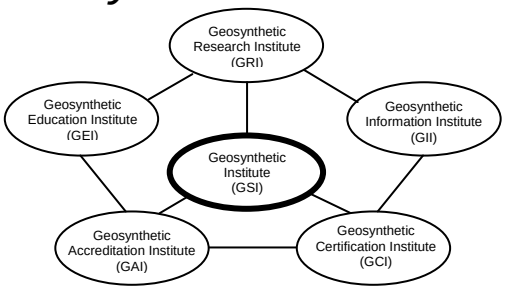
The GSI Newsletter/Report

Geosynthetic Institute



Vol. 26, No. 4 **December, 2012**

This quarterly newsletter, now in its 26th 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 gkoerner@dca.net or mvashley@verizon.net.

Happy Holidays and a Healthy and Prosperous New Year

Activities of GSI's Directors

1. The Instructor's Guide that accompanies and compliments the new 6th Edition of Designing With Geosynthetics is the hottest item we have…after all it's free! It consists of a CD with 1230 slides on it and it is not encrypted so one can add or subtract as desired. Just contact us and we will send it to you without any charge at all.
2. The geosynthetics webinars (eight of them) being released through ASCE are quite popular with 10 to 45 companies accessing each of them. The complete set is offered twice a year. Go to www.asce.org/webinars for information. That said, ASCE offers many civil engineering topics but we believe ours are the only ones on geosynthetics.
3. George is preparing to send proficiency samples to the GAI-LAP participants so expect them shortly before, or immediately after, the holidays.
4. The series of four in-house courses did not draw well this Fall. A repeat will be offered in March, 2013 and will assess the situation afterward.
5. We are in the midst of our Board of Directors election cycle of 2013-2015 with John Workman of Waste Management, Inc. replacing Tony Eith (changed job) for the Owner/Operator group and Mark Wayne of Tensar replacing Boyd Ramsey of GSE for the Geotextile/Geogrid group. The third position, which is At-Large is being balloted presently… more later.
6. The present BOD is as follows, along with their respective term ending year's.

Term Ends 2013

- David Jaros - Corps of Engineers (Government Agencies)
  e-mail: dave.l.jaros@usace.army.mil
- Lili Cui – Chevron Phillips Co. (Resin/Additive)
  e-mail: cuil@cpchem.com
- Kent von Maubeuge - NAUE GmbH & Co. KG (International-1)
  e-mail: kvmaubeuge@naue.com

In This Issue

Term Ends 2014

- Mark Sieracke - Weaver Boos (Consultants and Testing Labs)
  e-mail: msieracke@weaverboos.com
- Tim Rafter - CETCO (Geomembranes and GCLs)
  email: tim.rafter@cetco.com
- Wayne Hsieh - NPUST and GSI-Taiwan (International-2)
  e-mail: cwh@mail.npust.edu.tw

Term Ends 2015

- 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
- Presently being balloted (At-Large)

Overview of GRI Projects (Research)

Each issue of our Newsletter/Report provides a brief glimpse and update of current GRI research projects. It will be noted that most projects are of a very long duration; one being up to 50-years! (In this regard short projects are given to design firms or testing laboratories that are GSI Members). Details and full briefings are available to member organizations at their request. Dr. Grace Hsuan, Associate Director of GRI can be contacted for additional information as can the other project managers listed in the following write-ups. ***Projects marked with an asterisk have been written up as either short "in-progress" papers or complete papers.*** Grace can be reached by email <grace.hsuan@coe.drexel.edu> or phone at (610) 522-8440.

Important Notice: Use of GSI/GRI generated data and information is for member organization use assuming that the information is not taken out of the context of which it was developed. When used for formal publications such as proposals, regulatory permits, brochures and advertisements we would appreciate seeing a draft copy for possible comments. Thank you for your cooperation in this regard.

1. **In-Situ Temperature Monitoring of Liner and Cover Geomembranes in Dry and Wet Landfills*** - George Koerner is measuring the in-situ temperature behavior of liner and cover geomembranes and has installed 60± thermocouples for long term measurements in both wet and dry municipal solid waste landfills in Pennsylvania. The project has been extended into its 15th-year and has resulted in an extremely authoritative set of real-life data.
2. **Bioreactor (aka, Wet) Landfill Behavior and Properties*** - One of the landfill cells mentioned in Item #1 is at field capacity, hence it is a true anaerobic bioreactor. Dr. George Koerner is in charge of considerable monitoring at this cell which includes the following
   - waste moisture content
   - waste temperature
   - leachate chemical analysis
   - waste gas analysis
   - perched leachate within the waste

   Data is being collected on a quarterly basis. The timeline of the project calls for monitoring up to 10 years. This activity has been extended to an adjacent landfill to see how reproducible the data is with a slightly different waste mass.
3. **Flow Behavior of Fully Degraded Waste*** - A field project under sponsorship of GSI and Waste Management investigates the drainage of highly degraded MSW placed directly on leachate collection systems. The leachate collection materials consist of both natural soils and geosynthetic drains. The experimental setup has been dismantled and a presentation was given at the 2012 Global Waste Conference in Phoenix… a paper will follow.
4. **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) is often using a wrap-around configuration leaving the geogrid exposed to the atmosphere. A new project being conducted by George Koerner for Waste Management is presently investigating two different geogrid's behavior over time. A 50-year time frame is envisioned. The long-term behavior will eventually be compared to UV laboratory exposed data as noted in Item #7 below.
5. **Field Behavior of fPP and fPP-R Geomembranes** - We continue to receive and evaluate field samples of flexible polypropylene geomembranes (mainly scrim reinforced). They are regularly added to our database in this regard. The most recent was for potable water storage and had a service lifetime of 10-years. Using our correlation factor of 1200 light hours in D7238 at 70°C being equivalent to one-year in a hot climate, this is equivalent to a laboratory exposure in the weathering device of 12,000 light hours. Our GRI-GM18 specification calls for 20,000 light hours for an acceptable formulation which is essentially a factor-of-safety of 1.7.
6. **Laboratory Exposed Lifetime of Geomembranes*** - GSI is using three UV-fluorescent devices to estimate the projected exposed lifetime of many different types of geomembranes. Presently being incubated are HDPE, LLDPE, fPP, PVC (N.A.), and EPDM. Exposure times of 50,000 light hours are now

realized at 70°C and a replicate set of samples are being incubated at 60°C. Some will take at least 70,000 light hours (≈ ten years). The third sequence at 80°C was started on 1/1/2010. Ongoing data is being reported to manufacturers and resin producers. GRI Report #42 is available on the 70°C data using a correlation coefficient to estimate field lifetime of the various geomembranes.

7. **Laboratory Exposed Lifetime of PVC (European) Geomembranes** - Of late, we have been attempting to distinguish between PVC geomembranes manufactured in North America versus Europe. Of course, the difference is in the type of plasticizers and other additives used in the formulations. In this regard we have been evaluating various 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.
8. **Laboratory Exposed Lifetime of Geogrids** - The UV-fluorescent exposure of two different polypropylene biaxial geogrids which are used at the exposed faces of welded wire mesh MSE structures is ongoing. The various geogrids are now up to 40,000 light hours and data is being generated and sent to the respective manufacturers; Tensar and TenCate. Replicate samples are now being incubated at 60°C for eventual use in Arrhenius Modeling and lifetime prediction. The last set at 80°C has just begun incubation.
9. **Laboratory Exposed Lifetime of TRM Fibers** - We are also using UV-fluorescent exposure of four different turf reinforcement mat fibers to assess their lifetime capabilities. They are presently being incubated at 60°C, 70°C and 80°C. Communication between the manufacturer Propex is ongoing.
10. **Laboratory Exposed Lifetime of Geotextiles** - We have just completed a UV study on a heat-bonded nonwoven PP geotextile used for three dimensional cell structures which are exposed to the atmosphere. The results for the particular geotextile and its specific formulation at 20°C (68°F) average field temperature are 4.9 years for halflife of breaking strength and 4.1 years for halflife of breaking elongation.
11. **Laboratory Exposed Lifetime of Geomembrane Tapes** - There are several adhesive sided geomembrane tapes used to repair exposed geomembranes. Two different types are being evaluated in our QUV exposure devices.
12. **Retaining Wall Failure Evaluations* -** We presently have GRI Reports 38, 39, and 40 addressing mechanical stabilized earth (MSE) walls using geosynthetic reinforcement which document 82-failures. Our data base has now increased to 171 failures and continues to grow! The failures are either excessive deformation or 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. We have just recently presented the findings at two geotechnical conferences; one in Williamsburg and the other in Hershey. A paper on the first 141 failures is available.
13. **pH Between Masonry Block Wall Units*** - George Koerner has been measuring the pH between three types of masonry blocks for over six years to monitor the values. Concern here is over PET geogrids which are known to be sensitive to high alkalinity environments. Indeed, the values started high, but over time are now down to eight and lower. George Koerner has a paper in this regard.
14. **Landfill Failure Analysis** - Since our originally reported paper on ten landfill failures in a 2000 publication, we have accumulated ten more. All 20-failures have been analyzed by Dr. Connie Wong using the ReSSA Code and are now available to members and associate members as GRI Report #41.
15. **Puncture Behavior of Nontraditional Protection GSs** - A member organization asked about the protection afforded to a geomembrane by geonet composites and GCL's. As a result, we have just concluded a laboratory study using three different probes against various GMs protected by geotextiles, GCs and GCLs. The resulting paper has been published by ASTM's Journal of Geotechnical Testing… it's available.
16. **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 reasonable for most geomembrane types, it is questionable for HDPE which is semi-crystalline and cannot stress relax. To investigate slower rates Bob Koerner is performing a new project with rates as low as 6.9 kPa/month (1.0 psi/month)! Initial data is available.
17. **$CaCO_3$ in Bentonites Contained Within GCL's** - It is possible that the amount of calcium carbonate contained within the bentonite of different GCL's is indicative of their hydraulic performance. George Koerner has evaluated 15-bentonites and has a paper in progress.
18. **Generic Specifications** - A major effort is ongoing with respect to the development and maintenance of generic geosynthetic specifications. The current status of these specifications is as follows:

<u>Completed, Available and Regularly Updated</u>
GM13 – HDPE Geomembranes
GM17 – LLDPE Geomembranes

GM18 – fPP and fPP-R Geomembranes
GM21 – EPDM and EPDM-R Geomembranes
GM22 – Exposed Temporary Covers
GM25 – LLDPE-R Geomembranes
GM19 – Geomembrane Seams
GT10 – Geotextile Tubes
GT12 – Geotextile Cushions
GT13 – Geotextile Separators
GCL3 – Geosynthetic Clay Liners

Working Within Focus Group
GTXX – Turf Reinforcement Mats (tabled)
GCXX – Geocells

Delayed or Off in the Distance
GGXX – Bidirectional Geogrids
GGXX – Unidirectional Geogrids
GNXX – Geonet Drainage Composites
GCXX – Other Drainage Geocomposites
GSXX – High Strength Reinforcement Geotextiles

The complete set of specifications are available to everyone (members and nonmembers) on the open section of our Home Page. Please download and use them accordingly. Also note that this is where the latest modification will always be available. There is a brief tutorial accompanying each specification. They will be updated shortly. Copies of the above listed draft specification tables are also available to members and associate members.

19. **Other GRI Standards** - There are several GRI Standards in various forms of preparation. These include the following:
    - Guide for constructing test pads
    - guide for lifetime prediction using TTS and Arrhenius modeling
    - Test method for average geomembrane thickness
    - guide for geocell seaming efficiency
    - A group of test methods being prepared for both Milliken and ThermaGreen Companies for their respective new products.

Progress within GII (Information)

Our GSI Home Page (which has a revised opening format) is accessed as follows:

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

It has been completely 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:

- **Introduction to GSI**
- **Prospectus**
- **Associate Membership (Agencies)**
- **Members by Focus Groups**
- **GSI Publications**
- **GRI Specs, Guides, White Papers**
- **Laboratory Accreditation**
- **Product Certification**
- **Newsletter/Reports**
- **Internet Courses**
- **GSI Members Links**
- **GSI Member Meetings**
- **Courses at GSI**
- **Insp. Cert. Programs**

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 get 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 30,000 citations which is the majority of the geosynthetics literature published in English. It's quite easy to use 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.

In addition to the information provided in our home page as just mentioned, Jamie Koerner (Special Projects Coordinator) is performing various surveys of pertinent topics in geosynthetics.

Most of these have been turned into GRI White Papers; the following being the most recent.

#20 - GS Opportunities with Shale Gas Extraction
#21 - State Regulatory Departments Involved in Shale Gas Permitting
#22 - Selected GS Opportunities with Energy Production and Transmission
#23 - EPA Agencies Regarding Landfill Berms
#24 - Reduction Factor for Holes in GS Reinforcement
#25 - The Separation-in-Plane (SIP) Mode of Failure When Testing GM Seams
#26 - Need for Justification of Quality Management Systems for Successful GS Performance

Jamie's most recent survey is a retrospective review of the 136 faculty which participated in the Educate-the-Educators week-long courses at Auburn University from 1994-1998. Do ask for a copy if interested.

Progress within GEI (Education)

Free CD
We sent a broadcast e-mail to everyone stating that many power point presentations were available and

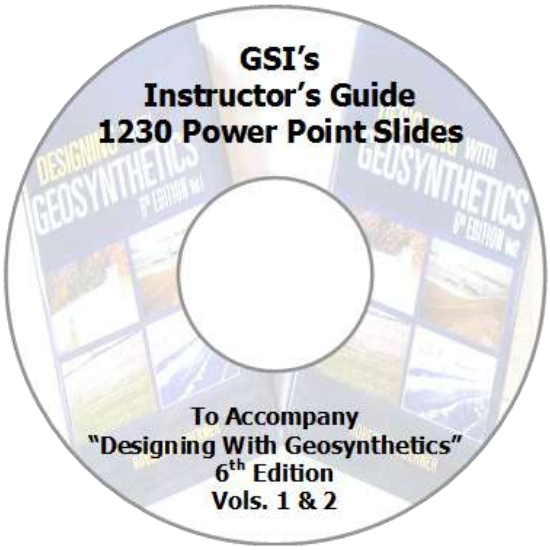
would be sent upon request. Many persons replied asking for all of them. Therefore, we put all 63 presentations on a CD which was sent to all GSI contact persons. That said, we have many copies still available so do ask and we will mail it to you immediately. Topic areas are all types of geosynthetics, plus walls/slopes, landfills, specifications, and miscellaneous.

6th Edition of Designing With Geosynthetics

The 6th Edition of Designing With Geosynthetics continues to sell well in all three of its formats; hardback, softback and e-book… the latter is really cheap!

The two volume set can be purchased through GSI, Xlibris, Amazon and Barnes and Noble. A special link in available on the cover page of our website.

Our most recent activity in this regard is to develop a power point presentation for the entire 914-page book. This is what it looks like and it does indeed contain 1230 nonencrypted ppt slides.



Call or e-mail if you want a copy. It is free to all, but we need your postal address.

GRI Reports

To date, we have 42 GRI Reports available to members and associate members. These reports vary in length from 30 to 200 pages and beginning with Report #25 they are on the password protected section of our home page. Prior to that date only the abstract is available online. All of them, however, are available in hard copy. The most recent reports are as follows:

- #38 – A Data Base and Analysis of Geosynthetic Reinforced Wall Failures
- #39 – Methods of Stabilizing Excessively Deformed MSE Walls
- #40 – On the Prevention of Failures of Geosynthetic Reinforced MSE Walls and Recommendations Going Forward
- #41 – Analysis and Critique of Twenty Large Solid Waste Landfill Failures
- #42 – Lifetime Prediction of Laboratory UV Exposed Geomembranes Based on a Correlation Factor (due January 2, 2012)

Courses

We have just scheduled the following set of courses:

#1 March 13, 2013
MSE Wall Failures and Their Remediation

#2 March 14, 2013
Construction Inspection of MSE Walls, Berms and Slopes
(Optional Exam Follows)

#3 March 20, 2013
Design and Testing of Geosynthetics in Waste Containment Systems

#4 March 21, 2013
QA/QC of Geosynthetics in Waste Containment Systems
(Optional Exam Follows)

Each course carriers with it 8 PDH's. All are held at GSI so demonstrations by George enliven and illustrate the respective lectures. GSI is approximately 4.5 miles from Philadelphia International Airport.

Course Registration and Fee:
$350/person for each one-day course (up to one month prior to course)
$400/person thereafter
$250/person – GSI Members
Contact: Marilyn Ashley (mvashley@verizon.net)

GSI Fellowships

As in the past, GSI has been awarding graduate fellowships for students performing geosynthetics research. There were nine new proposals this academic year. These proposals were then reviewed by the GSI Board of Directors along with Bob and George Koerner.

The presently established criteria are as follows:

- Students must be working on a geosynthetics topic which furthers the technology in a proactive manner.
- Students must have completed their candidacy requirements leading to a doctoral degree. (Comment, we hope that some of them will "go academic" and teach and/or research geosynthetics in their immediate future)
- Students must be recommended by their advisor or department head.

- The fellowships can be renewed for a total of three-years depending upon acceptable annual reports.
- Funding for each student is $10,000 the first year and $5000 for the second and third years.

The following table identifies the successful recipients, their university, advisor and topic. We congratulate the students and wish them success in their endeavors. If any readers wish to add congratulations or to find greater detail as to specific projects and students please contact us accordingly.

GSI Fellowship Status for 2012-'13 Academic Year

Class 4 (a) – 2nd Year Funding at $5,000 per student

No.	Name	University	Advisor	Topic
3-11	Felix Jacobs	RWTU-Aachen, Germany	Martin Ziegler	Geogrid Reinforced Soil in Biaxial Compression Tests
4-11	Mahmound Khachan	Syracuse University	Shobha Bhatia	Dewatering Performance of Geotextile Tubes

Class 5 (a) – 1st Year Funding at $10,000 per student

No.	Name	University	Advisor	Topic
1-12	Chuangi Wang	University of Memphis	David Arellano	Properties of Recycled Expanded Polystyrene
2-12	Xunchang Fei	University of Michigan	Dimitrois Zekkos	Biodegradation of Geotextiles
3-12	Jitendra K. Thakur	Univeristy of Kansas	Jie Han	Recycled Asphalt Used in Geocells

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. In short, this means that the 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 and documentation for specific standard ASTM, ISO or GRI 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 230 GAI-LAP test methods available for accreditation. Please consult our home page for a current listing.

As of December, 2012, 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. (118 tests)
Sam Allen -- (512) 263-2101
Sallen@tri-env.com

3[A] - Golder Associates (45 tests)
David Alexander -- (770) 492-8280
dalexander@golder.com

4[C] - Geosynthetic Institute (116 tests)
George Koerner -- (610) 522-8440
gkoerner@dca.net

8[B] - Propex, Ringgold (19 tests)
Todd Nichols -- (800) 258-3121
todd.nichols@propexinc.com

9[B] - Lumite (10 tests)
Rebecca Kurek -- (770) 869-1700
rpage@lumiteco.com

13[A] - Precision Laboratories, CA (95 tests)
Cora Queja -- (714) 520-9631
cqueja@precisionlabs.net

14[A] - Geotechnics (57 tests)
J. P. Kline -- (412) 823-7600
JPkline@geotechnics.net

20[A] - GeoTesting Express, MA (46 tests)
Gary Torosian -- (978) 635-0424
gtt@geotesting.com

22[B] - CETCO Hoffman Estates (13 tests)
Jim Olsta -- (847) 392-5800
jim.olsta@cetco.com

23[B] - CETCO Cartersville (10 tests)
Chris Cunningham -- (706) 337-5316
christopher.cunningham@cetco.com

24[B] - CETCO Lovell (10 tests)
Roger Wilkerson -- (307) 548-6521
roger.wilkerson@cetco.com

25[B] - Ten Cate, Pendergrass (11 tests)
Beth Wilbanks -- (706) 693-2226
b.wilbanks@tencate.com

26[B] - Agru America Inc. (17 tests)
Grant Palmer -- (843) 546-0600
gp@agruamerica.com

29[e] - FITI Testing and Research Institute (86 tests)
Hong-Kwan Kim -- 82-2-3299-8071
hoganKim@fiti.re.kr

31[D] - NYS Dept. of Transportation (9 tests)
John Remmers -- (518) 457-4104
Jremmers@dot.state.ny.us

32[A] - Geo-Logic Inc. (6 tests)
Ken Criley -- (530) 272-2448
criley@geologic.com

34[B] - GSE Richey Road (34 tests)
Jane Allen -- (281) 230-6726
Jallen@gseworld.com

37[B] - GSE Chile (21 tests)
Mauricio Ossa -- 56-2 6010153
Mossa@gseworld.com

38[C] - Sageos/CTT Group (91 tests)
Eric Blond -- (450) 771-4608
eblond@groupecttgroup.com

40[B] - GSE Lining Technology Inc. (17 tests)
Vicki Parrott -- (843) 382-4603
Vparrott@gseworld.com

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

42[C] - NPUST (GSI-Taiwan) (69 tests)
Chiwan Wayne Hsieh -- 011-886-8-7740468
CWH@mail.npust.edu.tw

43[A] - Ardaman & Associates (18 tests)
George DeStafano -- (407) 855-3860
gdestafano@ardaman.com

44[B] - Fiber Web, Inc. (9 tests)
Adam Lyons -- (615) 847-7575
adam.lyons@fiberweb.com

45[B] - Ten Cate Malaysia SDN Bhd. (23 tests)
C. P. Ng -- (603) 519 28568
cp.ng@tencate.com

46[B] - TAG Environmental Inc. (13 tests)
Colin Murphy -- (705) 725-1938
colin_murphy@tagenv.com

47[B] - Syntec LLC (9 tests)
Jeffrey Hicks – (410) 327-1070
jhicks@synteccorp.com

49[B] - Engepol Geossinteticos (19 tests)
Carolina Polomino -- (55) 11-4166 3001
carolina@engepol.com

50[B] - ADS, Inc. Hamilton (7 tests)
Terry McElfresh -- (513) 896-2065
mcelfresh@ads-pipe.com

51[B] - Solmax International Inc. (20 tests)
Simon Gilbert St. Pierre -- (450) 929-1234
simonGSP@solmax.com

53[B] - Polytex Inquique (13 tests)
Cristian Valdebenito -- 011 56 57 42 90 00
cvaldebenito@polytex.cl

54[B] - ADS, Inc. Finley (9 tests)
David Gonso -- (419) 424-8377
davegonso@ads-pipe.com

55[B] - Atarfil Geomembranes (20 tests)
Iganacio Garcia Arroyo -- 34 958 439 278
ngarcia@atarfil.com

56[B] - Polytex Santiago (11 tests)
Jamie Morales -- 56-2-627-2054
Jmorales@polytex.cl

57[B] - Ten Cate Cornelia (15 tests)
Melissa Medlin -- (706) 778-9794
m.medlin@tencate.com

58[B] - Propex Nashville (9 tests)
Tim Smith -- (229) 686-5511
Timothy.Stark@propexglobal.com

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

60[B] - Polytex Lima (11 tests)
Elias Jurufe -- 51 16169393
Ejarufe@polytex.cl

61[B] - Raven Industries (17 tests)
Justin Norberg -- (605) 335-0288
Justin.Norberg@ravenind.com

62[B] - Solmax International Asia (14 tests)
Marie Andre Fortin – (450) 929-1234
mafortin@solmax.com

63[A] - TRI Environmental, Inc.; DDRF (4 tests)
Joel Sprague -- (864) 242-2220
JSprague@tri-env.com

64[B] - Agru America (NV) (14 tests)
Chris Adams -- (775) 835-8282
ca@agruamerica.com

65[C] - Bombay Textile Rsearch Assoc. (BTRA) (24 tests)
Riyaz Shaikh
(0) 022-25003551
btra@vsnl.com

66[B] - Rowad International Geosynthetics Co. Ltd (14 tests)
Asad Ullah Khan -- +966-3-812-1360
usad@rowadplastic.com

67[A] - MicroBac Hauser Division (8 tests)
Steve Ferry – (720) 406-4806
steve.ferry@microbac.com

68[B] - Glen Raven Technical Fabrics LLC (3 tests)
Edmund Gant -- (336) 229-5576
egant@glenraven.com

69[B] - GSE Lining Technology Co. Ltd. (12 tests)
Siriporn Chayaporenlert – 6638-636638
siriporna@gseworld.com

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

71[B] - Plasticos Agricolas y Geomembranas S.A.C. (14 tests)
Jhoana Carolina Diaz Martinez – 6370 (20 110811)
calidad@pgaperu.com

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

If you desire more information on the GAI-LAP, its test methods, and the associated laboratories, a directory is published annually in December of each year. It is available on GSI's home page at http://www.geosynthetic-institute.org (Accreditation).

We thought is appropriate to mention that GRI has been developing Test Methods, Guides and Practices since its inception in the early 1980's. GRI started writing specifications in 1993 when NSF decided to withdraw Standard 54. At present we have the following list of GRI Standards; Test Methods, Guides, Practices and Specifications. As you can see many of these documents have morphed into ASTM documents. This transition can be fast or slow depending on need or finding the right task group chairmen as its champion.

Geotextile (GT) Related

GT1 Geotextile Filter Performance via Long Term Flow (LTF) Tests
~~GT2 Biological Clogging of Geotextile or Soil/Geotextile Filters (1987)~~ (see ASTM D1987)
~~GT3 Deterioration of Geotextiles from Outdoor Exposure~~ (see ASTM D5970)
~~GT4 Geotextile Permittivity Under Load (1991)~~ (discontinued, see ASTM D5493)
~~GT5 Tension Creep Testing of Geotextiles (April 6, 1992)~~ (see ASTM D5262)
~~GT6 Geotextile Pullout~~ (see ASTM D6706)
GT7 Determination of Long-Term Design Strength of Geotextiles
GT8 Fine Fraction Filtration Using Geotextile Filters
GT9 Grip Types for Use in Wide Width Testing of Geotextiles and Geogrids
GT10 Test Methods, Properties and Frequencies for High Strength Geotextile Tubes used as Coastal and Riverine Structures
GT11 Installation of Geotextile Tubes used as Coastal and Riverine Structures
GT12(a) Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials - ASTM Version
GT12(b) Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials - ISO Version
GT13(a) Test Methods and Properties for Geotextiles Used as Separation Between Subgrade Soil and Aggregate - ASTM Version

GT13(b) Test Methods and Properties for Geotextiles Used as Separation Between Subgrade Soil and Aggregate - ISO Version
GT14 The Hanging Bag Test for Field Assessment of Fabrics Used for Geotextile Bags, Containers and Tubes
GT15 The Pillow Test For Field Assessment of Fabrics/Additives for Geotextile Bags, Containers and Tubes

Geogrid (GG) Related

GG1 Geogrid Rib Tensile Strength (see ASTM D6637)
GG2 Geogrid Junction Strength
~~GG3(a) Tension Creep Testing of Stiff Geogrids (Jan. 30, 1991)~~ (see ASTM D5262)
~~GG3(b) Tension Creep Testing of Flexible Geogrids (Jan. 30, 1991)~~ (see ASTM D5262)
GG4(a) Determination of the Long-Term Design Strength of Stiff Geogrids
GG4(b) Determination of the Long-Term Design Strength of Flexible Geogrids
~~GG5 Test Method for Geogrid Pullout~~ (see ASTM D6706)
GG6 Grip Types for Use in Width Width Testing of Geotextiles and Geogrids
GG7 Carboxyl End Group Content of PET Yarns
GG8 Determination of the Number Average Molecular Weight of PET Yarns Based on a Relative Viscosity Value
GG9 Torsional Behavior of Bidirectional Geogrids When Subjected to In-Plane Rotation
GG10 Determination of the Flexural Rigidity of Geogrids

Geonet (GN) Related

~~GN1 Compression Behavior of Geonets~~ (see ASTM D6364)
GN2 Joining and Attaching Geonets and Drainage Geocomposites

Geomembrane (GM) Related

GM1 Seam Evaluation by Ultrasonic Shadow Method
GM2 Embedment Depth for Anchorage Mobilization
~~GM3 Large Scale Hydrostatic Puncture Test~~ (see ASTM D5514)
~~GM4 Three Dimensional Geomembrane Tension Test~~ (see ASTM D5617)
~~GM5(a) Notched Constant Tensile Load (NCTL) Test for Polyolefin Resins or Geomembranes (1992)~~ (see ASTM D5397)
~~GM5(b) Single Point NCTL Test for Polyolefin Resin or Geomembranes~~ (see ASTM D5397 Appendix)
GM5(c) Seam Constant Tensile Load (SCTL) Test for Polyolefin Geomembrane Seams
GM6 Pressurized Air Channel Test for Dual Seamed Geomembranes
GM7 Accelerated Curing of Geomembrane Test Strip Seams Made by Chemical Fusion Methods
~~GM8 Measurement of the Core Thickness of Textured Geomembranes~~ (see ASTM D5994)
GM9 Cold Weather Seaming of Geomembranes
GM10 The Stress Crack Resistance of HDPE Geomembrane Sheet
~~GM11 Accelerated Weathering of Geomembranes Using a Fluorescent UVA Device~~ (see ASTM D7238)
~~GM12 Asperity Measurement of Textured Geomembranes using a Depth Gage~~ (See ASTM D7466)
GM13 Test Methods, Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
GM14 Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes
~~GM15 Determination of Ply Adhesion of Reinforced Geomembranes~~ (see ASTM D6636)
GM16 Observation of Surface Cracking of Geomembranes
GM17 Test Methods, Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes
GM18 Test Methods, Properties and Testing Frequency for Flexible Polypropylene (fPP and fPP-R) Nonreinforced and Reinforced Geomembranes
GM19 Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes
GM20 Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using Control Charts
GM21 Test Methods, Properties and Testing Frequency for Ethylene Propylene Diene Terpolymer (EPDM) Nonreinforced and Scrim Reinforced Geomembrane
GM22 Test Methods, Required Properties and Testing Frequencies for Scrim Reinforced Polyethylene Geomembranes Used in Exposed Temporary Applications
GM23 Laboratory and/or Field Observation of Surface Chalking of Flexible Polypropylene Geomembranes
GM24 Incubation and Subsequent Evaluation of Single 180° and Double 180° Folding of Geomembranes

Geomembrane (GM) Related (cont.)

GM25 Test Methods, Test Properties and Testing Frequency for Reinforced Linear Low Density Polyethylene (LLDPE-R) Geomembranes
GM26 Smoke Testing of Field Fabricated Geomembranes

Geosynthetic Clay Liner (GCL) Related

~~GCL1 Swell Measurement of the Clay Component of GCL's~~ (see ASTM D5890)
~~GCL2 Permeability of Geosynthetic Clay Liners (GCLs)~~ (see ASTM D5887 and ASTM D6766)
GCL3 Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs)
GCL4 Gripping of Reinforced GCLs to End Platens During Direct (Interface) Shear Testing

Geocomposite (GC) Related

GC1 Soil-Filter Core Combined Flow Test
GC2 Strip Drain Flow Rate Under Load
GC3 Strip Drain Kinking Efficiency
GC4 Compression Behavior of Prefabricated Edge Drains and Sheet Drains
GC5 Erosion Control Systems to Protect Against Soil Detachment by Rainfall Impact and Overload Flow Transport
GC6 Erosion Control Systems for High Velocity Flows in Channels
~~GC7 Determination of Adhesion and Bond Strength of Geocomposites~~ (see ASTM D7005)
GC8 Determination of the Allowable Flow Rate of a Drainage Geocomposite
GC9 Mechanical Deformation Behavior of Geosynthetic Aggregate Drainage Systems
GC10 Hydraulic Behavior of Geosynthetic Aggregate Drainage Systems
GC11 Retrieval of Geocells from the Field to Evaluate Installation Distortion and/or Damage
GC12 Mechanical Deformation Behavior of Geocell Systems
GC13 Joining and Attaching Geonets and Drainage Geocomposites

Geosynthetic (GS) Related (i.e., Multipurpose)

~~GS1 CBR Puncture Strength~~ (see ASTM D6241)
GS2 Rupture Strength of Geosynthetics by Pendulum Impact
GS3 Selecting In-Situ Monitoring Methods and Devices for the Evaluation of Geosynthetic Performance
GS4 Time Dependent (Creep) Deformation Under Normal Pressure
GS5 Impregnation of Geosynthetics Under Load
~~GS6 Interface Friction Determination by Direct Shear Testing (Jan. 30, 1991)~~ (see ASTM D5321)
GS7 Determining the Index Friction Properties of

Geosynthetics
GS8 Determining the Connection Strength of Mechanically Anchored Geosynthetics
~~GS9 Oxidative Induction Time of Polyethylene Geosynthetics by High Pressure Differential Scanning Calorimetry~~ (see ASTM D5885)
~~GS10 Accelerated Tensile Creep and Creep Rupture of Geosynthetic Materials Based on Time Temperature Superposition Using the Stepped Isothermal Method~~ (see ASTM D6992)

All of these Standards are available to GSI members and associate members on our website. The specifications and guides are dual listed in the open section (for everyone), while the test methods and practices are only in the password protected section; as Marilyn Ashley at www.mvashley@verizon.net if you don't know or recall your password. Incidentally, a hard-copy of the complete set of GRI standards is available for purchase… see our Bookstore on the GSI home page.

George R. Koerner

Activities within GCI (Certification)

GSI presently has two 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 other (begun on Dec. 1, 2011) is focused on MSE Wall, Berm and Slope field inspection. See our website at www.geosynthetic-institute.org under "certification" for a description and information on both of them. They are both 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 CQA activities with either geosynthetic liner or cover systems or MSE walls, berms, or slopes using geosynthetic reinforcement.
- 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.
- 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.

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

This program now in its sixth year has been recommended, and in some cases required, by solid waste owners, state regulators, and design consultants for proper QCA in field installation of both geosynthetic materials and compacted clay liners. The statistics to date are as follows.

Inspector Certification Test Results
2006 – 2012

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 (1.5%)
2007	82	11 (13%)	73	12 (16%)	7 (8.5%)
2008	95	25 (26%)	89	20 (22%)	13 (14%)
2009	36	7 (19%)	36	2 (5%)	2 (6%)
2010	59	12 (20%)	54	7 (13%)	5 (8%)
2011	54	6 (11%)	53	3 (6%)	1 (2%)
2012	34	5 (15%)	28	3 (11%)	3 (9%)
TOTAL (to date)	**501**	**72 (15%)**	**461**	**59 (13%)**	**33 (7%)**

The 5-year renewal period for those having taken the exam in 2006 is at present and about 60% have renewed accordingly. This is felt to be encouraging from our perspective.

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

The official launch of the program was on December 1, 2011 with a course and the examination afterward. More recently a somewhat revised course on November 29, 2012 was presented. There are now fourteen persons certified by GCI for the inspection of MSE Walls, Berms and Slopes.

This one-day course and subsequent examination were developed by GSI and reviewed by a steering committee consisting of the following individuals:

- Kent von Maubeuge – NAUE Group
- Mohammed Karim – Virginia DEQ
- Bob Sabanas – NTH Consultants
- John Conturo and Maria Tanase – AECOM, Inc.
- John Lostumbo – TenCate Geosynthetics
- Mike Yako – GEI Consultants
- Steve Poirier – Geosyntec Consultants
- Willie Liew – Tensar International
- Doug Clark – CEC Consultants
- Dick Stulgis – Geocomp, Inc.
- Frank Adams, Paul Whitty, Rafael Ospina – Golder Associates
- Daniel Alzamora - FHWA
- Sam Allen – TRI Environmental Inc.
- Greg Cekander – Waste Management Inc.
- Greg Fedak – CETCO Contracting Services

Our thanks go to them in this regard.

While a field inspector cannot require proper design or instruct a contractor how to build the 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. Please contact George Koerner at gkoerner@dca.net or Jamie Koerner at jrkoerner@verizon.net for questions or additional information.

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 two countries (Korea and Taiwan), 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 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 an 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.

Items of Interest

1. **Geosynthetics Restore Gulf Coast**
   A new Duke University study, "Geosynthetics: Coastal Management Applications in the Gulf of Mexico" (www.cggc.duke.edu/pdfs/CGGC_Geosynthetics.pdf), details how the emerging geosynthetics industry can create job benefiting nearly 200 employee locations in 36 states, including more than 72 in the five gulf states and 24 in Louisiana. Increased investment in ecosystem restoration, flood prevention and erosion control is expected through the recently approved RESTORE Act, which will stimulate more local projects using geosynthetic materials.
   (ref. ASTM Review 09/12)
2. **Amount of Municipal Solid Waste Expected to Increased Significantly**
   Worldwide, municipal solid waste is projected to increase from today's rate of 1.3 billion lb per day to 2.2 billion lb per day by 2025, according to a recent report from the World Bank. Moreover, the annual cost to manage the waste is expected to nearly double during this period, rising from $205 billion to $375 billion. In general, as a country urbanizes and its population becomes wealthier, the consumption of inorganic materials increases as the relative organic fraction decreases, the report states.
   (ref. Waste Business Journal and Civil Engineering, 09/12)
   Editor's Note: The devastation that Hurricane Sandy created in the northeast U.S. is resulting in record amounts of waste disposal.
3. **World's Biggest Construction Firms by Revenue**

Rank	2012	Country	year, $bn	2003	Country
1	China State Construction & Engineering	China	72.6	Vinci	France
2	China Railway Construction	China	68.8	Skanska	Sweden
3	China Railway Engineering	China	68.4	Kajima	Japan
4	Vinci	France	52.4	Taisei	Japan
5	China Communications Construction	China	45.5	Bouygues*	France
6	ACS	Spain	39.7	Shimizu	Japan
7	China Metallurgical Group	China	34.4	Hochtief	Germany
8	Bouygues*	France	34.4	Bechtel	United States
9	Bechtel	United States	32.9	Obayashi	Japan
10	Hochtief†	Germany	32.4	Fluor	United States

Source: *International Construction* magazine *Construction divisions only †ACS now owns a majority stake in Hochtief

On the Estimation of "Live Loads" in Geosynthetic Design

In formulating a factor-of-safety value for a specific geosynthetic application a design engineer is essentially calculating a ratio of resisting forces-to-driving forces. This contrast is even further recognized when using load and resistance factor design (LRFD) which is apparently in our not-to-distant future.

Regarding the resisting forces, they are primarily the soil's shear strength and the geosynthetics tensile strength. In the writer's opinion both of these strengths are capable of being determined reasonably well. Even if one designs on a probability-of-failure hypothesis (Duncan, 2000) the statistical variations within the required performance tests (e.g., wide-width tensile, direct shear and transmissivity) are well established. [George Koerner's proficiency test program has a wealth of such data which is available in published form (2002)].

It is the required forces which are the focus of this particular writeup and they can be subdivided into dead and live loads. The dead loads are typically gravitational forces created by the mass of involved soil and they are quite deterministic. The live loads, however, are an altogether different set of circumstances and subjective estimates are often necessary. *Three situations will be commented upon; namely, surcharge loads, hydrostatic loads and seismic loads*.

Most mechanically stabilized earth wall and slope situations have a surcharge load at, or near, their crest. Building loads are usually tractable but temporary live loads from over-sized stationary vehicles, unanticipated storage of products and materials, unannounced swimming pools, and stockpiled snow/ice loads have been troublesome in the past. A conservative selection of such surcharge loads anticipating all aspects of long-term use of the site is necessary.

Hydrostatic loads require careful deliberation in their selection since intense storms have caused wall, slope, veneer stability and even waste stability failures. Hurricanes, cyclones, and other intense weather situations seem to be occurring with greater frequency than in the past. Clearly coastal communities and infrastructure have seen their share of problems, most recently with Hurricane Sandy causing several veneer slope failures in its wake. In this regard, one wonders if a designer should select the 50-year, 100-year or the most probable precipitation and furthermore just how good are these established values in an age of global-warming?

The selection of a seismic coefficient in earthquake prone applications is extremely important in calculating FS-values. As an illustration, the following factor-of-safety variation of a 30 m long veneer cover soil using different seismic coefficient (C_s) values is readily seen.

Seismic Coefficient (C_s)	Resulting FS-Value
0	1.25
0.025	1.16
0.050	1.07
0.075	1.00
0.100	0.94
0.125	0.88

In all three of these situations illustrating appropriate "live load" selection, the significance to the design community is heightened by the recent decision in Italy as reported in the Economist Magazine. No additional commentary is necessary!

> "**In Italy, sloppy seismology can lead to prison…**
> The earthquake that destroyed L'Aquila, a city in central Italy, on April 6th 2009 killed 309 people at the time. But it took until October 22nd of this year for it to claim its latest casualties. Those casualties were seven men (three seismologists, two engineers, a volcanologist and a public official) convicted on that day of manslaughter, for misleading L'Aquila's inhabitants about the risks they faced. Each was sentenced to six years in prison, though that may be reduced on appeal."

References

Duncan, J. M. (2000), "Factors of Safety and Reliability in Geotechnical Engineering," Jour. Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 126, No. 4, pp. 307-316.

Koerner, R. M. and Koerner, G. R. (2002), "Beyond Factor of Safety: The Probability of Failure," Proc. GRI-16 Conference, GII Publ., Folsom, PA, pp. 1-18.

The Economist, October 27, 2012, pg. 80.

Bob Koerner

Upcoming GSI Events

- ASCE Webinars
  December 20, 2012 – Geosynthetic Reinforced Mechanically Stabilized Earth Walls
  January 17, 2013 – Geosynthetic Applications Accompanying Shale Gas Drilling Operations
  February 21, 2013 – An Overview of Geosynthetics and Their Major Applications
  March 11, 2013 – Design of Geomembranes for Surface Impoundments (Ponds, Reservoirs, etc.)
  Contact: www.asce.org/webinars

- GSI Courses in Folsom, PA
  1. MSE Wall Failures and Remediation
     March 13, 2013
  2. Inspection of MSE Walls, Slopes and Berms
     March 14, 2013
     (Optional exam follows)
  3. Waste Containment Liner and Cover Design
     March 20, 2013
  4. QA/QC of Geosynthetics
     March 21, 2013
     (Optional exam follows)
     Contact: mvashley@verizon.net
- March 3-6, 2013
  GeoCongress 2013
  San Diego, CA
  Contact: www.asce.org/conferences
- April 1-4, 2013
  Geosynthetics 2013 and GRI-25
  Long Beach, CA
  Contact: www.ifai.com/conferences
- April 1, 2013
  GSI Annual Meeting after GRI-25
  5:30 to 7:00 PM
- April 1, 2012
  GSI Board of Directors Meeting after GRI-25
  7:00 to 8:00 PM
- May 5-8, 2013
  Strive for Sustainability
  Sagamore, NY
  www.nyfederation.org/Sagamore

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 ThermaGreen with Tim Walter/Blu Alexander/Ken vander Velden, Milliken & Co. with Randy Kohlman, Maccaferri with Massimo Ciarla and Pietro Rimoldi, and Jones and Wagener (Pty) Ltd. with Anton Bain as contact persons. Thanks to all and welcome to GSI.**

GSE Lining Technology, Inc.
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IN THE NEXT ISSUE

- Activities of the GSI Directors and Board
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- Activities within GAI (Accreditation)
- Activities within GCI (Certification)
- The GSI Affiliate Institutes
- The GSI Centers-of-Excellence
- Items of Interest
- “Geosynthetics and Coal Combustion Residuals”
- GSI’s Member Organizations