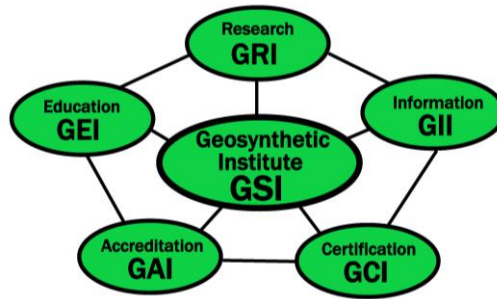


The GSI Newsletter/Report



Geosynthetic Institute

Vol. 34, No. 1

March, 2020

This quarterly newsletter, now in its 34th 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 marilyn@geosynthetic-institute.org.

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

The Geosynthetic Institute (GSI) is happy to announce the hiring of James E. Whitty (Jim) as our Senior Engineer. Jim was hired to help increase research in all fields related to geosynthetics, laboratory accreditation and testing support, and to spearhead the publication of whitepapers and GSI reports. We hope you join in welcoming Jim into the geosynthetics community (jim@geosynthetic-institute.org).

Jamie Koerner has been given the new title of General Manager. Her additional responsibilities include treasurer and office management.

GSI's Annual Meeting, followed by the Board of Advisor's (BOA) Meeting was held on March 9, 2020 in Charleston, South Carolina in connection with the IFAI Geosynthetics Conference 2020: Case Studies.

To be honest, the turnout at the meetings were disappointing. One can rationalize that we were late at night, competing with hospitality suites by several manufacturers and at a conference fighting a coronavirus scare. Still, we had a lot of good discussions about the latest GSI survey. The following is a summary of the GSI Customer Satisfaction Survey October (2019). The rating system was based on a scale of 5 to 1 (Excellent to Poor respectively). We had a 36 % return rate, which is disappointing. However, it is not insignificant and we appreciate those that took the time to respond. Going forward, we would like to have all GSI members contribute to this survey. The input helps us direct our efforts to the membership's needs.

The results of the 2019 membership survey were as follows:

1. Research: **4.4**
2. Information: **4.2**
3. Education: **4.6**
4. Accreditation: **4.5**
5. Certification: **4.1**
6. Conflict Resolution: **4.9**
7. Response to questions: **4.6**
8. Response to projects: **4.3**
9. Geosynthetic advocacy: **4.7**
10. Interaction with other organizations: **4.5**

Overall: 4.5, 90% = B+

Beyond the actual numerical evaluation above, there were comments associated with the survey, offering suggestions on how to improve GSI's performance. These comments plus our responses (in parenthesis) are summarized below.

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- The GSI Affiliate Institutes
- GSI's Member Organizations

1. More development of new test methods (we developed four (4) over the past year and are working of two (2) others)
2. Standardized procedures for in-plant inspection during production of geomembranes (CE Marking under ISO has this covered. It is a good program and well established worldwide)
3. More updated research (We did six (6) new projects over the past year, all of which are yielding publications)
4. Foster growth of geosynthetic knowledge in engineering to legitimize acceptance of geosynthetic products (We wrote a white paper on sustainability of geosynthetics as it related to applications in the transportation sector. In addition, we wrote up several case history papers showcasing the long-term effectiveness of polymers used in geotechnical applications.)
5. Promote Zero Destruct Testing Initiative (We wrote and published two papers in this regard to eliminate 1 in 500' with value added technologies, method of attribute, smart welders, clean edge, LIS etc. We also made three (3) presentations championing this effort which hopefully started a campaign to stop taking so many destructs of perfectly good seams.)
6. Industry calendar to integrate tradeshow, technical seminars, conferences.... (In truth there is no way our Institute can do this. GSI no longer holds conferences. We stopped convening these events in 2013 after twenty-five years.) We will encourage IFAI, GMA, ASCE, IECA, SWANA etc. to work together. However, our comments and concerns have fallen on deaf ears lately.
7. Promote long term performance of geosynthetics as a viable alternative to natural materials (The institute is regularly conducting R & D, showing that well formulated polymers last a very long time in buried applications. In addition, our work on sustainability paper plus case histories makes a very strong case for using geosynthetics rather than natural materials. Geosynthetics are enabling construction as well as allowing us to construct better, faster and more economically.)
8. More focus on international prospective rather than focus on US market. (We are dropping the ball on this and should improve our international outreach)
9. Compare and contrast which drainage geocomposite should be used for what application. (RMK's DwGS application graphics superimposed different applications with various ASTM D4716 results. I could make a tutorial out to this work)
10. Make sure labs are compiling true test report results per ISO and ASTM norms (It should be clearly stated that manufacturers are not held to same reporting requirements as 3rd party labs)
11. Report on effectiveness of geosynthetics in roads versus chemical stabilization. (It should be noted that chemical stabilization is entrenched in many DOT's with roads in low lying areas, having high ground water tables and fine-grained soils. In addition, there might not be free draining sands and

gravels to place on top of geotextile separators or biaxial geogrids for the "geosynthetic" approach. In short, best practices in this case is a challenge that needs to be investigated on each job site superimposed with benefit/cost analysis for each alternative.)

12. Research/Report on water quality and storage using geosynthetics. (Have not done this yet but can certainly look into it!)

Information about the IFAI Geosynthetics Conference can be found under GII information section.

2020-2022 Board of Advisors

Term Ends 2020

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

Term Ends 2021

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

Term Ends 2022

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

Overview of GRI Projects (Research)

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

1. **Field Exposed Lifetime of Geogrids Used at the Facing of Landfill Berms** - The facing of mechanically stabilized earth landfill berms (and other walls and slopes as well) often uses a wrap-around configuration leaving the geogrid exposed to the atmosphere. A project being conducted by George Koerner is presently investigating the behavior of two different geogrids and two erosion control materials at a local landfill over time. These four materials are also being exposed on the roof of the GSI carport. A 50-year time frame is envisioned! The long-term behavior will eventually be compared to our UV laboratory predicted database.
2. **Laboratory Exposed Lifetime of Geomembranes*** - GSI is using three UV-fluorescent devices to estimate the projected exposed lifetime of six different types of geomembranes. They are HDPE, LLDPE, fPP, EPDM and PVC (N.A. and European). They are being incubated at 60, 70, and 80°C until halflife of strength and elongation are measured. The goal is lifetime prediction. Incubation times are now over 60,000 light hours (8.2 years) and several are not yet complete. They will probably take as long as 90,000 light hours (~ 12.3 years). The information up to this point in time was made available to the public on April 6, 2016 at the GeoAmericas Conference in Orlando, Florida. It has been republished in the International Geosynthetics Journal. A copy is available. It is now also being offered as a 90 min. webinar.
3. **HDPE Geomembrane Lifetime as a Function of Thickness** - This often-encountered question is being evaluated at elevated temperature exposure at in a QUV weathering device per ASTM D7238. Formulations are exactly the same and only the sample thicknesses vary. These thicknesses are 2.76, 2.44, 1.58, 1.08, 0.77 and 0.48 mm. Parameters being evaluated in this decades long study are change in thickness and presence of crazing or cracking. Time will tell!
4. **Laboratory Exposed Lifetime of PVC (European) Geomembranes** - We have been evaluating five different European formulations for nine years using three dedicated UV-fluorescent devices and the results are very impressive. The study is being conducted for CARPI Tech, a GSI member organization. The project also allows us to distinguish between PVC geomembranes manufactured in North America versus Europe. The differences are in the type of plasticizers used in the formulations as well as thicknesses. The program will end this year but may be extended with new formulations.
5. **Retaining Wall Failure Evaluations*** - We have past GRI Reports 38, 39, and 40 addressing mechanically stabilized earth (MSE) walls using geosynthetic reinforcement which document 82-failures. Our data base has grown to 141, then 171, then 320 and now 346! *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, three ongoing GSI webinars are also available on this general topic.
6. **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.
7. **Slow Pressurization of HDPE Geomembranes in Axi-Symmetric Testing*** - The ASTM D5716 method of testing geomembranes in a 3-D axisymmetric mode uses a pressure rate of 6.9 kPa/min (1.0 psi/min). While such a rate is appropriate for most geomembrane types, it is very fast for HDPE which is semi-crystalline and cannot readily stress relax so as to accommodate the applied pressure. To investigate slower rates, we have initiated a project with rates as low as 6.9 kPa/month (1.0 psi/month)! The last test, begun in 2017, is at a rate of 6.9 kPa/six months (1.0 psi/six months) and it will take an estimated five years to conclude. Recently, yield was observed in the deformed geomembrane but air pressure is still sustained. A preliminary paper was presented at Geosynthetics '15 in Portland.
8. **Residual Stress in GS** - Short term project involving the tensile behavior of textiles, grids and fibers to hysteresis temperature modulation. Temperatures range from -10°C to 50°C.
9. **Generic Standards** - A major continuing effort is ongoing with respect to the development and updating of GRI's generic geosynthetic standards. As customary, "standards" consist of specifications, guides, practices and test methods. The current status of these standards is as follows.
 - 9a. **GRI Specifications** - Currently we have 21 generic specifications on most of the products generally used. The notable exception is geogrids, which is, and has been for years, very contentious with no obvious accommodations. Incidentally, all are currently copyrighted.
 - 9b. **GRI Guides** - Currently we have 12 guides on detailed aspects of geosynthetics, their installation and project performance. Topics vary widely; from statistical sampling-to-constructing test pads. Topics of interest for our development should be communicated to George or Bob Koerner.

9c. GRI Practices - Currently we have 8 practices on wide ranging topics generally used in design methods. They are very detailed and sometimes are based on our concept of what we perceive to be “best practice”.

9d. GRI Test Methods - Currently we have 29 test methods available on the following geosynthetic types:

Geotextile Related - 2
Geogrid Related - 2
Geomembrane Related - 6
GCL Related - 2
Geocomposite Related - 11
Geosynthetic (multipurpose) Related - 6

Additionally, 31 of our test methods 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.

Progress within GII (Information)

We are currently in the midst of a nation-wide tour of Geosynthetic events.

IFAI's Geosynthetics Conference: Case Histories Sharing Practical Applications, Charleston, South Carolina, March 8-10, 2010

AES' 25th anniversary celebration, Los Angeles, California, March 11, 2010 and
25th ESD conference and trade show, Lansing, Michigan

The events were well attended considering the concerns with COVID-19 Corona Virus. Although there was noticeably less hugging and hand-shaking going on.

GSI had a huge presence at these events. George Koerner performed many tasks at IFAI's Geosynthetics Conference: Case Histories, in Charleston, South Carolina. The following is a recap given by George:

- Short course: IGS TC-B Geosynthetic Barriers in Relevant Applications. I team taught this four-hour course with Kent von Maubeuge of NAUE. He opened the course and concentrated on GCL's. Kent showed several new items that I have not seen before. One of great interest was a graph of two

index tests (swell and fluid loss) that showed how they relate to hydraulic conductivity. This information is very powerful from the perspective of conformance testing. My involvement with the course included but was not limited to:

- Applications
- Product Types
- Geomembrane Selection
- Design practices
- Construction/Installation Considerations
- Recommendations

All of this was wrapped in multiple case histories showing the do's and don'ts of construction with Geosynthetics. The short course was attended by 26, who were a lively audience full of challenging questions.

- GS conference 2020 featured six special sessions, each organized by one of the conference supporting organizations. GSI session was highlighting “Three Case Histories Illustrating How Geosynthetics Were Used Effectively for Soft Soil Stabilization Projects Near Pigeon Point, Delaware.”
 - Introduction and Overview
 - DuPont Edgemoor Impoundment, John Guglielmetti
 - DSWA Cherry Island Landfill, Lindsey Baer
 - USA Corp Eng. DDA Region5, DePasquale Bothers (Richard and Anthony)
 - Summary, Conclusions and Recommendations
- How ASTM Standards are impacted by Case Histories. This session was chaired by Bob Mackey of S2LI and he had three speakers. Gary Torosian of GeoComp Geotesting Express discussing direct shear testing, George Koerner speaking on ASTM D35.02 durability Test Methods and GRI GM-13 HDPE Specification: A good marriage to access performance, and Beth Young of TENCATE speaking on MARV. In truth, this was a very unashamed advertisement for the ASTM D35 committee on Geosynthetics. We had about thirty people in the room and hopefully will get some new recruits for the committee. Our next ASTM meeting is in Boston, MA on the second and third of July 2020, which will include a very nice social outing at Fenway Park with the Red Sox and a workshop on “Weathering of Geosynthetics” held on July 1st, 2020 (Wednesday).

Save the Date: IFAI's with ICEA Geosynthetics Annual Conference and Expo, February 21-24, 2021, Kansas City, MO USA.

For AES Inc.'s Technical Seminar on “Current Trends in the Waste Containment Design and Geosynthetics Applications” on March 11th, 2020 Held in Costa Mesa California, we gathered with old friends (as you can see in the picture below) and lectured for two hours. The

seminar had about sixty people. All engineers and technicians who were stakeholders in the industry were very engaged and talkative with fantastic questions. We spoke on the following topics;

- Smart welder seaming of geomembranes
- Fingerprinting and weathering of multicomponent geosynthetics
- Managing gas under geomembranes at large sites
- Mid-plane shear strength with case history of geocomposites
- Soft soil stabilization with geosynthetic s as it relates to waste containment case histories
- Half-life, Service-life and Life cycle consideration for geosynthetics

It should be mentioned that Professor Timothy Stark of the University of Illinois and FGI lectured in between our two, one-hour lectures. It made for a nice morning. Kris Khilnani and the team at AES had a fantastic breakfast and lunch for the crowd. We would like to thank the AES team for a fantastic networking event and wish them the very best for another 25 years on this special anniversary, CONGRATS!



Left to right: Thevachandran Shenthan, Suji Somasundaram, Timothy Stark, George Koerner and Kris Khilnani

The last event of the week was the Engineering Society of Detroit in partnership with the Michigan Waste and Recycling Association ESD/MWRA's 30th Annual Solid Waste Technical Conference on Thursday, March 12th, 2020, held at the Kellogg Center on the campus of Michigan State University. Whether you are in private industry, government, consultant or a vendor of equipment and supplies, the conference had a great benefit in regards to networking and learning. There was about one hundred and sixty people at the event and a good time was had by all. "We spoke on "Recent Developments with Geosynthetics in Waste Containment Facilities" and the lecture was well received.

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 (names beneath member company) must obtain a password from Marilyn Ashley. Marilyn can be reached by e-mail at marilyn@geosynthetic-institute.org. When you get into this section, the following information is then available.

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

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

White paper #44 "Relative Sustainability of Road Construction/Repair: Conventional Methods versus Geosynthetic Materials" is available on our website for your review. We are interested in any comments you may have.

Also, if you have topics that you feel warrant a survey, please contact us.

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 in 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: For the single cost of \$250 (non-members) or \$200 (members), Adobe Connect streams the webinar to all requested sites. Webinars can be transmitted anywhere and to anyone. Recently, NY-DEC streamed our webinar to their auditorium and 13 regional offices. Clearly hundreds of participants were involved! In December, George presented a 3-part webinar on Transportation to the U.S. Army Corps of Engineers, which was attended by several regional offices. Clearly, this is the most efficient way to communicate information to masses of people. Following is a list of topics given on behalf of GSI and ASCE. Contact us for details in each case.

GSI Webinars

- GSI 1 – “A Data Base and Analysis of 320 Failed MSE Walls With Geosynthetic Reinforcement”
- GSI 2 – “MSE Wall Back Drainage Design”
- GSI 3 – “MSE Wall Remediation and Monitoring”
- GSI 4 – “MSE Wall Inspection”
- GSI 5 – “Geosynthetics in Hydraulic Applications”
- GSI 6 – “Geosynthetic Applications Used in Heap Leach Mining”
- GSI 7 – “Geosynthetics in Agriculture and Aquaculture”
- GSI 8 – “Geosynthetics Applications in the Private Sector”
- GSI 9 – “Behavior and Analysis of Twenty Solid Waste (Landfill) Failures”
- GSI 10 – “Wet (Bioreactor) Landfills for Rapid Degradation of MSW Organics”
- GSI 11 – “Lateral and Vertical Expansions Over Old and Existing Landfills”
- GSI 12 – “Landfill Covers: Past, Present, Emerging”
- GSI 13 – “Beneficial Uses of Abandoned and/or Closed Landfills”
- GSI 14 – “Lifetime Predictions of Covered and Exposed Geosynthetics”
- GSI 15 – “In-Situ Stabilization of Soil Slopes Using Nailed (or Anchored) Geosynthetics”
- GSI 16 – “Sand Drains-to-Wick Drains-to-Sand Columns (Including a Major Failure Case History)”
- GSI 17 – “Geosynthetics in Erosion Control”
- GSI 18 – Pond Liner Design and Performance
- GSI 19 – “Wave (or Wrinkle) Management [For Proper Deployment of Geomembranes]”
- GSI 20 – “Geosynthetic Drainage Materials: Applications, Design, Installation and Performance”
- GSI 21 – “A Brief Overview of Geosynthetics and Their Major Applications”
- GSI 22 – “Geosynthetic Reinforced MSE Walls; Overview, Failures and Items for Improvement”

- GSI-23 – “Geosynthetic Filters: Concerns and Issues
- GSI-24 – “Disposal of Coal Combustion Residuals”
- GSI-25 – “Soil Consolidation by Wick Drains, aka PVDs”
- GSI-26 – “Applications and Design of Geotextile Tubes”
- GSI-27 – “Stability Design of Landfill Cover Soils”

Courses

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

1. Quality Assurance/Quality Control of Geosynthetic in Waste Containment Facilities (recordings available)
2. Construction Inspection of Mechanically Stabilized Earth (MSE) Walls, Berms and Slopes (recordings available)

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

Eighteen (18) fellowships at \$5000 each were awarded this year 2019-2020. For details please go to our website. www.geosynthetic-institute.org/gsifellows.htm.

Activities within GAI (Accreditation)

As we all respond to the unprecedented events unfolding related to the coronavirus (COVID-19), we want to take a moment to communicate with our accredited laboratories expecting an audit this year. GSI has been monitoring news surrounding COVID-19 and determined steps our institute can take to ensure the wellbeing of our customers and staff.

First and foremost, our thoughts are with those directly and indirectly impacted by the global pandemic. We understand you may need to take time away from your business and your customers. If you find your organization in a unique situation, please let us know how we can assist.

For labs expecting an on-site audit this year, we will not be conducting any more for the remainder of 2020. They are being postponed until 2021. All GAI-LAP Accreditations in good standing and with passing

proficiency results will automatically be granted extensions for next year. These steps we are taking are in the best interest of everyone's health and safety.

GSI and GAI-LAP are committed to maintaining the highest level of customer service. Please reach out to us via phone or e-mail. The Institute remains open to staff only at this time. Circumstances continue to change rapidly as more news becomes available, but GSI remains committed to you. We appreciate your continued support and look forward to better times ahead.

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 257 GAI-LAP test methods available for accreditation. Please consult our home page for a current listing. As of September, 2019, 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 (17 tests)
Rebecca Kurek -- (770) 869-1787
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)
Joe Tomei -- (978) 635-0424
idt@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 (79 tests)
Hang Won-Cho -- 82-2-3299-8071
hwcho@fitiglobal.com
- 31^D - NYS Dept. of Transportation (9 tests)
Tom Burnett -- (518) 485-5707
tburnett@dot.ny.gov
- 34^B - Solmax (GSE) - Houston, TX USA (18 tests)
Lana Hickman
Lhickman@solmax.com
- 38^C - CTT Group SAGEOS (123 tests)
Oliver Vermeersch -- (450) 771-4608
overmeersch@gcttg.com
- 40^B - Solmax (GSE) - Kingstree, SC USA (14 tests)
Thomas Harrelson -- (843) 382-4603
tharrelson@solmax.com
- 41^A - SGI Testing Service, LLC (19 tests)
Zehong Yuan -- (770) 931-8222
ZYuan@sgilab.com
- 42^C - NPUST (GSI-Taiwan) (71 tests)
Chiwan Wayne Hsieh -- 011-886-8-7740468
CWH@mail.npust.edu.tw
- 43^A - Ardaman & Associates (22 tests)
George DeStefano -- (407) 855-3860
gdestafano@ardaman.com
- 44^B - Berry Global Inc. (9 tests)
Julie Solarz -- (615) 847-7299
juliesolarz@berryglob.com
- 45^B - Ten Cate Geosynthetics Malaysia SDN Bhd. (24 tests)
Boon Kean Tan -- (603) 519 28576
BK.tan@tencategeo.com
- 46^B - TAG Environmental Inc. (13 tests)
Ryan Ackerman -- (705) 725-1938
ryan_ackerman@tagenv.com
- 49^B - Engepol Geossinteticos (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 - Canada (21 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
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- 56^B - Polytex Santiago (13 tests)
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- 57^B - Ten Cate Cornelia (22 tests)
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- 58^B - Propex Furnishing Solutions - Hazlehurst (10 tests)
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- 59^B - Firestone (9 Tests)
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- 61^B - Raven Industries (24 tests)
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- 62^B - SOLMAX - Selangor - Malaysia (14 tests)
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- 63^A - TRI-SC Labs (12 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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- 74^B - Agru America Inc. (9 tests)
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- 75^B - GeoMatrix S.A.S. (37 tests)
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- 85^B - PAG Tacna (17 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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Anant Kandi - anant@techfabindia.com
- 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 Fibres (19 tests)
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Nilay Patel - 706-336-7000
[Nilay@skaps.com](mailto:nilay@skaps.com)
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cv.kanade@strataindia.com

^AThird Party Independent ^CInstitute
^BManufacturers QC ^DGovernment

If anyone desires more information on the GAI-LAP, its test methods, the associated laboratories, etc., please go to our website <https://geosynthetic-institute.org/gai/lab.htm>.

The semi-annual GAI-LAP meeting was held in Atlanta, Georgia USA in conjunction with ASTM D35 on Thursday, February 6th at the Marriott Marquis Hotel in downtown Atlanta. As you can see by the picture below, the meeting was very well attended with 21 people in the room. The meeting was held at 7:30 AM before the ASTM Task Group meetings began and lasted about an hour. For members who could not attend, a virtual repeat meeting was held as a webinar on Thursday, February 20th and 19 open portals were observed. In

addition, two groups requested the webcast recording. We thank ASTM for providing us this venue in Atlanta. I also want to thank all that attended for their time, interest and interaction. We are grateful for their participation and hope it stirs a robust conversation about geosynthetic laboratory quality.

The discussion at the one-hour meeting was as follows: A brief introduction and background of the GAI-LAP program was presented. Please note that we are in our 25th year of operation with the program starting 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 a total of a total of 88 labs. Forty-six (46) of these labs are GSI members and 39 are international labs from 21 different countries. Recently, there has been increased interest internationally. There are 257 possible tests for accreditation (199 ASTM and 58 ISO consensus standards). The number of accredited tests per lab varies greatly; ranging from a minimum of two to a maximum of 144, with an average of 27.

In the past year, 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 where 4,728 proficiency tests were conducted in 2019.

- 31 first submittal outliers ($> \pm 2$ std. dev.), which represents 0.7% of total tests
- 23 different laboratories
- 7% highest ever, 0% lowest ever, with a 2% overall average
- Results of proficiency tests are shared anonymously after all CARs are closed with root causes identified

There has been a challenge to the way in which we calculate statistics!

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



Figure 1

Front Row: Bill Kennedy, Sam Allen, Rich Lacey, Carol Hall, Gary Torosian, Dave Suits, Dave Beaumier, Rebecca Kurek
Back Row: Jimmy Youngblood, Henry Mock, Marshall Sossoman, Joel Sprague, Beth Young, Nathan Ivy, Jeff Kuhn, Zahisul Islam, David Alexander, J. P. Kline, Melissa Medlin, Rob Valorio, Eli Cuelho
Not Pictured: Katrina Koperna and George Koerner

Several other certification and accreditation programs around the world are now requiring proficiency test data per ISO 17025. All GAI-LAP labs and PTP labs comply with these requirements. In addition, we have the tools needed to calculate uncertainty for each test in their repertoire.

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 for laboratory

testing: Lumite for woven geotextile and erosion control material, Propex for nonwoven geotextile, TenCate for geotextile and geogrid, Mineral Tech (CETCO) for two different GCL's, Aquatan for the geomembrane seam, ADS for the plastic pipes, Maccaferri for the drainage geocomposite, Solmax for the geomembrane, Firestone for the geomembrane, PolyAmerica for the geomembrane, and ACF Inc. for a bunch of GeoStuff year after year (we appreciated your continued friendship and generosity). Thank you!

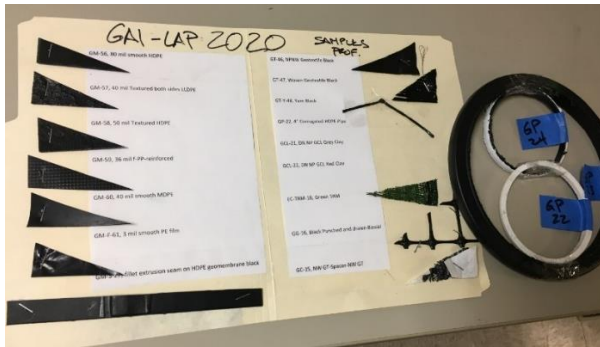


Figure 2. PTP samples for 2020.

It should be clearly stated that GSI's Proficiency Testing Program (PTP), which started 25 years ago, 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 enables laboratories to evaluate and improve performance, while maintaining and fulfilling 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 program. 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, with a 33% (28/85) return which is an average return rate. The following are the results (5 best to 1 poorest):

1.	GAI-LAP information exchange	4.5
2.	Conflict Resolution Service	4.75
3.	Proficiency Test Program	4.92
4.	GAI-LAP Directory	4.39
5.	GAI-LAP Internet Information	4.35
6.	Timeliness of Service	4.78
7.	Shipping and Handling	4.75
8.	Accuracy of Deliverable	4.64
9.	Impartiality	4.89
10.	Confidentiality	4.92
11.	Benefit versus Cost of Program	4.7
12.	GAI-LAP Overall	4.75

Overall, results to date: 2019 (4.7), 2018 (4.5), 2017 (4.3), 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 (4.2), 2007 (3.9), 2006 (4.0), 2005 (4.0), 2004 (4.1), 2003 (4.1), 2002 (4.2)

As you can see by the tabulation above, this is the best result we have ever received. We must be doing something right with everyone working together to make a better geosynthetic industry!

A total of 19 on-site audits were conducted in 2019, all by GSI staff. There always seems to be a reciprocal learning from each experience, which is very satisfying. In most labs, management and technicians are doing a

fantastic job. We have a total of 16 audits scheduled for 2020. It appears that the Corona virus will curtail some travel; however, we will get to all of them in a timely manner.

As usual, we had a lively discussion at the GAI-LAP meeting regarding the conflict resolution (CR) cases addressed by the GAI-LAP during the past six months. Eight (8) of them are summarized below:

1. ASTM D6496, GCL Peel

GRI- GCL3 states that a reinforced GCL should have a specified peel strength of 360 N/m (2.1 PPI). When materials hover near this relatively low value, they can be compromised by rough (aggressive) shipping and handling. It is recommended that the initial wrap of material from the shipped GCL rolls is discarded before taking a roll width sample. It was determined that at this particular site, the low peel strength of the material was aggravated by poor handling practice on the first round of conformance testing.

2. ASTM D5321, Direct Shear

A witness challenged data acquisition (PAQ) versus display reading of shear stress. This was a mistake picked up by coincidence. Note that the client was observing the interface shear test in progress. It is a reminder to all of us that the correlation coefficients must be regularly verified for all load cells and that redundant displays that monitor and record agree with one another.

3. ASTM 751, Grab r-PE

The type of grab tensile grip faces are important, and will affect results. When dealing with the grab tensile test the grip faces of the clamps matter. The test 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 groove, etc. This is by no means cheating and has been used regularly in the geosynthetic testing business since the inception of the standard.

4. ASTM 751, Hydrostatic Burst r-PE

The strange thing about ASTM D751 Test Methods for Coated Fabrics is that it gives guidance on six (6) different test methods: (thickness), (mass/unit area), (tongue tear), (grab), (hydrostatic resistance) and/or (bonded seam strength). In my humble opinion, the description of the procedure in each case is brief to say the least. Hydrostatic resistance is probably the most complex method in the standard and has the least description written about it. This lack of specificity has

led to different devices being used to test this property. Unfortunately, this nonuniformity in equipment yields different results, particularly when high pressure is encountered with strong geomembranes. This standard needs to be revised, but it is not under the purview of ASTM D35 (Geosynthetics). It is an ASTM D20 (Plastic) standard, and they do not want to update it.

5. ASTM D5885, HP OIT

Analysis: "Fingerprinting" of multicomponent geomembranes, or geosynthetics for that matter, can be problematic. The make-up of any geosynthetic will be influenced by its formulation, manufacture, and fabrication. Gone are the days when a manufacturer or "converter" loads the hopper of an extruder with a base resin and a masterbatch (consisting of a carrier resin and an additive package) and extrudes a geomembrane. Most materials are blends of several different compounds. In addition, there could be textured, special performance layers such as EVAL-EVOH vapor barrier inclusions, tie layers, different colors, reinforcement, conductive layers, etc. The purpose for the differing configurations or layers is to either enhance the properties, change the appearance, or increase benefit/cost. The possibilities are endless and the client has a large range of options.

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

Prior to commissioning any testing of these multilayered geomembranes, there needs to be an open and frank discussion of what should be tested, how coupons are exposed, and how specimens should be prepared prior to testing. In regard to the latter issue, there is precious little guidance in regard to specimen preparation of multilayered geomembranes. There are two very different alternatives available for specimen preparation, homogenization or dissection. GSI has procedures or alternatives. For example, GSI White Paper #36 "Sample and/or Specimen Preparation for Testing Multilayer Geomembranes" may aid in this regard.

6. ASTM D5890 Swell Index

It was discovered that the nature of distilled deionized water used in the test matters significantly to the results. It was also noted that how one handles (cleans) the glass ware is significant. One can imagine residual soap if left on the glassware would alter the Swell Index of GCL's bentonite. It was also discovered that polymer modified bentonite alter swell results. Polymers have the effect of changing the viscosity of reagent grade 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 settling at the bottom of the graduated cylinder. D35 is making adjustments to the standard to address all of the above concerns. Until it is promulgated, clients and labs need to keep an open conversation on the subject.

7. ASTM D5397, NCTL Stress crack (notch)

We have known for many years that the key to good SPNCTL testing is sharp consistent notching. If you are running the test per the appendix, for conformance testing, all the specimen ligament thicknesses should be 80% of the average specimen thickness. Hence, all the masses on the five rocker arms should be the same. Now, let us introduce multilayer geomembranes like conductive HDPE with a 5-7 mil skin of 20-25% carbon black on one side. Depending on what side of the sheet one makes the notch, you can have very different results, (ligament including high CB layer, SPNCTL result 150-200 hours versus ligament without high CB layer, SPNCTL result >500 hours).

This discussion is very similar to number 5 (HP-OIT) above. We reiterate that prior to commissioning any testing of multilayered geomembranes, there needs to be an open and frank discussion of what sampling and specimen preparation procedures should be used prior to initiation of testing.

8. ASTM D6637, GG Tensile

Who says you can't teach an old dog new tricks? I just found out that I have been conducting part of GG Tensile incorrectly. Section 11.2.1 of ASTM D6637/D6637M-15 clearly states that one needs to make both a slack displacement and slack tension correction to data for correct interpretation of results. In truth, I have never made a slack tension correction to any tensile test and always thought of this as cheating the material of a couple pounds of pre-load. I apologize for this oversight. Going forward, I will audit per the ASTM standard-norme verbatim.

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, July 2, 2020 in conjunction with ASTM D-35 in Boston Massachusetts USA. It is always a pleasure working with the GAI-LAP labs. We appreciate their participation and urge them to contact us accordingly with questions and concerns. GSI takes pride in servicing the program to the best of our ability.

George R. Koerner

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 listed below. As you can clearly see, it was a very good year for the GCI-ICP program. We would like to thank TRI Environmental Inc. for their significant contribution to the success of this certification program. Their promotional strategies and in-house QA/QC course have generated renewed interest in the program. Special thanks to Sam Allen, Jeffrey Kuhn and Mark Sieracke for teaching the course.

Inspector Certification Test Results 2006 – 2020

Year	Geosynthetic Materials		Compacted Clay Liners		Commentary No. of people failing both exams
	No. of people taking exam	No. of people failing exam	No. of people taking exam	No. of people failing exam	
2006	141	5 (3%)	128	12 (9%)	2
2007	82	11 (13%)	73	12 (16%)	7
2008	95	25 (26%)	89	20 (22%)	13
2009	36	7 (19%)	36	2 (5%)	2
2010	59	12 (20%)	54	7 (13%)	5
2011	54	6 (11%)	53	3 (6%)	1
2012	34	5 (15%)	28	3 (11%)	3
2013	32	4 (12%)	30	1 (3%)	1
2014	45	1 (3%)	42	3 (7%)	0
2015	56	6 (11%)	51	6 (12%)	1
2016	36	3 (10%)	35	5 (18%)	0
2017	78	5 (6%)	66	3 (4%)	1
2018	53	5 (10%)	51	1 (3%)	0
2019	114	20 (18%)	119	15 (13%)	9
2020	3	-	3	-	
TOTAL (to date)	918	115 (13%)	858	93 (11%)	47 (5%)

There are currently 420 practicing certified inspectors, 340 inspectors (2015-2020) and 80 inspectors (2006-2014) who have renewed to keep certification current.

The GCI-ICP Program had a 53% increase in participants from 2018-2019. The QA/QC course and exam is being held on April 8-10 in Austin, Texas at TRI Environmental. We've already received nine applications for the GCI-ICP Inspector Certification Program and expect this number to double by the time "Gcoll" is in session.

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

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

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

The status of the program is shown in the following table. Here it can be seen that this particular GSI certification has been less than anticipated even though we have 340 similar MSE wall failures. We do have one positive announcement regarding the program. We have received our first renewal for inspector certification this month.

Inspector Certification Test Results for
MSE Walls and Berms Inspectors
2011 – 2019

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
2017-19	GSI On-Line Course	0	0
TOTAL		24	0

Program #3 - Geosynthetic Designer Certification

The “Geosynthetic Designer Certification Program (GDGP)” 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 $\geq 70\%$ 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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Marilyn Ashley marilyn@geosynthetic-institute.org

The GSI Affiliated Institutes

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

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

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

GSI-Taiwan was formed on August 18, 2000 and is wholly contained within the National Pingtung University of Science and Technology in Nei Pu, Pingtung (southern Taiwan). It completely parallels GSI in that it has specific units for research, education, information, accreditation and certification. The Director is Dr. Chiwan Wayne Hsieh who is a Professor in the Department of Civil Engineering and Dean of the R & D Office. GSI-Taiwan has a Taiwanese consortium of geogrid/geotextile manufacturers who work toward producing quality products according to the draft GRI geogrid specifications and the associated test methods. As such, GSI-Taiwan is a GAI-LAP accredited laboratory for 59 geosynthetic test methods. Dr. Hsieh has 10 students working on geosynthetic-related projects and is extremely active nationally and internationally. GSI 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 direction of Dr. A. K. Mukhopadhyay 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.

GSI Member Organizations

We sincerely thank all of our sponsoring organizations for their continued support. Without them, GSI could not exist. The current GSI member organizations and their contact members are listed below. **Our newest member is Engepol Geossinteticos Ltda., located in Brasil. We welcome you to GSI.**

U.S. Environmental Protection Agency

David A. Carson (BOA)

Federal Highway Administration

Silas Nichols/Daniel Alzamora

Golder Associates Inc.

Frank Adams/Paul Whitty/Linda Grover

Tensar International Corporation

Mark H. Wayne/Joseph Cavanaugh/Doug Brown

TenCate Geosynthetics

John Henderson/John Lostumbo/Chris Lawson

CETCO

Dave Chiet/Michael Donovan/Rob Valorio

Huesker, Inc.

Flavio Montez/Andreas Elsing/Lilma Schimmel

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