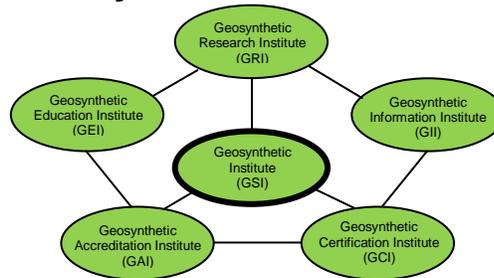


# The GSI Newsletter/Report

## Geosynthetic Institute



Vol. 30, No. 1

March, 2016

This quarterly newsletter, now in its 30<sup>th</sup> 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](http://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](mailto:gkoerner@dca.net) or [mvashley@verizon.net](mailto:mvashley@verizon.net).

## Activities of GSI's Directors and Officers

1. GSI is fully involved with GeoAmericas 2016 scheduled for April 10-13, 2016 in Miami, Florida. Included are a Keynote lecture, full-day course, six individual presentations, the Annual Meeting and our BoD Meeting. The final program is currently on-line.
2. The multichaptered Geotextile Book (27 chapters) is at the publication stage and should be available for the GeoAmericas Conference mentioned above. The publisher is Woodhead a Division of Elsevier Publications headquartered in The Netherlands.
3. The Geolnstitute of ASCE is honoring Dr. Dave Daniel and Dr. Bob Koerner via two separate, but back-to-back, Symposia on August 15, 2016 in connection with its GeoEnvironmental Conference in Chicago, Illinois... see <http://www.geoenvironmentconference.org/program/>
4. GSI Webinars are ongoing on a regular basis and each successive one is advertised on our home page. They carry 1.5 professional development hours and have had many positive reviews. A complete list is available.
5. The nine person GSI Board of Directors is presently as follows:

### Term Ends 2015

- John Workman - Waste Management Inc. (Owners and Operators)  
e-mail: [jworkman@wm.com](mailto:jworkman@wm.com)

- Mark Wayne – Tensar Earth Technology (Geotextiles and Geogrids)  
e-mail: [mwayne@tensarcorp.com](mailto:mwayne@tensarcorp.com)
- Sam Allen – TRI Environmental Inc. (At-Large)  
e-mail: [Sallen@tri-env.com](mailto:Sallen@tri-env.com)

### Term Ends 2016

- A. N. Desai – BTRA & GSI-India (Agencies)  
e-mail: [btra@vsnl.com](mailto:btra@vsnl.com)
- Edgard Chow – Kuraray (Resin Producers)  
e-mail: [edgard.chow@kuraray.com](mailto:edgard.chow@kuraray.com)
- Kent von Maubeuge - NAUE GmbH & Co. KG (International-1)  
e-mail: [kvmaubeuge@naue.com](mailto:kvmaubeuge@naue.com)

### Term Ends 2017

- Tony Eith - CEC Consultants , Inc. (Consultants and Testing Labs)  
e-mail: [teith@cecinc.com](mailto:teith@cecinc.com)
- Nathan Ivy - AGRU America Inc. (Geomembranes and GCL's)  
e-mail: [nivy@agruamerica.com](mailto:nivy@agruamerica.com)
- Moreno Scotto - Maccaferri (International - 2)  
e-mail: [moreno.scotto@gmail.com](mailto:moreno.scotto@gmail.com)

## IN THIS ISSUE

- Activities of GSI's Directors and Officers
- Overview of GRI Projects (Research)
- Progress within GII (Information)
- Progress within GEI (Education)
- Activities within GAI (Accreditation)
- Activities within GCI (Certification)
- The GSI Affiliated Institutes
- Method to Avoid Bubbles From Forming in GM-Lined Surface Impoundments
- GSI's Member Organizations

## 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 ([gkoerner@dca.net](mailto:gkoerner@dca.net)), Grace Hsuan ([g.hsuan@coe.drexel.edu](mailto:g.hsuan@coe.drexel.edu)) or Bob Koerner ([robert.koerner@coe.drexel.edu](mailto:robert.koerner@coe.drexel.edu)) for details and/or discussions.

- 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 multiple thermocouples for long term measurements in both wet and dry municipal solid waste landfills in Pennsylvania. The project has been extended into its 19<sup>th</sup>-year and has resulted in an extremely authoritative set of real-life data which is being used by many researchers in their geomembrane lifetime predictions.
- 2. Flow Behavior of Innovative Leachate Collection and Removal Systems (LCRS's)** – Several new geocomposite drainage systems are being compared to traditional geonet composites. The project is in its second year and will be a multi-year effort. It is likely that a Standard Guide will be developed on this topic.
- 3. GT Flow Behavior of CCR Materials** - This laboratory project examines the behavior of four geotextile filter material to fly ash, bottom ash, coal desulphurization material and a well graded sand for control. George Koerner is handling the project.
- 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 project being conducted by George Koerner is presently investigating two different geogrids 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 #8 below.
- 5. Laboratory Exposed Lifetime of Geomembranes\*** - GSI is using three UV-fluorescent devices to estimate the projected exposed lifetime of six different types of geomembranes. They are HDPE, LLDPE, fPP, EPDM, PVC (N.A.) and PVC (Euro.). They are being incubated at 60, 70, and 80°C until half-life

or strength and elongation are measured. The goal is lifetime prediction. Some will take at least 90,000 light hours ( $\approx$  12.3 years). GRI Report #44 is available on results to date and a webinar is also available. The information will be made available to the public in April 2016 and will be the topic of our Keynote Lecture. (In this regard it should be noted that we have withheld the information for well over a year which has been our custom.)

- 6. HDPE Geomembrane Lifetime as a Function of Thickness** - This often encountered question is being evaluated by exposure at 80°C in a QUV weathering device per ASTM D7238. Formulations are exactly the same and only the sample thicknesses vary. These thicknesses are 2.76, 2.44, 1.58, 1.08, 0.77 and 0.48 mm. Parameters being evaluated in this decade long study are change in thickness and presence of crazing or cracking. Time will tell!
- 7. Laboratory Exposed Lifetime of PVC (European) Geomembranes** - We have been evaluating five different European formulations for four years using three dedicated UV-fluorescent devices and the results are very impressive. The study is being conducted for CARPI Tech, a GSI member organization. This 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 thickness.
- 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 were incubated at 80, 70 and 60°C until half-life was achieved for strength and elongation. Laboratory lifetime predictions at 20°C as well as field predictions for Phoenix, Arizona are provided in GRI Report #44.
- 9. Laboratory Exposed Lifetime of TRM Filaments** - We are also using UV-fluorescent exposure of four different turf reinforcement mat filaments to assess their lifetime capabilities. They have been incubated at 60°C, 70°C and 80°C. A final report to the manufacturer (Propex) has been submitted.
- 10. Laboratory Exposed Lifetime of Geotextiles** - A similar UV study as with geomembranes (Items 5, 6 and 7), geogrids (Item 8) and TRM filaments (Item 9) has been conducted on various geotextiles. Woven monofilaments, woven slit films, nonwoven heat bonded and needle punched types are included. In the latter are four different weights of needle punched nonwovens. All data and laboratory and field lifetime predictions are included in GRI Report #44.

- 11. Laboratory Exposed Geotextile Yarns** - A new effort on behalf of a member organization (TenCate) is evaluating polypropylene yarns with and without long-term antioxidants. It will be interesting to observe differences in behavior insofar as long-term strength and elongation. As with all of our long-term exposure research, incubation is using UV-fluorescent devices per ASTM D7238.
- 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 grown to 141, then 171, and now 277! *Readers, we have a very serious situation in this regard!* 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 was published by the Journal of Geotextiles and Geomembranes in October, 2013 and the publisher (Elsevier) reports that 900 requests have been made to date. It was voted as being the best paper of 2013 by the journal. This will be the topic of a GSI course and lecture presented at GeoAmericas in April, 2016.
- 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 very high alkalinity environments. Indeed, the values started high, but over time are now down to eight and lower. George 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 using the ReSSA Code and are now available to members and associate members as GRI Report #41. The latest failure in this regard is in Easton, Pennsylvania. It is presently in litigation.
- 15. Slow Pressurization of HDPE Geomembranes in Axi-Symmetric Testing\*** - The ASTM D5716 method of testing geomembranes in a 3-D axi-symmetric mode uses a pressure rate of 6.9 kPa/min (1.0 psi/min). While such a rate is appropriate for most geomembrane types, it is very fast for HDPE which is semi-crystalline and cannot readily stress relax so as to accommodate the applied pressure. To investigate slower rates we have initiated a project with rates as low as 6.9 kPa/month (1.0 psi/month)! The last test, just now begun, is at a rate of 6.9 kPa/six months (1.0 psi/six months) and it will take about five years to conclude. A preliminary paper was presented at Geosynthetics '15 in Portland.
- 16. Shrinkage of GCLs Under Wet/Dry Cycling** - George Koerner has been evaluating shrinkage of various GCLs in boxes on the overhead roof of GSI. The study is on behalf of CETCO and will be presented at GeoAmericas in April, 2016.
- 17. Temperature Behavior Under Different Geosynthetic Layers** - Since exposed lifetime of geosynthetics is influenced by sunlight the lifetime of layers directly beneath the uppermost one (heat only, but no sunlight) is of interest. George Koerner has set up such a scenario on behalf of Watershed Inc., a GSI member.
- 18. Generic Specifications** - A major continuing effort is ongoing with respect to the development and updating of GRI's generic geosynthetic specifications. The current status of these specifications is as follows:
- Completed and Available on our Website  
 GM13 – HDPE Geomembranes  
 GM17 – LLDPE Geomembranes  
 GM18 – fPP and fPP-R Geomembranes  
 GM21 – EPDM and EPDM-R Geomembranes  
 GM22 – Scrim Reinforced PE Barriers  
 GM25 – LLDPE-R Geomembranes  
 GM19 – Geomembrane Seams  
 GM28 – CSPE-R Geomembranes  
 GT10 – Geotextile Tubes  
 GT12 – Geotextile Cushions  
 GT13 – Geotextile Separators  
 GCL3 – Geosynthetic Clay Liners  
 GC14 – Turf Reinforcement Mats (new)  
 GS15 – Geocells
- Working; Available Upon Request  
 GGXX – Bidirectional Geogrids (active)  
 GGXX – Unidirectional Geogrids (active)  
 GNXX – Geonet Drainage Composites (active)
- Delayed; Available Upon Request  
 GCXX – Other Drainage Geocomposites  
 GSXX – Polymeric Marine Mattresses (tabled)  
 GSXX – High Strength Reinforcement Geotextiles
- The complete set of formalized specifications are available to everyone (members and nonmembers) on the open section of our Home Page. Please download and use them accordingly. There is a brief tutorial accompanying each specification. Also note that this is where the latest modification will always be available. Of note is that GM22 and GCL 3 have been upgraded for stiffness and hydraulic conductivity, respectively.
- 19. Other GRI Standards** - There are several GRI Standards in various forms of preparation. These include the following:

- A practice on field seaming inspection emphasizing the electrical leak location system (ELLS).
- Three standards on GCL joining so as to prevent/monitor panel separation.
- A guide as to recommended testing of drainage geocomposites.
- A practice explaining the use of MARV for geotextiles
- A transverse rib bending test for homogeneous geogrids

## Progress within GII (Information)

Our GSI Home Page is accessed as follows:

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

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

- |                                   |                         |
|-----------------------------------|-------------------------|
| • Introduction to GSI             | • Product Certification |
| • Prospectus                      | • Newsletter/Reports    |
| • Associate Membership (Agencies) | • Internet Courses      |
| • Members by Focus Groups         | • GSI Members Links     |
| • GSI Publications                | • GSI Member Meetings   |
| • GRI Specs, Guides, White Papers | • Courses at GSI        |
| • Laboratory Accreditation        | • 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](mailto:mvashley@verizon.net). When you get into this section, the following information is available. This includes:

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

The Keywords Section contains about 35,000 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) performs various surveys on pertinent topics in geosynthetics. If you have topics in need of the current status please advise accordingly.

## Progress within GEI (Education)

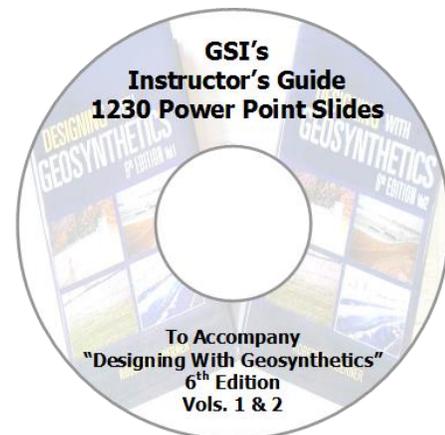
### Free CD

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 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.

### 6<sup>th</sup> Edition of Designing With Geosynthetics

The 6<sup>th</sup> 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; i.e., \$3.50 for each volume! The two volume set can be purchased through GSI, Xlibris, Amazon and Barnes and Noble. A special link is available on the cover page of our website. All proceeds go to GSI.

Additionally, we have developed 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 45 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. Our most recent report is:

- #45 - A Review of 3000 Geosynthetic Q&As on the GMA Techline Since Its Inception in 2004. In it are the 100 "most difficult" questions asked and answered since the Techline's inception in 2004.

## Courses

Due to lack of attendance for day-long courses at GSI we have not scheduled further in-house dates. That said, our two certification courses are available on-line via a series of six, ninety-minute, interconnected webinars. Contact Jamie Koerner at [jrkoerner@verizon.net](mailto:jrkoerner@verizon.net) if you want information and details.

## GSI Webinars (90 minutes long)

(Second Wednesday of Every Month)  
11:30 AM – 1:00 PM (Eastern Time Zone)  
Registration at

[www.geosynthetic-institute.org/webinar.htm](http://www.geosynthetic-institute.org/webinar.htm)

1.5 Professional Development Hours

Nonmembers Cost - \$250; Members Cost - \$200

*Commentary on Webinars:* Never in Bob K's long career has he "reached out" to so many people than when giving these GSI and ASCE webinars. For the single cost of \$250 or \$200 a feed is delivered over Adobe Connect to the requested site. This can be anywhere, e.g., office, conference room, auditorium or even sent to additional offices and sites. For example, NY-DEC had the feed going into their Albany auditorium and then into the 13-regions of New York State. Clearly, hundreds of participants were involved. For one ASCE webinar there were 62-sites! We are now abandoning our in-house, one-day, courses (which have been given for the past 30-years) and delivering them in six segments over three days each morning and afternoon. *Readers; on-line distance learning, aka, webinars, is the way to communicate information to masses of people in an inexpensive and time efficient manner. Indeed, the future of learning is here!*

- GSI 1 - "MSE Wall Failures Data Base"
- GSI 2 - "MSE Wall Back Drainage Design"
- GSI 3 - "MSE Wall Remediation"
- GSI 4 - "MSE Wall Inspection"
- GSI 5 - "Geosynthetics In Hydraulic Applications"
- GSI 6 - "Geosynthetics in Heap Leach Mining"
- GSI 7 - "Geosynthetics in Agriculture"
- 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 Used 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"

GSI 17 - "Geosynthetics in Erosion Control"

GSI 18 - "Pond Liner Design and Performance"

## GSI Fellowships

A major change over previous years has been quite successful this year. We now offer fellowships for masters and doctoral students. Also the stipend is \$5000 for a single year, rather than three multiple years. This change resulted in 22-proposals which were reviewed and graded by the GSI-BoD and ourselves. Twelve were accepted and are listed below. If a specific proposal is of interest please contact Jamie Koerner at [jrkoerner@verizon.net](mailto:jrkoerner@verizon.net).

	Name	School	Advisor	Topic
1	Beauragar, Melissa	University of Colorado	Jonathan Wu	Protocol for Selecting Wall Facing for GS Reinforced Structures
2	Bester, Karl James	University of Cape Town	Kelvin Legge	Test Methods for GT Filters used in Waterway Engineering
3	Bredacs, Marton	Montan University	Gerald Pinter	Aging Mechanisms and LT Assessment of PE Tunnel Liner
4	Gutierrez, Angel	Arizona State University	Edward Kavazanjian	Evaluation of GM Seam Strain Concentration Factors
5	Huang, Muji	NPUST	Wayne Hsieh	RECP Soil Protection Properties due to Variables in Channel Flow
6	Huang, Grace	Virginia Tech	George Filz	GS Contribution to Stability of Column- Supported Embankments
7	Javadi, Sadra	University of Louisville	Qian Zhao	Advection and Sorption of Organic Containment in GCL with Organobentonite
8	Jiang, Yan	University of Kansas	Jie Han	Evaluating Performance of Hybrid GRE Walls
9	Kiffle, Zeru	Syracuse University	Shobha Bhatia	Finite Element Model of GT Tubes Stacking in Dewatering Projects
10	Sievering, Roland	RWTH Aachen University	Martin Ziegler	Interaction Modeling in Finite Element Simulation of GG Reinforced Soil
11	Xu, Lei	Columbia University	Hoe Ling	Centrifuge modeling of wire mesh facing GS reinforced Soil Retaining Wall
12	Zadeh, Shahin Ghazi	Colorado State	Chris Bareither	Evaluation of Long Term Internal Shear of GCLs in Mining Applications

## Activities within GAI (Accreditation)

The Geosynthetic Accreditation Institute's (GAI) current mission is focused on a Laboratory Accreditation Program (LAP) for geosynthetic test methods. George Koerner is in charge of the program. The GAI-LAP was developed for accrediting geosynthetic testing laboratories on a test-by-test basis. GAI-LAP suggests that laboratories use ISO 17025 as their quality system model. In addition, the program uses the GSI lab as the reference test lab and operates as an ISO 17011 enterprise. *It should be*

*emphasized that 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 245 GAI-LAP test methods available for accreditation. Please consult our home page for a current listing.

As of December, 2015, 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<sup>A</sup> - TRI/Environmental Inc. (155 tests)  
Jarrett Nelson -- (512) 263-2101  
[jnelson@tri-env.com](mailto:jnelson@tri-env.com)
- 3<sup>A</sup> - Golder Associates (43 tests)  
Henry Mock -- (770) 492-8280  
[Henry\\_Mock@golder.com](mailto:Henry_Mock@golder.com)
- 4<sup>C</sup> - Geosynthetic Institute (109 tests)  
George Koerner -- (610) 522-8440  
[gkoerner@dca.net](mailto:gkoerner@dca.net)
- 8<sup>B</sup> - Propex Operating Co., Ringgold (11 tests)  
Todd Nichols -- 438-553-3757  
[todd.nichols@propexglobal.com](mailto:todd.nichols@propexglobal.com)
- 9<sup>B</sup> - Lumite (17 tests)  
Benjamin Bell -- (770) 869-1187  
[bell@lumiteco.com](mailto:bell@lumiteco.com)
- 13<sup>A</sup> - TRI Env. Inc. (Precision Labs) (85 tests)  
Cora Queja -- (714) 520-9631  
[cqueja@tri-env.com](mailto:cqueja@tri-env.com)
- 14<sup>A</sup> - Geotechnics (49 tests)  
J. P. Kline -- (412) 823-7600  
[JPKline@geotechnics.net](mailto:JPKline@geotechnics.net)
- 20<sup>A</sup> - GeoTesting Express, MA (52 tests)  
Gary Torosian -- (978) 635-0424  
[gtt@geotesting.com](mailto:gtt@geotesting.com)
- 22<sup>B</sup> - CETCO Hoffmann Estates (13 tests)  
Barbara Gebka -- (847) 851-1500  
[barbara.gebka@cetco.com](mailto:barbara.gebka@cetco.com)
- 24<sup>B</sup> - CETCO Lovell (10 tests)  
Roger Wilkerson -- (307) 548-6521  
[roger.wilkerson@cetco.com](mailto:roger.wilkerson@cetco.com)
- 25<sup>B</sup> - Ten Cate, Pendergrass (13 tests)  
Beth Wilbanks -- (706) 693-2226  
[b.wilbanks@tencate.com](mailto:b.wilbanks@tencate.com)
- 26<sup>B</sup> - Agru America Inc. (27 tests)  
Maria Coffey -- (843) 546-0600  
[mcoffey@agruamerica.com](mailto:mcoffey@agruamerica.com)
- 29<sup>E</sup> - FITI Testing and Research Institute (68 tests)  
Dong Whan Kim -- 82-2-3299-8071  
[dwhkim@fitiglobal.com](mailto:dwhkim@fitiglobal.com)
- 31<sup>D</sup> - NYS Dept. of Transportation (9 tests)  
Tom Burnett -- (518) 457-4704  
[tburnett@dot.ny.gov](mailto:tburnett@dot.ny.gov)
- 32<sup>A</sup> - Geo-Logic Inc. (6 tests)  
Ken Criley -- (530) 272-2448  
[kcriley@geo-logic.com](mailto:kcriley@geo-logic.com)
- 34<sup>B</sup> - GSE Environmental Richey Road (35 tests)  
Debra Gortemiller -- (281) 230-6890  
[dgortemiller@gseworld.com](mailto:dgortemiller@gseworld.com)
- 38<sup>C</sup> - Sageos/CTT Group (122 tests)  
Eric Blond -- (450) 771-4608  
[eblond@GCTTG.com](mailto:eblond@GCTTG.com)
- 40<sup>B</sup> - GSE Environmental (13 tests)  
Mary Thompson -- (843) 382-4603  
[mthompson@gseworld.com](mailto:mthompson@gseworld.com)
- 41<sup>A</sup> - SGI Testing Service, LLC (18 tests)  
Zehong Yuan -- (770) 931-8222  
[ZYuan@interactionspecialists.com](mailto:ZYuan@interactionspecialists.com)
- 42<sup>C</sup> - NPUST (GSI-Taiwan) (69 tests)  
Chiwan Wayne Hsieh -- 011-886-8-7740468  
[CWH@mail.npust.edu.tw](mailto:CWH@mail.npust.edu.tw)
- 43<sup>A</sup> - Ardaman & Associates (22 tests)  
George DeStafano -- (407) 855-3860  
[gdestafano@ardaman.com](mailto:gdestafano@ardaman.com)
- 44<sup>B</sup> - PGI and Fiber Web, Inc. (9 tests)  
Mitchell Clendenin -- (615) 847-7155  
[Mitchell.Clendenin@avintiv.com](mailto:Mitchell.Clendenin@avintiv.com)
- 45<sup>B</sup> - Ten Cate Geosynthetics Malaysia SDN Bhd. (25 tests)  
Boon Kean Tan -- (603) 519 28576  
[b.k.tan@tencate.com](mailto:b.k.tan@tencate.com)
- 46<sup>B</sup> - TAG Environmental Inc. (13 tests)  
Colin Murphy -- (705) 725-1938  
[colin\\_murphy@tagenv.com](mailto:colin_murphy@tagenv.com)
- 49<sup>B</sup> - Engepol Geosinteticos (15 tests)  
Patricia Ferreira -- (55) 51 3303-3901  
[patricia@engepol.com](mailto:patricia@engepol.com)
- 50<sup>B</sup> - ADS, Inc. Hamilton (7 tests)  
Terry McElfresh -- (513) 896-2065  
[terry.mcelfresh@ads-pipe.com](mailto:terry.mcelfresh@ads-pipe.com)
- 51<sup>B</sup> - Solmax International Inc. (21 tests)  
Simon Gilbert St. Pierre -- (450) 929-1234  
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- 53<sup>B</sup> - Polytex Autofagasta (18 tests)  
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- 57<sup>B</sup> - Ten Cate Cornelia (22 tests)  
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- 58<sup>B</sup> - Propex Operating Co.Hazelhurst (16 tests)  
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- 60<sup>B</sup> - Polytex Lima (14 tests)  
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- 61<sup>B</sup> - Raven Industries (18 tests)  
Clint Boerhave -- (605) 335-0288  
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- 62<sup>B</sup> - Solmax International Asia (14 tests)  
Pei Ching Teoh -- (450) 929-1234  
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- 63<sup>A</sup> - TRI Environmental, Inc.; DDRF (4 tests)  
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- 64<sup>B</sup> - Agru America (NV) (14 tests)  
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- 65<sup>C</sup> - Bombay Textile Research Assoc. (BTRA) (23 tests)  
Riyaz Shaikh  
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- 66<sup>B</sup> - Rowad International Geosynthetics Co. Ltd (14 tests)  
Asad Ullah Khan -- +966-3-812-1360  
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- 68<sup>B</sup> - Glen Raven Technical Fabrics LLC (4 tests)  
Richard Greeson -- (336) 229-5576  
[rgreeson@glenraven.com](mailto:rgreeson@glenraven.com)

- 69<sup>B</sup> - GSE Environmental (13 tests)  
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[Siriporn@gseworld.com](mailto:Siriporn@gseworld.com)
- 70<sup>A</sup> - RSA Geo Lab LLC (47 tests)  
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- 71<sup>B</sup> - Plasticos Agricolas y Geomembranas S.A.C. (19 tests)  
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- 72<sup>B</sup> - Tensar Corp. GA (4 tests)  
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- 73<sup>B</sup> - Gai Loi JSE (10 tests)  
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- 74<sup>B</sup> - Agru America Inc. (9 tests)  
Mark Locklear (843) 221-4121  
[mlocklear@AgruAmerica.com](mailto:mlocklear@AgruAmerica.com)
- 75<sup>B</sup> - GeoMatrix S.A.S. (15 tests)  
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- 76<sup>B</sup> - Tehmco (Chile) (15 tests)  
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- 78<sup>B</sup> - PQA Mexico (13 tests)  
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- 79<sup>A</sup> - TRI Geosynthetic Testing and Services (32 tests)  
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- 80<sup>B</sup> - Texel (Canada) (8 tests)  
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- 81<sup>B</sup> - GSE Germany (18 tests)  
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- 84 - Interwrap India (14 tests)  
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- 85 - PAG Tacna (11 tests)  
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<sup>A</sup>Third Party Independent    <sup>C</sup>Institute  
<sup>B</sup>Manufacturers QC            <sup>D</sup>Government

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

*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 in 2011) is focused on MSE Wall, Berm and Slope field inspection. See our website at [www.geosynthetic-institute.org](http://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 eighth 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 – 2015

Year	Geosynthetic Materials		Compacted Clay Liners	
	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%)
2007	82	11 (13%)	73	12 (16%)
2008	95	25 (26%)	89	20 (22%)
2009	36	7 (19%)	36	2 (5%)
2010	59	12 (20%)	54	7 (13%)
2011	54	6 (11%)	53	3 (6%)
2012	34	5 (15%)	28	3 (11%)
2013	32	4 (12%)	30	1 (3%)
2014	45	1 (3%)	42	3 (7%)
2015	56	6 (11%)	51	6 (12%)
2016	4	4	4	0
<b>TOTAL (to date)</b>	<b>638</b>	<b>82 (13%)</b>	<b>588</b>	<b>69 (12%)</b>

The 5-year renewal periods for those having taken the exam before 2010 is ongoing and about 60% have renewed accordingly. This is felt to be encouraging from our perspective.

## 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. More recently a somewhat revised course on November 29, 2012 was presented. Next year, the corresponding course for this certification program will now be transferred into a series of six presentations over a three-day period. Contact Jamie Koerner at [jrkoerner@verizon.net](mailto:jrkoerner@verizon.net) for details and arrangements.

The status of the program is shown in the following table.

Inspector Certification Test Results  
MSE Walls and Berms  
(2011-2015)

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 Course	2	0
<b>TOTAL</b>		<b>24</b>	<b>0</b>

The on-line courses for preparation of both of these certification programs is available in a series of six-90 minute webinars. Contact Jamie Koerner at [jrkoerner@verizon.net](mailto:jrkoerner@verizon.net) for details and arrangements.

## The GSI Affiliated Institutes

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

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

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

**GSI-Taiwan** was formed on August 18, 2000 and is wholly contained within the National Pingtung University of Science and Technology in Nei Pu, Pingtung (southern Taiwan). It completely parallels GSI in that it has specific units for research, education, information, accreditation and certification. The Director is Dr. Chiwan Wayne Hsieh who is a Professor in the Department of Civil Engineering and Dean of the R & D Office. GSI-Taiwan has 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.

**GSI-India** under the direction of Dr. A. N. Desai has been formed in 2015. The hosting organization is the Bombay Textile Research Association (BTRA) which is world known for its excellence in textile R & D and is currently branching out into all forms of geosynthetics. We are delighted in this regard and, as a side-note, Dr. Desai has just been elected to GSI's Board of Directors. (See associated writeup on the "Global Geosynthetics Summit" in the December, 2014 Newsletter/ Report).

## Items of Interest

*Please note that this section will no longer be carried in these quarterly GSI Newsletter/Reports. This is due primarily to limit the length of the reports which have grown considerably over time.*

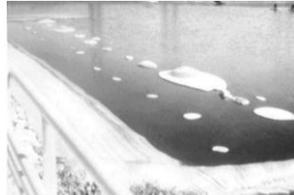
# Method to Avoid Bubbles from Forming in Geomembrane Lined Surface Impoundments

As shown in the following photographs the incidence of bubbles (also called “whales” or “hippos”) is not uncommon in geomembrane lined surface impoundments.

Bubbles; aka, Whales/Hippos



(anonymous photo due to litigation)



(photo compl. IFAI)



Perhaps the largest whale or hippo to date. Note the people in the photo for scale. (ref. R. Thiel, 2016)

The contents of the bubbles are either liquid or gases, or even a combination of gases over liquids and there are myriad causes, e.g.,

### Liquids

- GM leakage
- rising water table
- sudden drawdown
- perched water

### Gases

- trapped air
- degrading organics
- displaced soil gases
- rising VOCs

Whatever the growing medium, it meets the underside of the geomembrane and exerts upward pressure. This in-turn causes uplift at a localized high spot and then continues for as long as additional liquid or gas is generated.

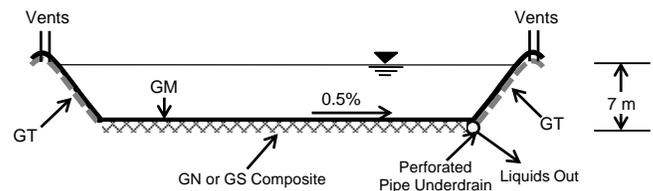
In order to avoid such situations we recommend a combination liquid/gas drainage system as follows;

- uniformly slope the subgrade soil to the low side of the embankment
- construct a perforated toe drain which then exits through the embankment for liquid removal
- provide a geonet or geospacer composite beneath the GM over the entire base
- provide a NP-NW geotextile beneath the GM on the sideslopes

- gas transmission is within the GT upslope to the vents
- vents must be provided at top of slope
- a numeric example follows...

### Numeric Example Assuming Liquid Leakage and Rising Gases Beneath Geomembrane

Consider a 7 m deep geomembrane-lined pond that is leaking liquid and might have rising gases from the subgrade soil. The width is 200 m, with the grade down from left-to-right as shown. A high estimate of GM leakage is 5000 l/ha-day. The proposed underdrain to be used is a 6.3 mm thick biplanar geonet with GTs bonded to each surface. What is the factor of safety of this geocomposite's transmissivity?



Note: The gases and liquids will flow in opposite directions along the base within the same geocomposite drainage system by the concept of “permselectivity”.

### Solution:

- (a) Estimate the leakage rate as being 5000 l/ha-day  
 (=  $5 \times 10^{-4} \text{ m}^3/\text{m}^2\text{-day}$ )

$$\begin{aligned}
 q &= 0.0005(200 \times 1) \\
 q &= 0.10 \text{ m}^3/\text{day} \\
 &= \frac{0.10}{(24)(60)} \\
 &= 6.9 \times 10^{-5} \text{ m}^3/\text{min}
 \end{aligned}$$

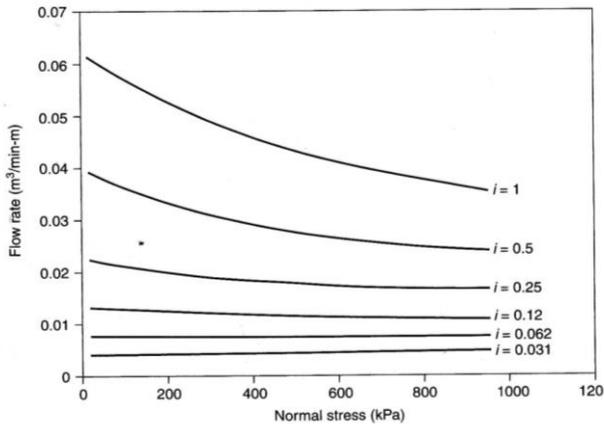
- (b) The critical slope is along the base of the reservoir.

$$0.5\% \text{ slope} = 0.005$$

- (c) Use Darcy's formula since it is a conservative approach:

$$\begin{aligned}
 q &= kiA = ki(t \times W) \\
 kt &= \theta_{reqd} = \frac{q}{i \times W} \\
 \theta_{reqd} &= \frac{6.9 \times 10^{-5}}{(0.005)(1.0)} \\
 &= 0.0139 \text{ m}^3/\text{min-m}
 \end{aligned}$$

- (d) The allowable liquid flow rate of the geocomposite is taken from the Designing With Geosynthetics textbook and is as follows. Here we obtain a flow rate (q/w) of 0.003 m<sup>3</sup>/min-m at a stress of 7 (9.81) = 70 kPa. This converts to a transmissivity (θ) of 0.003/0.005 = 0.60 m<sup>3</sup>/min-m.



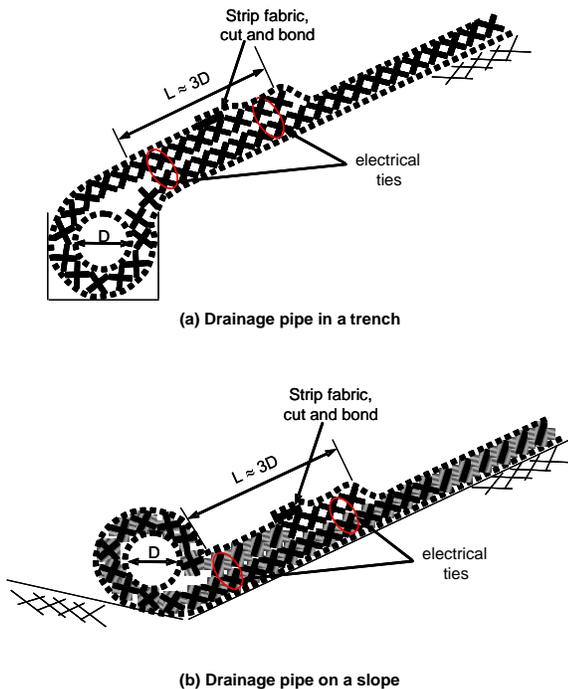
Flow rate behavior of a 6.3 mm thick biplanar geonet sandwiched between a 550 g/m<sup>2</sup> nonwoven needle-punched geotextile with clay above and a 1.5-mm HDPE geomembrane below.

(e) The factor-of-safety of the proposed geocomposite is:

$$FS = \frac{\theta_{allow}}{\theta_{reqd}} = \frac{0.60}{0.0139} = 43!$$

This is obviously very acceptable and the geocomposite could actually accept significantly higher liquid flows.

While the above example used a geonet drainage composite, there are many different drainage core options under the growing category of geospacers, e.g., webs, nubs, cuspatations, columns, etc. The connection of the drainage composite to the perforated drainage pipe is shown below (sketches are compliments of U.S. Army Corps of Engineers).



The usual option for sidewall gas drainage would generally be a needle punched nonwoven geotextile. At the top of slope the gases must be vented and the options are (i) an inverted “U” pipe systems, (ii) stack vents, or (iii) flap vents. A separate design is available.

There are indeed other design and material options but this type of combined liquid and gas removal system will likely be the most economical. *Whatever is decided upon one should never place the geomembrane directly on the soil subgrade which simply begs for bubbles to form and grow and grow and grow!*

## 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 Altakomol Alhadith Cont. Co. of Saudi Arabia with Carlos Lasserre; INOVA Geosynthetics/AERO Aggregates with Archie Filshill; Sotrafa Agrualura y Geosinteticos of Spain with Jose Miguel Munoz Gomez; Kaytech Fabrics Co. of South Africa with Garth James; Interwrap Inc. with Clive Mills/Martin Vido, Bourouge Pte. Ltd. of Singapore with Julia Putih and Intermas Group of Spain with Rubén Palacios contact members. Thanks to all and welcome to GSI!!!**

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#### **IN THE NEXT ISSUE**

- Activities of the GSI Directors and Board
- Overview of GRI (Research) Projects
- Activities within GII (Information)
- Progress within GEI (Education)
- Activities within GAI (Accreditation)
- Activities within GCI (Certification)
- The GSI Affiliate Institutes
- The GSI Centers-of-Excellence
- Items of Interest
- Retrospective of GeoAmericas '16
- GSI's Member Organizations