quality assurance mechanism that enable laboratories to evaluate and improve performance, and maintain and fulfill mandatory accreditation requirements. The program is conducted only on geosynthetic tests and can be initiated annually on a schedule that follows that of the GAI-LAP. Note that one can participate in the PTP without obtaining GAI-LAP accreditation.

The GAI-LAP Customer Survey was again sent out to all program participants and the findings were reviewed at the meeting via a 34% return; this is pretty good due to Jamie's pestering. The following are the results (5 best to 1 poorest); (a) Information exchange = 4.5; (b) Conflict resolution = 4.1; (c) Proficiency testing = 4.6; (d) Directory and internet = 4.4; Overall = 4.5 which, as you can see by the tabulation below, is the best result we

have ever received; we must be doing something right! Overall results to date: 2017 (4.2), 2016 (4.2), 2015 (4.3), 2014 (4.2), 2013 (4.2), 2012 (4.1), 2011 (4.1) 2010 (4.3), 2009 (4.4), 2008 (4.4), 2007 (3.9), 2006 (4.0), 2005 (4.0), 2004 (4.1), 2003 (4.1), 2002 (4.2). A total of eleven on-site audits were conducted in 2017. We would like to thank TRI Environmental for their assistance with six audits.

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

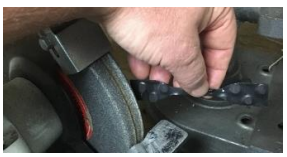
1. **ASTM D4632, sampling light NPNW GTs.** Unfortunately, very few test methods in ASTM or ISO have a sampling protocol. If they do, it is very general and states that one should remove the outer 150 mm (6") selvage edge and then evenly spaced the specimens across the remaining roll width in the machine and cross machine directions. When dealing with light weight NPNW geotextiles, there may be sections of the roll width sample that are nearly absent of fibers. These scantly covered locations can't be the target of conformance sampling for specimens. To remove this sampling bias, GAI-LAP recommends the use of cutting dies and a clicker press. In short, the roll width sample can be accordion folded and then cut randomly with a die and press.

2. **ASTM D4632 Grab tensile grip faces.** When dealing with the grab tensile test the grip faces of the clamps matter. Section 6.2 of the method gives some general description of the "clamps." However, the big three items when testing are, grips cannot initiate failure, grips should minimize slippage and one needs to have failure in gauge length. With this said, an owner was very surprised to hear that rubber grip faces were being used by some manufactures when evaluating grab tensile strength. They even stated that this was "cheating the specification." GAI-LAP humbly disagrees. Grip faces are regularly optimized in all types of testing. Grip faces, can be smooth steel, fine serrated, course serrated, rubber faced, tongue and grove etc. This is by no mean cheating and has been used regularly in the geosynthetic testing business since the inception of the standard.

3. **ASTM D638 vs D882 for PVC tensile testing.** This conflict was discussed in great detail at the last meeting six month ago. Again, the issue arose and again GAI-LAP feels strongly that PVC geomembrane should be tested with a dog bone tensile type specimen instead of a strip tensile specimen. The rational for this is that the stress distribution at the grip interface is difficult to overcome even with proper padding for a strip tensile type specimen. We realize that ASTM D882 is grandfathered into many PVC specification. However, this would be an improvement to the current state of the practice.

4. **When dealing with plans and specifications**, it is at times necessary to consider non-ideal conditions. One sometimes considers that plans and specifications may not be practically achievable and that real-world situations often require some compromise. This CR dealt with hot hydraulic oil regularly contacting fresh geomembrane from a leaking gearbox during manufacture. The conflict was between the owner and the manufacturer. The two parties involve wanted to know if regular marks in the geomembrane were blemishes (a small mark or flaw which spoils the appearance of the sheet) or defects (a shortcoming or imperfection which results in the material not meeting specification values). This CR was difficult to resolve. It required testing that showed that several physical, mechanical and endurance properties had been compromised by the oil leak.

5. **ASTM D6693 Tensile testing geomembranes with large protrusions.** There are geomembranes that have protrusions that are four to five times the thickness of the parent material (i.e. for drainage and/or friction). As you can see in the photos below, the pronounced protrusions need to be removed from the sheet (a bench grinder works well) to facilitate even grip pressure for good repeatable tensile testing. If one does not remove the protrusions, you get irregular stress strain curves where the strain at yield and break often do not meet the specification. GAI-LAP believes that the protrusions should be carefully removed prior to testing.

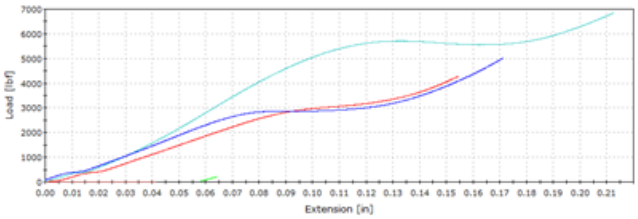


6. **ASTM D4751, damage to geotextile during AOS testing.** When dealing with an extremely light weight spun lace geotextile (3 oz/yd^2), a lab was observing damage to the textile during the very violent shaking and beating from a Ro-Tap sieve shaker. They looked for options and the use of the ASTM D6767 Bubble Point was adopted. This was a very elegant solution to a vexing problem of determining the AOS of lightweight, fragile geotextiles.

7. **ASTM D5323, 2% secant modulus.** As of the end of 2018, the determination of 2% secant modulus should be done via ASTM D638 testing not ASTM D6693. The big difference in these two dog-bone tensile tests is that the ASTM D638 test requires the use of an extensometer where ASTM D6693 makes use of cross head movement to determine

elongations. I know this difference seems small, however, it is significant at very low strains. Therefore, GAI-LAP sided with the lab that ran the ASTM D5323 test via ASTM D638. PLEASE NOTE!!! This situation has changed as of 2019. The ASTM D5323 task group has now changed the method to include testing by way of ASTM D6693. I know this is confusing but is again case in point why you need to be up to date on the proper standard-norm revision.

8. **ASTM D6364 Three different methods within the compression standard.** It should be clearly stated that ASTM D6364 test method for short-term compression behavior of geosynthetics, actually contains three different methods that yield different results. Within Section 6, the containment apparatus of the standard, one learns of "Fixed Plate", "Movable Plate", and "Variable Plate" configurations for this test method. As you can see by the compression results below for the same material, results will be markedly different depending on which configuration is used. Labs need to stipulate what configuration they are using.



9. **ASTM D5397 SP-NCTL MD vs X-MD.** It was discovered that a geomembrane made from a high-quality resin had a very different stress crack resistance in the machine versus cross machine direction. Note 7 of the Standard, states that the operator should challenge the "weakest" direction of the sheet material. There has been some discussion on whether the term weakest refers to tensile strength or lower stress crack resistance. This point of contention resulted in one lab passing the material and the other failing it.
   Note 1, ASTM D5397 has now been changed so that only cross machine direction specimens are tested (hence the notch is in the machine direction) and there is no reference to "weakest."
   Note 2, Stress cracking was always thought to be a resin issue. This exercise proves that artifacts from manufacturing or fabrication could be a factor affecting stress crack performance in geomembranes.

10. **ASTM 5721 oven ageing of geomembrane.** It was discovered through much effort that there are large temperature variations (up to six degrees Celsius) within some forced air convection ovens. Based on this discovery, GAI-LAP will recommend to the ASTM D5721 task group that the set temperature of the oven be based on the "Black Panel" temperature of a specimen. This temperature reading would be obtained by a thermocouple adhered to an actual specimen within the oven under test and connected to the oven heater control.

11. **ASTM D5585 & D1238 MFI traceability.** It was discovered that a distributer of geomembranes was comingling productions from several manufactures and labeling them as the same lot. We were troubled by this revelation and identified this material not in compliance with GRI GM17 due to a traceability error. After HP-OIT, melt flow index testing and visual observations of the rolls, it was determined that the rolls were not produced on the same equipment (some material was produced on a cast line and others were from a blown film line).
12. **ASTM D6567 Light penetration of TRM.** This was an unusual one, we were asked to enter into round robin testing of a white slit film woven geotextile for light penetration as seen in the figure below. This is not a TRM by our definition however, we played along and did the testing. It was discovered that one of the labs in the round robin had a defective light meter with a percent change key that was stuck or defective. We also know from past experience that color is a factor affecting results for this test (i.e. dark colors adsorb light where light colors reflect it).

13. **ASTM D1987, Long Term Filtering of Coal Combustion Residuals (CCR).** We found out with this material it is very hard to repeat long term filtration results within a given laboratory. It is even more difficult to reproduce results lab to lab when filtering fines from baghouse residuals. We found that precipitate clogging varied from two months to eight months. These are not results that lend themselves to efficient or conclusive designs.

14. **ASTM D5890, Swell Index of GCL's Bentonite.** It was discovered that there was an error at a plant involving polymer modified bentonite. While transitioning production, it appears that trace amounts of polymer got mixed into the next lot of material which was not polymer modified. Polymer has the affect of changing the viscosity of DDD water. It interferes with particle flocculation and settling. Hence the water becomes more viscous as the test proceeds and more particles are held in suspension rather than settle to the bottom of the graduated cylinder. This different result did not meet GRI GCL3 specification and was unnerving the owner.

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, June 6, 2019 in conjunction with ASTM D-35 in Denver Colorado. It is a pleasure working with you. We appreciate your participation and please contact accordingly with questions and concerns.

George R. 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 thirteenth 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 as follows. The examination has been gradually revised attesting to the changes occurring over the past years.

Inspector Certification Test Results for
Waste Containment Inspectors
2006 – 2018

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	6	0	6	0	0
TOTAL (to date)	**807**	**95 (12%)**	**742**	**78 (11%)**	**36 (4%)**

There are currently 324 practicing certified inspectors - 268 inspectors (2014-2018) and 56 inspectors (2006-2013) who have renewed to keep certification current. Renewals represent 17%. This is felt to be encouraging from our perspective. The next on-line courses are June 4-5- 6, 2019 and December 3-4-5, 2019.

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 jrkoerner@verizon.net 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 not been particularly successful even though we have 340 similar MSE wall failures (recall Item #7 in the research section on page 3).

Inspector Certification Test Results for
MSE Walls and Berms Inspectors
(2011-2018)

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
2017-18	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 http://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.

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Jamie Koerner jrkoerner@verizon.net

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). 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 10students working on geosynthetic-related projects and is extremely active nationally and internationally. GSI Taiwan has hosted three very successful internal conferences to date and has also held a much broader one, namely, GSI-Asia in Taichung, Taiwan.

GSI-India under the new direction of Dr. A. K. Mukhopadhyay (who succeeds Dr. A. N. Desai) was formed in 2015. The hosting organization is the Bombay Textile Research Association (BTRA) which is world known for its excellence in textile R & D and is

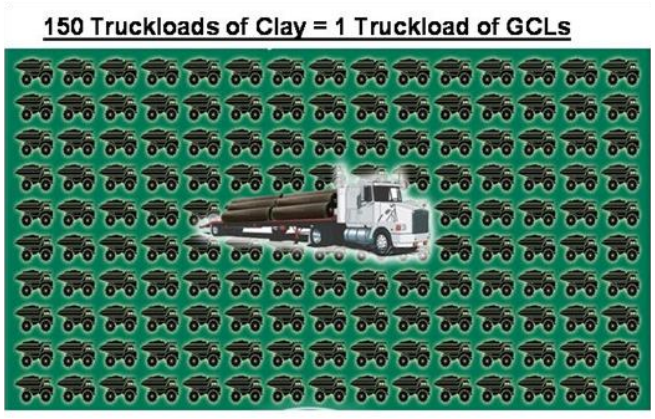
currently branching out into all forms of geosynthetics. We are delighted in this regard and, as a side-note, Dr. Mukhopadhyay has replaced Dr. Desai on GSI's Board of Directors to fill out his term.

Reflections on Sustainability With Respect to Geosynthetic Materials

Listening and reading the "news", there seems to be a regular criticism of all plastics insofar as concerns as to their post-use disposal in light of their exceedingly long lifetimes. Rarely, if ever, is the distinction made as to which plastics are really necessary to society and which are indeed disposable. Of course, we all feel that geosynthetics are necessary and must be dependable for long service lifetimes. Our general rejoinder in the above discussion is that geosynthetics provide either…

(i) better and longer performance than natural material solutions, or
(ii) provide less costly solutions than using traditional materials.

That said, we certainly could, and perhaps should, add "enhanced sustainability" to the above two items when dealing with geosynthetic applications. This is inherently due to the competitive natural materials (gravel, sand, cement, clay, etc.) all of which carry an enormous carbon footprint in comparison to geosynthetic materials. This is due to the energy required in quarrying operations and the trucking of the massive quantities generally required. Even without going through the necessary calculations, the following advertisement by CETCO depicts the situation for the case of 150 truckloads of clay being brought to a site versus comparable coverage by one truckload of geosynthetic clay liners!



Quantitatively, the numeric decrease in carbon footprint using geosynthetics was nicely shown in a report titled, "Sustainable Systems in Civil Engineering Applications" by the Waste and Resources Active Program (WRAP) in May, 2009. The report was authored by representatives of 16 U.K. organizations of which one-third were involved in geosynthetics. In it are five worked-out case studies; see Table 1. They address both slopes and walls and show that when replacing traditional material solutions with geosynthetic materials, costs are greatly reduced (as expected) and the CO_2 footprint is reduced even more. The differences shown in the table are apparent.

Table 1 - Case Studies from WRAP Report (May, 2009)

Case History	Traditional Approach		Geosynthetic Approach	
	Cost (K)	CO_2 Footprint (tons)	Cost (K)	CO_2 Footprint (tons)
Slope Stability	$571	157	$23	21
Bridge Approach	$1,282	500	$574	346
Crib Wall	$51	35	$41	11
Sheet Piling Wall	$246	433	$121	69
Concrete Wall	$98	107	$20	20

The above report stimulated an entire GRI-Conference titled "Optimizing Sustainability Using Geosynthetics", which was held in Dallas, Texas on March 16, 2011. It included twenty papers, the keynote being by Dr. Russell Jones who was one of the authors of the WRAP report. The average CO_2 savings of the various papers grouped by application area are given in Table 2.

Table 2 - Case Studies from GRI-24 Conference (March, 2011)

Application Area	No. Cases Described	Average CO_2 Savings
Walls	6	69%
Embankments	4	65%
Armoring	4	76%
Covers	3	75%
Liners	2	30%
Retention	3	61%
Drainage Pipe	3	40%
TOTALS	25	65%

Having presented the above data, we pose the question that if we begin promoting geosynthetics as being worthwhile and sustainable (particularly in comparison to natural materials), how should we proceed? Individually, we can start daylighting such information but it also seems that a unified approach might be worth pursuing. This could well be publications dedicated to the topic (like the Journal of Sustainable Engineering by Taylor & Francis which began in 2008), or designated

sections of our existing geosynthetic conferences and publications like Geosynthetics magazine. Of course, discussion of any type is always welcomed but we feel that some effort should be made to counter the ever-increasing news that “all plastics are bad”!

Bob and George Koerner

GSI's Member Organizations

We sincerely thank all of our sponsoring organizations. Without them, GSI simply could neither happen nor exist. The current GSI member organizations and their contact members are listed below. **Our newest members are (i) the Thrace Group with James Brown/Stella Karavasili, (ii) SKAPS Industries with Edward Zimmel, Nilay Patel and Anurag Shah and (iii) Chesapeake Containment Systems (CCS) with Steven Mayes as main contact persons. Thanks to all and welcome to GSI!!!**

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- Activities within GAI (Accreditation)
- Activities within GCI (Certification)
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