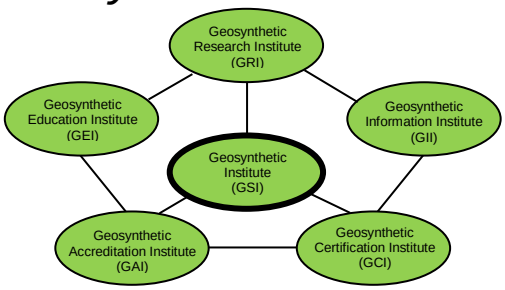
The GSI Newsletter/Report

Geosynthetic Institute



Vol. 32, No. 4 **December, 2018**

This quarterly newsletter, now in its 32nd 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.

Happy Holidays and a Healthy and Prosperous New Year

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

1. Elections to the GSI Board of Advisors has concluded with the following three members being elected for the 2019-2021 three-year term.
   - David Andrews of Propex representing the Geotextile/Geogrid focus group
   - John Workman (re-elected) of Waste Management representing the Owner focus group
   - Sam Allen (re-elected) of TRI Environmental representing one of the At-Large members
2. Until the end of the year, the current nine-person BOA is as follows:

Term Ends 2018
- John Workman - Waste Management Inc. (Owners and Operators) e-mail: jworkman@wm.com
- Mark Wayne – Tensar Earth Technology (Geotextiles and Geogrids) e-mail: mwayne@tensarcorp.com
- Sam Allen – TRI Environmental Inc. (At-Large) e-mail: Sallen@tri-env.com

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

3. The Annual Meeting of GSI and the BOA Meeting are scheduled for the Geosynthetics '19 Conference in Houston in February. Contact George Koerner at gsigeokoerner@gmail.com for date, time and location of both back-to-back meetings.
4. The GeoMEast Conference was held in Cairo, Egypt last month and it was a resounding success with 900 participants. It is rapidly segueing from a strictly geotechnical emphasis to one favoring geosynthetics. For example, the following occurred:
   - Organized the 2nd IGS official lecture, the 2nd GSI official lecture and the 1st GMA-IFAI official lecture.
   - Organized a group of Geosynthetics main lectures delivered by a distinguished group of global experts.
   - Organized two successful courses and one successful workshop on Geosynthetics theme.
   - Organized an important session with attending leaders of many Geosynthetics companies with some of their CEOs.
   - Meeting was held with the Minister of Transport who met with all the geosynthetics companies attending the event during the first conference day.

   Dr. Hany Farouk (hanyfarouk808@gmail.com) is (and has been) the driving force behind the conference.
5. Kent von Maubeuge of NAUE presented the 2nd Koerner Lecture at the GeoMEast Conference and the written paper on landfill regulations proposed by the ISO was presented. It is critically important since solid waste disposal in emerging countries in Asia and Africa is in a robust growth stage. The paper is available in the conference proceedings.
6. Considerable effort has been expended assessing the status of reinforcing (stabilization) design of the gravel base course in paved and unpaved roads. A GRI White Paper (#40) based on a national survey of transportation agencies is available on our website at (www.geosynthetic-institute.org/papers/paper40.pdf).
7. As a result of yet another survey (all excellently conducted by special projects manager Jamie Koerner) is on the status of geosynthetics laboratories conducting long-term geotextile filtration clogging tests. The background and its results are included (pages 10 and 11) in this Newsletter/Report.

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, PVC (N.A.) and PVC (Euro.). 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 are not yet complete. Some will take at least 90,000 light hours (~ 12.3 years). GRI Report #44 is available on results to date and a webinar is also available. The information was made available to the public on April 6, 2016 at Orlando and was again presented in Peru on March 30. 2017. It has been republished in the International Geosynthetics Journal. A copy is available.
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. **Exposed Lifetime of Creased Geomembranes** - Stemming from a recent webinar on the effect of backfilled GM waves or wrinkles, we now have seven geomembranes which are purposely creased in double 180° bends being incubated at 80, 65, 55 and 25°C temperatures as of February 10, 2017. They are HDPE, LLDPE, LLDPE-R, fPP, fPP-R, EPDM and PVC. We are focusing on if, when, and where, cracking might occur. To date cracks have occurred in both the HDPE and PVC materials at the 80°C exposure. The cracks occur precisely along the tops of the 180° bends. They occur at both bends exposed to the light and

shielded away from it. They have been replaced with new samples to assess repeatability.

5. **Laboratory Exposed Lifetime of PVC (European) Geomembranes** - We have been evaluating five different European formulations for four 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.
6. **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.
7. **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 286 and now 334! *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. A paper was published by the Journal of Geotextiles and Geomembranes in October, 2013 and the publisher (Elsevier) reports that 1400 requests have been made to date. An updated paper on 320 has just been published in the same journal. Lastly, an ongoing GSI webinar is also available.
8. **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.
9. **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.
10. **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.
11. **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 is presently under review and the included geonet/ geocomposite specification is on our website at www.geosynthetic-institute.org/ grispecs/gn4.pdf.
12. **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.
13. **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
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 Drainage Composites
GC14 – Turf Reinforcement Mats
GC16 – Prefabricated Vertical Drains

Working; Available Upon Request
GGXX – Bidirectional Geogrids (tabled)
GGXX – Unidirectional Geogrids (tabled)
GSXX – Geospacers and Geospacer Drainage Composites (active)

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 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.

14. **Guides and Practices** - GSI also develops standard guides and practices and these are also available free on our website. There are 11 guides and 6 practices. They are modified on a regular basis and the latest version is updated regularly.
15. **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 share our test methods in this manner, but not specifications, guides or practices.

16. **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

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	**Research**
Prospectus	**Certification**
Specifications	**Information**
White Papers	**Education**
Bookstore	**Accreditation**
Keyword Search	**Personnel Contacts**
Members Only	**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 available. This includes:

- **GRI Test Methods**
- **GRI Reports**
- **GRI Technical Papers (Citations)**
- **Notes of GSI Meetings**
- **Links to the GSs World**
- **Keyword Search for Literature**
- **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 Coordinator) 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.

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 January 14, 15, 16; 2019) and October 15, 16, 17; 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

Drexel Night at GSI

The best way to experience GSI is in person. With the help of Prof. Robert Swan Drexel's geosynthetic class took advantage of their proximity to the institute and visited us for several hours on the evening of December 4th.

As with other Universities in the area teaching geosynthetics, we open our lab up to student and faculty for information sessions, tours and visits. However, this formal latest visit gave those in attendance an idea of the function of GSI's five institutes and then a tutorial of the three major performance tests in geosynthetics, (namely, ASTM D4595 wide width tensile, ASTM D4716 transmissivity and ASTM D5321 direct shear.) An SOP for each test was discussed, a design example supported by a case history and finally a demonstration of each method with multiple take home results. It was a fun experience for all and hopefully we have some new converts in the group. A picture of Drexel night at GSI is shown below along with a pretty cool Steampunk art sculpture gift. "Go Drexel Dragons!"

Front row (left to right): Antonio Tartaglia, Anthony Rizzo, Jerry Geese, and Albert Manginelli
Back row (left to right): Prof. Robert Swan, Andrew Bock, Sean Seibert, Michael Kullmann, and William Davis

Our new Steampunk Dragon gifted to us by Drexel

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.

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

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

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

8B - 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)
Victoria Shoupe -- (912) 375-6180
Victoria.Schoupe@propexglobal.com

59[B] - Firestone (8 Tests)
Janie Simpson -- (864) 439-5641
SimpsonJanie@firestonebp.com

60[B] - TDM Geosintéticos S.A. (17 tests)
Roberto Diaz -- 051-1-6300330
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61[B] - Raven Industries (18 tests)
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62[B] - Solmax GSE (14 tests)
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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)
Siriporn Chayaporenlert – 6638-636638
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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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75[B] - GeoMatrix S.A.S. (29 tests)
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76[B] - Tehmco (Chile) (15 tests)
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78[B] - PQA Mexico (15 tests)
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79[A] - TRI Geosynthetic Testing and Services (32 tests)
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80[B] - Texel Technical Materials (10 tests)
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81[B] - Solmax GSE (18 tests)
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85[B] - PAG Tacna (15 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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91[B] - Techfab (India) Industries Ltd. - Rakholi (3 tests)
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92[B] - Techfab (India) Industries Ltd. - Khadoli (2 tests)
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93[B] - Garware Technical Flbres (18 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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98[B] - NeoPlastic Filmes e Embalagens Plasticas Ltda. (7 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

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 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 twelfth 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
TOTAL (to date)	**801**	**95 (12%)**	**736**	**78 (11%)**	**36 (4%)**

The 5-year renewal periods for those having taken the exam before 2010 is ongoing and about 60% have renewed accordingly. This is felt to be encouraging from our perspective. The next on-line courses are January 14, 15, 16; 2019 and October 15, 16, 17; 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 334 similar MSE wall failures (recall Item #7 in the research section on page 3).

Inspector Certification Test Results for
MSE Walls and Berms Inspectors
(2011-2017)

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	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 numerical 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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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 in the transition of being 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.

On the Nonuse of Long-Term Geotextile Filter Test Methods

Since the first use of "filter fabrics" (in the U.S. it was by Bob Barrett of Carthage Mills in 1966) there have been many thousands of successful applications to the point where geotextile filters are commonplace and have replaced sand drainage layers in many regulations and specifications. The most commonly used specification is that of the various Departments of Transportation under the designation of AASHTO M288-16. It calls for several physical and mechanical test properties and also two hydraulic properties; namely, permittivity and apparent opening size. Together these hydraulic properties are meant to balance the fabric's openings so as to simultaneously allow adequate flow and yet retain the upstream soil. This topic is one of the most researched of all geosynthetics with over 260 citations in GSI's database in the category of laboratory testing focused on excessive clogging or soil loss.

Beyond such short-term test methods for geotextile filters, however, there have been field cases exhibiting poor or even non-performance. In a paper written by the authors, sixty-nine failures are cited and examined accordingly. While this is a minuscule percentage of the number of actual filter applications, it is likely a concern to those involved. See the following table.

Summary of 69 Geotextile Filter Failures in Cited Reference

Category	Type	No. Cited Occurrences	Resulting Situation
Design	Poor fabric selection	1	Inadequate fabric voids
	Poor fabric design	5	Inadequate fabric voids
	Socked drainage pipe	2	Inadequate fabric voids
	Reversing flow conditions	6	Soil loss and piping
Atypical soils	Cohesionless fines	6	Soil loss and piping
	Gap-graded soils	3	Soil loss and piping
	Dispersive clays	2	Excessive fabric clogging
	Ochre clogging	6	Excessive fabric clogging
Atypical permeants	Oil and sludges	2	Excessive fabric clogging
	Turbid water	2	Excessive fabric clogging
	High alkalinity water	2	Excessive fabric clogging
	Landfill leachates	10	Excessive fabric clogging
	Wastewater and Agricultural	5	Excessive fabric clogging
Field Installation	Lack of intimate contact	16	Soil loss and piping
	Glued filter fabric	1	Excessive fabric clogging

ref. Koerner, R. M. and Koerner, G. R. (2015), Jour. Geotex. and Geomemb., Vol. 43, pp. 272-281.

Beyond the AASHTO M288-16 specification and related testing standards mentioned previously, there are four laboratory performance tests focused on *long-term* geotextile filter behavior. They are as follows along with the year of initial adoption:

- Long-Term Flow Test, per GRI-GT1 (1986)
- Gradient Ratio Test, per ASTM D5101 (1990)
- Biological Clogging Test, per ASTM D1987 (1991)
- Hydraulic Conductivity Test, per ASTM D5567 (1994)

Brief commentary on advantages and disadvantages of each method is as follows:

Long-Term Flow (GT1)
- easy setup
- lengthy results
- bio-growth issue
- rarely used

Gradient Ratio (D5101)
- special device
- quick results
- a GR value of 3 is arbitrary
- most accepted

Biological Clogging (D1987)
- easy setup
- lengthy results
- leachate in laboratory
- rarely used

Hydraulic Conductivity Ratio (D5567)
- modified soil permeameter
- intermediate results
- requires skilled technician
- best simulation

Since these long-term tests have been available for use for well over 20-years, *we were interested in assessing their current use among geotextiles testing laboratories.* A 2018 survey was sent to 35 worldwide laboratories testing geosynthetics with a return of 15 (43%). A table is attached. It was found that only four labs performed such tests, with Gradient Ratio being the most often cited. Also, from the survey results, it was found that only 8 to 14 requests per year by the above labs were received. Clearly, these requisite long-term tests are available and equally clear is that they have not seen much use. The important question is "why"? Some possibilities are as follows:

1. Perception that existing specifications are adequate to prevent filter failures.
2. Users are unaware that these long-term filtration tests exist.
3. The implication of filter failures is not as significant as it is for other types of applications.
4. Site-specific soil cannot be determined due to its inherent variability.
5. Representative samples of the most troublesome fine-grained silt and clay soils are difficult to sample.
6. There exist many possible candidate geotextiles for testing.
7. The tests are somewhat time-consuming to obtain definitive answers.
8. The tests are too expensive, especially compared to short-term index tests

Whatever the situation, the survey's results appear to challenge the appropriateness or even need for such long-term filter tests. We think that all four of these test methods are credible but we are underwhelmed by their non-use. That said, we are always available for discussion and recommendations regarding geotextile filters particularly when challenging and critical applications are concerned. Please advise accordingly.

Bob and George Koerner

2018 Survey Results on Use of GT Filter Testing

Testing Labs	Does your lab perform any of the following tests?	Long term Flow Test GRI-GT1 (Requests/Year)	Gradient Ratio Test ASTM D5101 (Requests/Year)	Biological Clogging Test ASTM D1987 (Requests/Year)	Hydraulic Conductivity Ratio Test ASTM D5081 (Requests/Year)
TRI	yes	< 1-2	3-5	< 1-2	3-5
Geotechnics	yes	-	-	-	1 every other year
GCTTG	yes	never	5-10	Every other year	1-2 in 10 years
Geotesting Express	yes	-	infrequent	-	infrequent
Terra Testing	no				
Golder	no				
Solmax Canada	no				
Solmax USA	no				
NPUST Taiwan	no				
Techfab India	no				
Agru America	no				
TUV SUD	no				
ADS-Pipe	no				
FITI	no				

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 the Thrace Group with James Brown/Stella Karavasili and SKAPS Industries with Edward Zimmel, Nilay Patel and Anurag Shah as main contact persons. Thanks to all and welcome to GSI!!!**

GSE Environmental
Jimmy Youngblood [BoA]/Mark Harris
U.S. Environmental Protection Agency
David A. Carson
Federal Highway Administration
Silas Nichols/Daniel Alzamora
Golder Associates Inc.
Frank Adams/Paul Whitty
Tensar International Corporation
Mark H. Wayne [BoA]/Joseph Cavanaugh/Doug Brown
TenCate Geosynthetics
John Henderson/Chris Lawson
CETCO
Davie Chiet/Michael Donovan/Rob Valorio
Huesker, Inc.
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NAUE GmbH & Co. KG
Kent von Maubeuge [BoA]
Propex Operating Company LLC
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Berry Global Inc.
Keith Misukanis
TRI/Environmental Inc.
Sam R. Allen [BoA]/C. Joel Sprague
U. S. Army Corps of Engineers
Kevin Pavlik
Chevron Phillips Chemical Co.
Ashish Sukhadia [BoA]/ Vergil Rhodes
AECOM (formerly URS Corp.)
John Volk/John Bove/Michael Stepic
Solmax Géosynthétiques
Jacques Cote/Simon Gilbert St-Pierre
CARPI, Inc.
Alberto M. Scuero/John A. Wilkes
Civil & Environmental Consultants, Inc.
Tony Eith [BoA]
Agru America, Inc.
Nathan Ivy [BoA]/Markus Haager

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Daniel S. Rohe/Ryan Whalen
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Monte Christie
Weaver Consultants Group, Inc.
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American Wick Drain
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INOVA Geosynthetics/AERO Aggregates
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Garth James
Thrace Group
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SKAPS Industries
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IN THE NEXT ISSUE

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- Activities within GCI (Certification)
- The GSI Affiliate Institutes
- The GSI Centers-of-Excellence
- Changing the 1/500 ft Destructive Seam Testing Paradigm
- GSI's Member Organizations