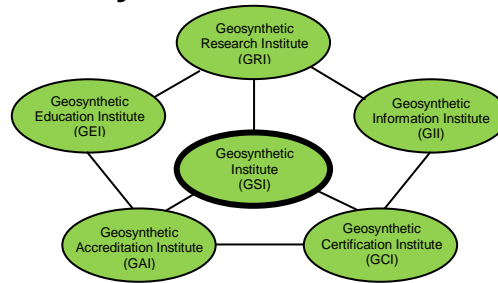


# The GSI Newsletter/Report

## Geosynthetic Institute



Vol. 30, No. 3

September, 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. The dual symposia for Dave Daniel and Bob Koerner was held on August 15, 2016 at ASCE's GeoEnvironmental Conference in Chicago. It was a memorable event and one that we will fondly remember. A CD will be available on the 30-papers in the Koerner Symposium.
2. The full on-line "Designing With Geosynthetics" course is available. It completely follows the textbook of the same name completely. See the Education section of this newsletter/report.
3. The new accompanying "Geosynthetic Designer Certification" program is also available. It follows the structure of our other two certification programs (QA/QC of Waste Containment Systems and MSE Walls) and is described in the certification section of this newsletter/report.
4. GSI Fellowship checks (nine at \$5,000 each) have been mailed to the respective recipients. See the education section of this newsletter/report.
5. GSI Board of Director elections for the three members whose terms conclude this year (Agencies, Resin Producers and International-1,) will be held this Fall. Watch for our emails.
6. The nine person GSI Board of Directors is presently as follows:

### Term Ends 2016

- A. K. Mukhopadhyay – BTRA & GSI-India (Agencies)  
e-mail: [btra@vsnl.com](mailto:btra@vsnl.com)/[btradirector@gmail.com](mailto:btradirector@gmail.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)

### Term Ends 2018

- 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)

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## Overview of GRI Projects (Research)

The following projects are all funded by GSI membership dues unless specifically noted. Most are long-term projects for which we are well positioned to accomplish. *Those projects marked with an asterisk have written papers available; please ask and we will send them accordingly.* Contact George Koerner ([gsigeokoerner@gmail.com](mailto:gsigeokoerner@gmail.com)), 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.
- 3. 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.
- 4. 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 was made available to the public in April 2016 and will be the topic of our Keynote Lecture and will

be republished in the International Geosynthetics Journal. (In this regard it should be noted that we have withheld the information for well over a year which has been our custom.)

- 5. 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!
- 6. 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.
- 7. 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. The results have just been published in Chapter 10 of the new Geotextile book mentioned earlier.
- 8. 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.
- 9. Laboratory Exposed GeoFoam** - A new study examining the exposed lifetime of EPS and XPS geofoam has been initiated. Incubations are at 80, 65 and 55°C according to ASTM D7238 the UV-fluorescent exposed device. The criterion being used is thickness decreases over time since the phenomenon involved is a gradual powered of the samples.
- 10. Cable Tied Geonet Evaluations** - A new study is focused on the plastic cable ties used to connect the overlapped ends and edges of geonets. The draft of a new GRI Test Standard has been prepared as well as the draft of a

technical paper. Preliminary details are available.

11. **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 286! *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 was the topic of a GSI course and lecture presented at GeoAmericas in April, 2016.
12. **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.
13. **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.
14. **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.
15. **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.

16. **Forensic Analysis of Field Exposed GMs** - We have three ongoing analyses of GMs retrieved from the field after years of service. One is from a surface impoundment (comp. of EPI), another from a canal (comp. of BuRec) and the third from a landfill in New Jersey.
17. **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  
GM19 – Geomembrane Seams  
GM21 – EPDM and EPDM-R Geomembranes  
GM22 – Scrim Reinforced PE Barriers (New)  
GM25 – LLDPE-R Geomembranes  
GM28 – CSPE-R Geomembranes  
GM30 – Coated Tape PE Barriers (New)  
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)

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.

18. **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 standard on GN joining with plastic cable ties... see Item 10.
  - 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. The GeoEnvironmental papers are being added. Citation retrieval is quite easy provided that you have a specific topic, or area, in mind. This is the section of the website that we (and others we are told) use the most in our daily activities.

In addition to the information provided in our home page as just mentioned, Jamie Koerner (Special Projects Coordinator) performs various surveys on pertinent topics in geosynthetics. The latest is a survey on the regulatory use of the Electrical Leak Location Survey (ELLS) method. If you have topics in need of the current status please advise accordingly.

## Progress within GEI (Education)

### 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.

### 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! *Dear 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 19 - "Wrinkle Management for GM Field Placement"

### Courses

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 consecutive days each morning and afternoon.

The newest of these course is an On-Line "Designing With Geosynthetics (DwG)" course. Please go to <http://www.geosynthetic-institute.org/courses.htm> and scroll down to Course #3. Here you will see the requisite details. The course itself is completely coordinated with the 6<sup>th</sup> Edition of the DwG textbook. It consists of 1540 slides with ~ 18 hours of voice over; about one minute for each slide. See the following table for the specific contents.

GSI's New On-Line, Distance Learning Course  
"Designing With Geosynthetics (DwG)"  
by  
Bob Koerner

DwG Book Chapter Number	Title	DwG Course Sections Covered	Number of Slides	Presentation Time (min.)
1	Geosynthetics	all	121	60
2a	Geotextiles	2.1 to 2.4	119	90
2b	Geotextiles	2.5 to 2.6	122	85
2c	Geotextiles	2.7	65	70
2d	Geotextiles	2.8 to 2.11	126	85
3	Geogrids	all	112	85
4	Geonets	all	72	60
5a	Geomembranes	5.1 to 5.2	92	65
5b	Geomembranes	5.3 to 5.5	115	70
5c	Geomembranes	5.6	100	80
5d	Geomembranes	5.7 to 5.13	152	90
6a	GCLs	all	89	70
6b	GCLs	new topics	72	55
7	Geofoam	all	67	40
8	Geocomposites	all	116	80
TOTALS			1540	1085 ~ 18 hours

That said, we feel the way to optimize the learning process during this course is to have a copy of the DwG e-book on a lap-top or tablet (it is available from Amazon, Barnes & Noble and the publisher Xlibris for \$7.00), with the on-line course slides on a desk-top and work the two computers simultaneously slide-by-slide and page-by-page. The fee is \$1000 for members and \$3000 for nonmembers, each having six-months of access time. Obviously, a group of people can take

the course together as well as individuals by themselves. Furthermore, it can be delivered in any conceivable location. If desired, the course carries with it 18 professional development hours.

Contact Jamie Koerner at [jrkoerner@verizon.net](mailto:jrkoerner@verizon.net) if you want information and details.

### GSI Fellowships

A major change over previous years has been quite successful again this year. We now offer fellowships for masters and doctoral students. The stipend is \$5000 for a single year, rather than three multiple years. This change resulted in 16-proposals which were reviewed and graded by the GSI-BoD and ourselves. Nine 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).

#### GSI Fellowships for 2016-'17 A.Y.

No.	Name	University	Advisor	Topic
1	Abbaspour, Aiyoub	George Mason University	Burak Tanyu	Clogging evaluation of drainage geotextiles using recycled concrete aggregate
2	Ekici, Anil	Middle East Technical Univ.	Nejan Huvaj	Interaction of marginal fills and geogrids for walls and slopes
3	Guo, Jun	University of Kansas	Jie Han	Soil column tests to evaluate wicking geotextile to remove water
4	Haselton, Henry	Montana State University	Steve Perkins	Biaxial response of geosynthetics
5	Kermani, Behnoud	Penn State University	Ming Xiao	Geotextile separation preventing particle movement into pavements due to cyclic loading
6	Maddah, Layal	Texas A&M	Jean-Louis Briaud	MSE Walls subjected to vehicle impact on roadside barrier systems
7	Morsy, Amr	University of Texas	Jorge Zornberg	Composite behavior of geosynthetic reinforced structures
8	Yilmaz, Mehmet	University of Wisconsin	James Tinjum and Craig Benson	Co-extruded EVOH geomembrane covers to avoid Landfill gas emissions
9	Zheng, Yewei	University of California SD	Patrick Fox	GRS abutments with bridge superstructure under seismic loading

## Activities within GAI (Accreditation)

The Geosynthetic Accreditation Institute's (GAI) current mission is focused on a Laboratory Accreditation Program (LAP) for geosynthetic test methods. George Koerner is in charge of the program.

The GAI-LAP was developed for accrediting geosynthetic testing laboratories on a test-by-test basis. GAI-LAP suggests that laboratories use ISO 17025 as their quality system model. In addition, the program uses the GSI lab as the reference test lab and operates as an ISO 17011 enterprise. *It should be emphasized that our GSI lab does not conduct outside commercial testing.*

It should also be made clear that GAI-LAP does not profess to offer ISO certification, nor does it “certify” laboratory results. GAI-LAP provides accreditation to laboratories showing compliance with equipment 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 September , 2016, 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  
[bbell@lumiteco.com](mailto:bbell@lumiteco.com)
- 13<sup>A</sup> - TRI Env. Inc. (Precision Labs) (86 tests)  
Cora Queja -- (714) 520-9631  
[cqueja@tri-env.com](mailto:cqueja@tri-env.com)
- 14<sup>A</sup> - Geotechnics (51 tests)  
J. P. Kline -- (412) 823-7600  
[JPkline@geotechnics.net](mailto:JPkline@geotechnics.net)
- 20<sup>A</sup> - GeoTesting Express, MA (59 tests)  
Gary Torosian -- (978) 635-0424  
[gtt@geotesting.com](mailto:gtt@geotesting.com)
- 22<sup>B</sup> - CETCO Hoffman 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)  
Melissa Medlin -- (706) 693-2226  
[m.medlin@tencate.com](mailto:m.medlin@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 (80 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

- 32<sup>A</sup> - [tburnett@dot.ny.gov](mailto:tburnett@dot.ny.gov)  
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 (30 tests)  
Mauricio Ossa  
[mossa@gseworld.com](mailto:mossa@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) (71 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. (24 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 Geossintéticos (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. (22 tests)  
Simon Gilbert St. Pierre -- (450) 929-1234  
[simonGSP@solmax.com](mailto:simonGSP@solmax.com)
- 53<sup>B</sup> - Polytex Autofagasta (19 tests)  
Ximena Parra Pizarro -- 011 55-2883308  
[xparra@polytex.cl](mailto:xparra@polytex.cl)
- 55<sup>B</sup> - Atarfil Geomembranes (21 tests)  
Gabriel Martin Sevilla -- 34 958 439 200  
[gmartin@atarfil.com](mailto:gmartin@atarfil.com)
- 56<sup>B</sup> - Polytex Santiago (13 tests)  
Marta Tenorio F. Jeff -- 011 56-2-677-1000  
[MTenorio@polytex.cl](mailto:MTenorio@polytex.cl)
- 57<sup>B</sup> - Ten Cate Cornelia (22 tests)  
Melissa Medlin -- (706) 778-9794  
[m.medlin@tencate.com](mailto:m.medlin@tencate.com)
- 58<sup>B</sup> - Propex Operating Co. Hazelhurst (16 tests)  
Victoria Shoupe -- (912) 375-5406  
[Victoria.Shoupe@propexglobal.com](mailto:Victoria.Shoupe@propexglobal.com)
- 59<sup>B</sup> - Firestone (9 Tests)  
Janie Simpson -- (864) 439-5641  
[SimpsonJanie@firestonebp.com](mailto:SimpsonJanie@firestonebp.com)
- 60<sup>B</sup> - Polytex Lima (14 tests)  
Roberto Diaz Palacios -- 51 16169393  
[rdiaz@polytex.cl](mailto:rdiaz@polytex.cl)
- 61<sup>B</sup> - Raven Industries (18 tests)  
Clint Boerhave -- (605) 335-0288  
[Clint.Boerhave@ravenind.com](mailto:Clint.Boerhave@ravenind.com)
- 62<sup>B</sup> - Solmax International Asia (14 tests)  
Pei Ching Teoh -- (450) 929-1234  
[pcteoh@solmax.com](mailto:pcteoh@solmax.com)
- 63<sup>A</sup> - TRI Environmental, Inc.; DDRF (4 tests)  
Jay Sprague -- (864) 346-3107  
[Jesprague@tri-env.com](mailto:Jesprague@tri-env.com)
- 64<sup>B</sup> - Agru America (NV) (14 tests)  
Ryan Steele -- (775) 835-8282  
[RSteele@AgruAmerica.com](mailto:RSteele@AgruAmerica.com)

- 65<sup>C</sup> - Bombay Textile Research Assoc. (BTRA) (23 tests)  
Riyaz Shaikh  
(0) 022-25003551  
[bra@vsnl.com](mailto:bra@vsnl.com)
- 66<sup>B</sup> - Rowad International Geosynthetics Co. Ltd (14 tests)  
Mohammad Usman Ansari -- +966-3-812-1360  
[mu.ansari@tasnee.com](mailto:mu.ansari@tasnee.com)
- 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)  
Siriporn Chayaporenler -- 6638-636638  
[Siriporn@gseworld.com](mailto:Siriporn@gseworld.com)
- 70<sup>A</sup> - RSA Geo Lab LLC (47 tests)  
Rasheed Ahmed -- (908) 964-0786  
[geolab13@yahoo.com](mailto:geolab13@yahoo.com)
- 71<sup>B</sup> - Plásticos Agrícolas y Geomembranas S.A.C. (21 tests)  
Manuel Constantino Olivares Espinoza --  
073-511814-511829  
[calidad@pqaperu.com](mailto:calidad@pqaperu.com)
- 72<sup>B</sup> - Tensar Corp. GA (4 tests)  
Lynn Cassidy (770) 968-3255  
[lcassidy@tensarcorp.com](mailto:lcassidy@tensarcorp.com)
- 73<sup>B</sup> - Gai Loi JSE (10 tests)  
Paul Wong 84-650-362-5825  
[paul905677@gmail.com](mailto:paul905677@gmail.com)
- 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. (24 tests)  
Javier Diaz Cipagauta (571) 424-9999  
[jdiaz@geomatrix.com.co](mailto:jdiaz@geomatrix.com.co)
- 76<sup>B</sup> - Tehmco (Chile) (15 tests)  
Patricia Rojas Perez (562) 580-2852  
[projas@tehmco.cl](mailto:projas@tehmco.cl)
- 78<sup>B</sup> - PQA Mexico (14 tests)  
Cesar Augusto Arcila (669) 954-8202  
[directorcalidad@payq.mx](mailto:directorcalidad@payq.mx)
- 79<sup>A</sup> - TRI Geosynthetic Testing and Services (32 tests)  
Ping Wang 86-512-6283-1396  
[Pwang@tri-env.com](mailto:Pwang@tri-env.com)
- 80<sup>B</sup> - Texel (Canada) (8 tests)  
André Parent (418) 387-4801  
[andre.parent@texel.ca](mailto:andre.parent@texel.ca)
- 81<sup>B</sup> - GSE Germany (18 tests)  
Evelyn Kroeger 49-40-767420  
[ekroeger@gseworld.com](mailto:ekroeger@gseworld.com)
- 82<sup>B</sup> - CARNO ATC (1 test)  
Mary Lynn Smith (770)-427-9456  
[marylynn.smith@cardno.com](mailto:marylynn.smith@cardno.com)
- 83<sup>B</sup> - GSE Egypt (13 tests)  
Ahmed Abdel Tawab - 202-2-828-8888  
[atawab@gseworld.com](mailto:atawab@gseworld.com)
- 84 - Interwrap India (14 tests)  
Ashutosh Dixit - 1-778-945-2888  
[adixit@interwrap.com](mailto:adixit@interwrap.com)
- 85 - PAG Tacna (11 tests)  
Manuel Constantino Olivares Espinoza --  
073-511814-511829  
[calidad@pqa.peru.com](mailto:calidad@pqa.peru.com)
- 86 - BOSTD China (29 tests)  
Zheng Hong - 86-532-8780-6919  
[zhenghong@bostd.com](mailto:zhenghong@bostd.com)
- 87 - Willacoochee Industrial (18 tests)  
Jason Booth - 912-534-5757  
[jason@winfabusa.com](mailto:jason@winfabusa.com)

<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).

The annual GAI-LAP meeting was held in Chicago, IL in conjunction with ASTM D35 on June 30, 2016. Seventeen people attended representing 26% of the 64 active GAI-LAP labs. This meeting was held at 8:00 AM in the morning before Task Groups began. We are grateful that ASTM allowed us the venue. I want to thank all that were in attendance for their time and effort.



Front row: Nathy Ivy (AGRU), Sam Allen (GRI), Cora Queja (TRI), Joel Sprague (TRI), John Paulson (Dison)  
Back row: Melissa Medlin (TenCate), Zabdul Islau (GeoSyntec), Larry Booth (Willacoochee Ind. Fabrics), Jason Booth (Winfab), Eric Blond (Sageos), Beth Wilbanks (TenCate), Drew Loizeaux (Propex), Nigel Wrigley (New Grids), Michael Robeson (Profile)  
Not Pictures: Missy Marley (American Excelsoir), James Goddard (ASTM), George Koerner (GSI)

The results of the meeting were as follows.

1. A brief introduction and background of the GAI-LAP program was discussed. Please note that we are in our 26<sup>th</sup> year of operations.
  1. Program started in 1995
  2. Accredited only geosynthetic labs
  3. ISO 17025 is our model
  4. On-site audits (Years, 1, 5, 10, etc...)
  5. Proficiency tests every year
  6. Our goal is  $C_v < 5$  for each test
2. The Demographics of the current GAI-LAP organizations are summarized as follows.
  - 19 independent labs
  - 40 manufacturer QC labs
  - 5 centers (research or government)
  - 64 total**
3. In addition...
  - 33 are GSI members
  - 21 are nonmember labs
  - (19 are international labs)
  - the newest members are:
    - GSE (Egypt and Germany)
    - Interwrap
    - PQA Tacna
    - Bostd Ltd.
    - WinFab
    - GS Testing Services (India)

This demograph shows an ever increasing interest in the program particularly from international laboratories. There are 244 possible tests for accreditation (182 ASTM, 1 FTM, 8 GRI, 53 ISO). The number of accredited tests per lab varies greatly, e.g., 4 min., 27 ave. 128 max.

There has been a rapid rise of new test methods. New tests added appear to be outside the ASTM D35 arena. The international arm of testing is very strong. We particularly see this in Europe and Asia.

4. Proficiency testing is still the hallmark of GAI-LAP. Of the 3617 proficiency test results submitted this year, only 64 first submittals were outliers representing 1.8% of the total. All outliers were resolved. Results of the proficiency tests were shared at the meeting and also distributed electronic via e-mail and CD.

Congratulations to the GSI-LAP members on a job well done. Several other certification and accreditation programs around the world are now requiring proficiency test data per ISO 17025. All GAI-LAP labs easily comply with this requirement. Your hard work over the years is exemplary and has been summarized in a paper presented at GeoAmericas in Miami entitled, "GSI's GAI-LAP: A Twenty (20) Year Review," by G. R. Koerner, GeoAmericas 2016, Miami, GeoSynthetica Minerva, FL USA, pgs. 296-304.

The GAI-LAP proficiency test program would not function without samples to test. In this regard we would like to thank the following organizations for their generous contribution of geosynthetics to this cause.

- TenCate Inc. and Propex for geotextiles
- GSE Lining Technology Inc. and AGRU America for geomembranes
- NAUE for geogrids and for GCLs
- ADS Inc. for plastic pipe
- Maccaferri for geonets and geocomposites

5. The GAI-LAP Customer Survey was again sent out to all program participants and the findings were reviewed at the meeting.

18% return; the following are results (5 best to 1 poorest)

- (a) Information exchange = 4.1
- (b) Conflict resolution = 4.5
- (c) Proficiency testing = 4.7
- (d) Directory and internet = 2.8

**Overall = 4.0**

Overall results to date: 2015 (4.3), 2014 (4.2), 2013 (4.2), 2012 (4.1), 2011 (4.1) 2010 (4.3), 2009 (4.4), 2008 (4.4), 2007 (3.9), 2006 (4.0), 2005 (4.0), 2004 (4.1), 2003 (4.1), 2002 (4.2)

We feel that the program has had a very good year in 2016 and look forward to expanding our outreach going forward.

As usual at these annual meetings we had a lively discussion regarding the conflict resolution cases

addressed by the GAI-LAP this year. They are summarized below;

**Conflict Resolution**

1. ASTM D638 Tensile, non use of extensometer
2. ASTM D882 Strip tensile, yield versus break elongation (strain)
3. ASTM D4716 Transmissivity, Tubular drainage geocomposites width of the specimen and soil above
4. ASTM D4716 Transmissivity, 0.01 psi normal pressure with gradient of one
5. ASTM D5199 (Thickness) very thick NPNW GT, manner in which load is applied (sticky rack and pinion) and dwell time
6. ASTM D5321 DS, PVC friction angle changes with temperature and environment conditions
7. ASTM D5321 DS, extremely light normal pressure
8. ASTM D5887 GCL, Flux for polymer modified GCL with 0.1M CaCL3 solution
9. ASTM D5994 Core thickness, search three times and minimum
10. ASTM D7005 Ply, average versus minimum
11. ASTM D7466 Asperity, maximum

Per a discussion on deliverables from GAI-LAP they are as follows:

**Deliverables**

1. Certificate, e-mail and then hardcopy
  2. Congratulations letter, then hardcopy
  3. Proficiency test results, then hardcopy
  4. Proficiency data base
  5. Directory, e-copy
  6. Website update
  7. Audit report if applicable
  8. Proficiency samples as requested
6. At the conclusion of the meeting we had an open discussion highlighted by the following housekeeping items:
    - a. The next GAI-LAP annual meeting will be held in June 2017 in conjunction with ASTM D-35.
    - b. GAI solicited manufacturers for geosynthetic materials for 2017 proficiency testing.
    - c. Each lab can add up to seven tests per year.

It is a pleasure working with you. We appreciate your participation and congratulate you on your success!

If you have questions, please contact me accordingly.

George Koerner ([gsigeokoerner@gmail.com](mailto:gsigeokoerner@gmail.com))



## Activities within GCI (Certification)

GSI presently has three separate inspector certification programs. One (begun in 2006) is focused on QA/QC of field inspection of waste containment geosynthetics and compacted clay liners. The second (begun in 2011) is focused on MSE Wall, Berm and Slope field inspection. The third on Geosynthetic Designer Certification was begun on September 1, 2016. See our website at [www.geosynthetic-institute.org](http://www.geosynthetic-institute.org) under "certification" for a description and information on all three of them. They are similar in that a perspective candidate must...

- Be recommended by a professional engineer who knows, and can attest to, at least six months of acceptable experience performing professional services within the specific application area.
- Submit a completed application and be approved by the Geosynthetic Certification Institute to take the exam.
- Must successfully pass a written examination (70% of the questions is the passing grade) proctored by GCI or a GCI designated organization and graded by the Geosynthetic Certification Institute to become a certified inspector.
- 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 QA/QC in field installation of both geosynthetic materials and compacted clay liners. The statistics to date are as follows.

#### Inspector Certification Test Results for Waste Containment Inspectors 2006 – 2016

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	29	2 (12%)	28	2 (6%)
<b>TOTAL (to date)</b>	<b>663</b>	<b>84 (13%)</b>	<b>613</b>	<b>71 (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. Presently, the corresponding course for this certification program has been transferred into a series of six presentations over a consecutive 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 for MSE Walls and Berms Inspectors (2011-2016)

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>

### Program #3 - Geosynthetic Designer Certification

The "Geosynthetic Designer Certification Program (GDPCP)" is also now available. Please go to <http://www.geosynthetic-institute.org/gdcpintro.pdf> for the requisite details. Included are introduction (rationale behind the program was given in a recent GSI Column called "We're Losing the Battle"), disclaimer, requirements, application, reference material, sample questions, proctor manual and proctor application. In the *requirements section* you will see that the applicant must;

- be a graduate of an accredited engineering program,
- have six-months geosynthetic designer experience,
- complete the application form,

- pay the \$500 fee for 5-years certification, and
- take a 45-question examination with  $\geq$  70% passing.

The *examination* itself is subdivided into 15-sections, each consisting of five questions. A candidate must answer any 3 questions in each section, making a total of 45 questions to be answered. Most of the questions are numeric, as is geosynthetic design practice in general. Unlike our other certification examination questions, however, this examination is of an open-book, open-notes format and does require a calculator so as to “crunch the numbers”.

The on-line courses for preparation of three 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.

Lastly, please spread-the-word within your organization and to others as well. We sincerely hope that one, or all three, of the above programs will be beneficial in upgrading the technical base of geosynthetic design and installation so as to properly utilize all of our geosynthetic materials in all of their many applications. All three programs are ready to go and if you have questions and/or comments please contact us accordingly.

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 Marilyn Ashley [mvashley@verizon.net](mailto:mvashley@verizon.net)  
 Jamie Koerner [jrkoerner@verizon.net](mailto:jrkoerner@verizon.net)

## The GSI Affiliated Institutes

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

**GSI-Korea** was formed on February 9, 1998 as a collaborative effort between FITI Testing and Research Institute (a quasi-government organization) and INHA University (through its Geosynthetics Research Laboratory). It is presently 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 new direction of Dr. A. K. Mukhopadhyay (who succeeds Dr. A. N. Desai) was formed in 2015. The hosting organization is the Bombay Textile Research Association (BTRA) which is world known for its excellence in textile R & D and is currently branching out into all forms of geosynthetics. We are delighted in this regard and, as a side-note, Dr. Mukhopadhyay has replaced Dr. Desai on GSI's Board of Directors to fill out his term. (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.*

## **A Tribute to Robert E. Landreth, P.E.**

### **Former Head of EPA's Risk Reduction Engineering Laboratory (RREL)**



An unsung hero of the geoenvironmental and geosynthetics fields is a retired former research director at the U. S. Environmental Protection Agency, Mr. Robert E. Landreth. It was Bob Landreth's vision and tenacity in advocating for research funds that made possible pioneering research in the 1980's that led to dramatic increases in use of geosynthetics for waste containment applications and to better engineering of waste containment liner and cover systems. The pioneering advances made possible by this research literally changed the way that waste materials were managed not only in the U.S. but throughout the world. It was the researchers, including students, professors, and professionals in industry, who performed the research, but it was the advice and guidance from Landreth that was critical in conceiving, funding, and communicating that made all these outcomes possible. He is truly a giant of the geoenvironmental and geosynthetics industries.

Robert E. Landreth graduated from New Mexico State University with both a BSCE and MSCE in 1963. He joined the U.S. Public Health Service and was detailed to the U.S. Environmental Protection Agency. His first assignment was in Cincinnati, Ohio training state public health officials in radiological health issues. He was transferred to Las Vegas in 1966 where he was a member of the aerial group monitoring the Nevada Nuclear Test Site. In 1972 Robert was transferred back to Cincinnati where he spent his career until retirement. He was critical in developing the research data base in support of the Federal regulations on the use of natural soils and geosynthetics in both hazardous and non-hazardous waste management. These regulations were embodied in the 1982 RCRA legislation for hazardous solid waste (HSW) as Subtitle "C" and for municipal solid waste (MSW) as Subtitle "D". They were subsequently extended to heap leach

mining, coal combustion residuals and surface impoundments for all types of solid and liquid disposal.

It was at RREL where he was pivotal in implementing engineered landfill and surface impoundment lining systems, as well as landfill cover systems for EPA and Superfund sites. This entailed all types of natural soil and geosynthetic materials. In addition to performing in-house research at his Cincinnati EPA laboratory, Mr. Landreth funded many individual research projects at universities, consultancies and other governmental laboratories. Topics varied between a balance of manufacturing, design, testing, installation, contracting, quality control and quality assurance. This plethora of information was daylighted by conferences, symposia and workshops, many of which were held at EPA in Cincinnati. At the time – throughout the 1980's – these EPA conferences were must-attend meetings for anyone in the industry who was interested in changes in waste disposal technology. The state of the art was literally re-defined every year at these meetings.

In order, however, to transfer this knowledge base directly to state environmental regulators he formed a team of speakers in 1988 for landfill liner training courses which were held in each of the ten EPA Regions. These courses were free and open to EPA staff, state regulators, engineers, owners, etc. The course format was quickly established. Bob Landreth presented regulations, Dave Daniel focused on CCLs and other natural soils, Bob Koerner presented geosynthetics and Greg Richardson presented an array of topics which captivated everyone in attendance. Two years later, a second course series was held which focused on landfill closures. Paul Schroeder joined the team to describe the HELP model. Approximately 10,000 regulators attended these twenty regional EPA courses and for most this was their first exposure to modern landfill design practices and procedures. Even decades later, it is rare to meet with regulators regarding a landfill or surface impoundment that someone in the group has not attended one of these courses.

Over the years, Mr. Landreth's sponsored research with various contractors resulted in the following benchmarks;

1. Compacted clay liners (CCLs) having hydraulic conductivity  $\leq 1 \times 10^{-7}$  cm/s
2. CCL thickness of 600 mm for MSW and 900 mm thick for HSW
3. Geomembranes (called FMLs in regulations) of at least 0.75 mm (or 1.5 mm for HDPE) thickness
4. Geomembranes resin type was site-specific
5. Composite GM/CCL or (later) GM/GCL action
6. Intimate contact required between geomembrane and underlying clay
7. Double lined systems with leak detection required for HSW

8. Maximum leachate head on geomembranes of 300 mm
9. Gravity flow drainage (minimum of 2% slope) for leachate collection and leak detection
10. Minimum time for leachate to reach downgradient sump of 24 hrs.
11. Incorporation of GCLs and geonets on site-specific basis
12. Significant latitude for individual states, via their solid waste director, provided that technical equivalency to the federal regulations could be shown

Whatever was the former site-specific situation (most generally, dumps), before Mr. Landreth waste disposal is currently a major activity for professionals in the U.S. and around the world and is immeasurably more environmentally safe and secure in comparison to the past.

The tremendous insight, perspective, guidance, determination and support shown by Robert Landreth is a testimony to the very best of regulators and regulatory agencies. He played an absolutely critical role in changing the world for the better. Everyone in the waste containment industry owes him a sincere depth of gratitude.

Bob retired in 1996 and enjoys wood working activities and his garden challenges. He and his wife, Mitch, live in Cincinnati, have two daughters and three grandchildren. We wish him and his family well.

Dave Daniel and Bob Koerner

## GSI's Member Organizations

We sincerely thank all of our sponsoring organizations. Without them, GSI simply could neither happen nor exist. The current GSI member organizations and their contact members are listed below. **Our newest members are 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, Borouge Pte. Ltd. of Singapore with Julia Putih and Intermas Group of Spain with Rubén Palacios contact members. Thanks to all and welcome to GSI!!!**

**GSE Environmental**  
*Steve Eckhart/Boyd Ramsey/Aigen Zhao*  
**U.S. Environmental Protection Agency**  
*David A. Carson*  
**Chemours Technology**  
*John L. Guglielmetti*  
**Federal Highway Administration**  
*Silas Nichols/Daniel Alzamora*  
**Golder Associates Inc.**  
*Mark E. Case/Tim Bauters/Paul Sgriccia*

**Tensar International Corporation**  
*Mark H. Wayne [BoD]/Joseph Cavanaugh/Doug Brown*  
**Bonar Inc. (formerly Colbond)**  
*Richard Goodrum*  
**Geosyntec Consultants**  
*Steve Poirier*  
**LyondellBasell Industries**  
*Fabio Ceccarani/Rob Olivero*  
**TenCate Geosynthetics**  
*John Henderson/Chris Lawson*  
**CETCO**  
*Davie Chiet/Michael Donovan/Rob Valorio*  
**Huesker, Inc.**  
*Sven Schröer/Dimiter Alexiew/Lilma Schimmel*  
**NAUE GmbH & Co. KG**  
*Kent von Maubeuge [BoD]*  
**AVINTIV (formerly Polymer Group Inc.)**  
*Brian H. Whitaker*  
**TRI/Environmental Inc.**  
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