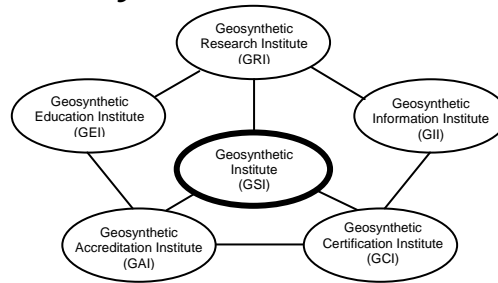


The GSI Newsletter/Report

Geosynthetic Institute



Vol. 26, No. 3

September, 2012

This quarterly newsletter, now in its 26th year, presents the activities of GSI and its related institutes to all who are interested. It is available on the institute's home page at www.geosynthetic-institute.org. It also serves as a quarterly report to its member organizations. Details are available by contacting George R. Koerner or Marilyn Ashley at phone (610) 522-8440; fax (610) 522-8441 or e-mail at gkoerner@dca.net or mvashley@verizon.net.

Activities of GSI's Directors

1. Webinars are the rage! In addition to eight of them given regularly for ASCE, a new effort on behalf of the International Society for Soil Mechanics and Geotechnical Engineering will be initiated.
2. A set of ~ 750 power point slides will accompany the new 6th Edition of Designing With Geosynthetics. It is described in this Newsletter/Report and will be available by the end of the month.
3. Regarding conferences, Grace Hsuan will be in Spain for EuroGeo 5, George Koerner will be at Global Waste in Phoenix, Bob Koerner will be in San Diego for the GeoInstitute Conference and all three of us will be at Geosynthetics '13 in Long Beach, California.
4. The GRI-25 conference speakers/topics are set for Long Beach, California in April, 2013. The theme is "25-Year Retrospectives on the Geosynthetic Industry and Glimpses Into the Future"...it should be a "keeper".
5. Both George and Bob are doing many in-house presentations for member organizations. In this regard all of the ASCE Webinars are available plus about 100 others. If you want a list, please advise and we can work something out in this regard.
6. BoD elections for the positions representing Owners/Operators, Geotextiles/Geogrids and At-Large will be initiated in October.
7. The present BOD is as follows, along with their respective term ending year's.

Term Ends 2012

- Tony Eith (Chairman) - Waste Management Inc. (Owners and Operators)
e-mail: aeith@wm.com
- Boyd Ramsey - GSE Lining Technology, Inc. (Geotextiles and Geogrids)
e-mail: bramsey@gseworld.com
- Sam Allen - TRI/Environmental, Inc. (At-Large)
e-mail: Sallen@tri-env.com

Term Ends 2013

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

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- GSI's Member Organizations

Term Ends 2014

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

Overview of GRI Projects (Research)

Each issue of our Newsletter/Report provides a brief glimpse and update of current GRI research projects. It will be noted that most projects are of a very long duration; one being up to 50-years! (In this regard short projects are given to design firms or testing laboratories that are GSI Members). Details and full briefings are available to member organizations at their request. Dr. Grace Hsuan, Associate Director of GRI can be contacted for additional information as can the other project managers listed in the following write-ups.

Projects marked with an asterisk have been written up as either short "in-progress" papers or complete papers. Grace can be reached by phone at (610) 5228440 or e-mail at <grace.hsuan@coe.drexel.edu>.

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

- 1. In-Situ Temperature Monitoring of Liner and Cover Geomembranes in Dry and Wet Landfills*** - George Koerner is measuring the in-situ temperature behavior of liner and cover geomembranes and has installed 60± thermocouples for long term measurements in both wet and dry municipal solid waste landfills in Pennsylvania. The project has been extended into its 15th-year and has resulted in an extremely authoritative set of real-life data.
- 2. Bioreactor (aka, Wet) Landfill Behavior and Properties*** - One of the landfill cells mentioned in Item #1 is at field capacity, hence it is a true anaerobic bioreactor. Dr. George Koerner is in charge of considerable monitoring at this cell which includes the following
 - waste moisture content
 - waste temperature
 - leachate chemical analysis
 - waste gas analysis
 - perched leachate within the wasteData is being collected on a quarterly basis. The timeline of the project calls for monitoring up to 10 years. This activity has been extended to an adjacent landfill to see how reproducible the data is with a slightly different waste mass.
- 3. Flow Behavior of Fully Degraded Waste*** - A field project under sponsorship of GSI and Waste Management investigates the drainage of highly degraded MSW placed directly on leachate collection systems. The leachate collection materials consist of both natural soils and geosynthetic drains. The experimental setup has been dismantled and a paper will be given at the 2012 Global Waste Conference in Phoenix.
- 4. Field Exposed Lifetime of Geogrids Used at the Facing of Landfill Berms** - The facing of mechanically stabilized earth landfill berms (and other walls and slopes as well) is often using a wrap-around configuration leaving the geogrid exposed to the atmosphere. A new project being conducted by George Koerner for Waste Management is presently investigating two different geogrid's behavior over time. A 50-year time frame is envisioned. The long-term behavior will eventually be compared to UV laboratory exposed data as noted in Item #7 below.
- 5. Field Behavior of fPP and fPP-R Geomembranes** - We continue to receive and evaluate field samples of flexible polypropylene geomembranes (mainly scrim reinforced). They are regularly added to our database in this regard. The most recent was for potable water storage and had a service lifetime of 10-years. Using our correlation factor of 1200 light hours in D7238 at 70°C being equivalent to one-year in a hot climate, this is equivalent to a laboratory exposure in the weathering device of 12,000 light hours. Our GRI-GM18 specification calls for 20,000 light hours for an acceptable formulation which is essentially a factor-of-safety of 1.67.
- 6. Laboratory Exposed Lifetime of Geomembranes*** - GSI is using three UV-fluorescent devices to estimate the projected exposed lifetime of many different types of geomembranes. Presently being incubated are HDPE, LLDPE, fPP, PVC (N.A.), and EPDM. Exposure times of 50,000 light hours are now realized at 70°C and a replicate set of samples are being incubated at 60°C. Some will take at least 70,000 light hours (≈ ten years). The third sequence at 80°C was started on 1/1/2010. Ongoing data is being reported to manufacturers and resin producers. GRI Report #42 is available on the 70°C data using a correlation coefficient to estimate field lifetime of the various geomembranes.

7. **Laboratory Exposed Lifetime of PVC (European) Geomembranes** - Of late, we have been attempting to distinguish between PVC geomembranes manufactured in North America versus Europe. Of course, the difference is in the type of plasticizers and other additives used in the formulations. In this regard we have been evaluating various European formulations for four years using three additional UV-fluorescent devices and the results are very impressive. The study is being conducted for CARPI Tech, a GSI member organization.
8. **Laboratory Exposed Lifetime of Geogrids** - The UV-fluorescent exposure of two different biaxial geogrids which are used at the exposed faces of welded wire mesh MSE structures is ongoing. The various geogrids are now up to 35,000 light hours and data is being generated and sent to the respective manufacturers. Replicate samples are now being incubated at 60°C for eventual use in Arrhenius Modeling and lifetime prediction. The last set at 80°C has just begun incubation.
9. **Laboratory Exposed Lifetime of TRM Fibers** - We are also using UV-fluorescent exposure of four different turf reinforcement mat fibers to assess their lifetime capabilities. They are presently being incubated at 60°C, 70°C and 80°C. Communication between the manufacturer Propex is ongoing.
10. **Laboratory Exposed Lifetime of Geotextiles** - We have just completed a UV study on a heat-bonded nonwoven PP geotextile used for three dimensional cell structures which are exposed to the atmosphere. The results for the particular geotextile and its specific formulation at 20°C (68°F) average field temperature are 4.9 years for half-life of breaking strength and 4.1 years for half-life of breaking elongation.
11. **Laboratory Exposed Lifetime of Geomembrane Tapes** - There are several adhesive sided geomembrane tapes used to repair exposed geomembranes. Two different types are being evaluated in our QUV exposure devices.
12. **Retaining Wall Failure Evaluations*** - We presently have GRI Reports 38, 39, and 40 addressing mechanical stabilized earth (MSE) walls using geosynthetic reinforcement which document 82-failures. Our data base has now increased to 161 failures and continues to grow! The failures are either excessive deformation or collapses. We have presented one-day courses on this topic along with inspector training and development insofar as a field inspectors certification program; see the certification section of this Newsletter/Report. We have just recently presented the findings at two geotechnical conferences; one in Williamsburg and the other in Hershey.
13. **pH Between Masonry Block Wall Units*** - George Koerner has been measuring the pH between three types of masonry blocks for over six years to monitor the values. Concern here is over PET geogrids which are known to be sensitive to high alkalinity environments. Indeed, the values started high, but over time are now down to eight and lower. George Koerner has a paper in this regard.
14. **Landfill Failure Analysis** - Since our originally reported paper on ten landfill failures in a 2000 publication, we have accumulated ten more. All 20-failures have been analyzed by Dr. Connie Wong using the ReSSA Code and are now available to members and associate members as GRI Report #41.
15. **Puncture Behavior of Nontraditional Protection GSs** - A member organization asked about the protection afforded to a geomembrane by geonet composites and GCL's. As a result, we have just concluded a laboratory study using three different probes against various GMs protected by geotextiles, GCs and GCLs. The resulting paper has been accepted by ASTM's Journal of Geotechnical Testing.
16. **Slow Pressurization of HDPE Geomembranes in Axi-Symmetric Testing – The** ASTM D5716 method of testing geomembranes in a 3-D axis-symmetric mode uses a pressure rate of 6.9 kPa/min (1.0 psi/min). While such a rate is reasonable for most geomembrane types, it is questionable for HDPE which is semi-crystalline and cannot stress relax. To investigate slower rates Bob Koerner is performing a new project with rates as low as 6.9 kPa/month (1.0 psi/month)!
17. **CaCO₃ in Bentonites Contained Within GCL's** - It is possible that the amount of calcium carbonate contained within the bentonite of different GCL's is indicative of their hydraulic performance. George Koerner has evaluated 15-bentonites and is preparing a paper for an ASTM-STP publication.
18. **Generic Specifications** - A major effort is ongoing with respect to the development and maintenance of generic geosynthetic specifications. The current status of these specifications is as follows:
 - Completed, Available and Regularly Updated
 - GM13 – HDPE Geomembranes
 - GM17 – LLDPE Geomembranes
 - GM18 – fPP and fPP-R Geomembranes
 - GM21 – EPDM and EPDM-R Geomembranes
 - GM22 – Exposed Temporary Covers
 - GM25 – LLDPE-R Geomembranes
 - GM19 – Geomembrane Seams
 - GT10 – Geotextile Tubes
 - GT12 – Geotextile Cushions
 - GT13 – Geotextile Separators
 - GCL3 – Geosynthetic Clay Liners

Working Within Focus Group

GTXX – Turf Reinforcement Mats (tabled)

Delayed or Off in the Distance

GGXX – Bidirectional Geogrids

GGXX – Unidirectional Geogrids

GNXX – Geonet Drainage Composites

GCXX – Other Drainage Geocomposites

GSXX – High Strength Reinforcement Geotextiles

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

19. **Other GRI Standards** - There are several GRI Standards in various forms of preparation. These include a test method to extract plasticizers from PVC geomembrane formulations, a GCL overlap permeability and a group of test methods being prepared for both Milliken and ThermaGreen Companies for their respective new products.

Progress within GII (Information)

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

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

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

- | | |
|--|--------------------------------|
| • Introduction to GSI | • 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. 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 30,000 citations which is the majority of the geosynthetics literature published in English. It's quite easy to use provided that you have a specific topic, or area, in mind. This is the section of the website that we (and others we are told) use the most in our daily activities.

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

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

- #15 - Allowable S.I. Leakage Rates
- #16 - Conformance Testing Requirements
- #17 - Post Closure Care of MSW Landfills
- #18 - UMT and LLRW Disposal Sites in USA
- #19 - Monitoring Movements of MSE Structures
- #20 - GS Opportunities with Shale Gas Extraction
- #21 - State Regulatory Departments Involved in Shale Gas Permitting
- #22 - Selected GS Opportunities with Energy Production and Transmission
- #23 - EPA Agencies Regarding Landfill Berms

Incidentally, two new White Papers have just been added; one on reduction factors for holes in GS reinforcement and the other to explain separation-in-plane when testing geomembrane seams.

Progress within GEI (Education)

Free CD

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

6th Edition of Designing With Geosynthetics

The 6th Edition of Designing With Geosynthetics continues to sell well in all three of its formats; hardback, softback and e-book.

The 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.

Our more recent activity in this regard is to develop a power point presentation for the entire 914-page book. Marilyn Ashley is presently typing it and after proof-reading we will send the final CD out for duplication and distribution. Contact Bob Koerner for this free CD!

GRI Reports

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

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

Courses

We have just scheduled the following set of courses:

- #1 MSE Wall Failures and Their Remediation
November 28, 2012 and March 13, 2013
- #2 Construction Inspection of MSE Walls, Berms and Slopes
November 29, 2012 and March 14, 2013
(Optional Exam Follows)
- #3 Design and Testing of Geosynthetics in Waste Containment Systems
December 5, 2012 and March 20, 2013
- #4 QA/QC of Geosynthetics in Waste Containment Systems
December 6, 2012 and March 21, 2013
(Optional Exam Follows)

The above courses will be held at:
Geosynthetic Institute
475 Kedron Avenue
Folsom, PA 19033
(approx. 4.5 miles from Phila. International Airport)

Course Registration and Fee:
\$350/person for each one-day course (up to one month prior to course)
\$400/person thereafter

\$250/person – GSI Members
Contact: Marilyn Ashley (mvashley@verizon.net)

GSI Fellowships

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

The presently established criteria are as follows:

- Students must be working on a geosynthetics topic which furthers the technology in a proactive manner.
- Students must have completed their candidacy requirements leading to a doctoral degree. (Comment, we hope that some of them will “go academic” and teach and/or research geosynthetics in their immediate future)
- Students must be recommended by their advisor or department head.
- The fellowships can be renewed for total of three-years depending upon acceptable annual reports.
- Funding for each student is \$10,000 the first year and \$5000 for the second and third years.

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

GSI Fellowship Status for 2012-‘13 Academic Year

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

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

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

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

Activities within GAI (Accreditation)

The Geosynthetic Accreditation Institute's (GAI) current mission is focused on a Laboratory Accreditation Program (LAP) for geosynthetic test methods. George Koerner is in charge of the program. The GAI-LAP was developed for accrediting geosynthetic testing laboratories on a test-by-test basis. GAI-LAP suggests that laboratories use ISO 17025 as their quality system model. In addition, the program uses the GSI lab as the reference test lab and operates as an ISO 17011 enterprise. In short, this means that the GSI lab does not conduct outside commercial testing.

It should also be made clear that GAI-LAP does not profess to offer ISO certification, nor does it "certify" laboratory results. GAI-LAP provides accreditation to laboratories showing compliance with equipment and documentation for specific standard test methods ASTM, ISO or GRI standards. In addition, GAI-LAP verifies that an effective quality system exists at accredited laboratories by way of proficiency testing.

There have been significant additions to the number of GAI-LAP tests. Presently, there are 230 GAI-LAP test methods available for accreditation. Please consult our home page for a current listing.

As of September, 2012, the following laboratories are accredited by the GAI-LAP for the number of test methods listed in parenthesis. Contact personnel, telephone numbers and e-mails are also listed.

- 1^A - TRI/Environmental Inc. (118 tests)
Sam Allen -- (512) 263-2101
Sallen@tri-env.com
- 3^A - Golder Associates (45 tests)
David Alexander -- (770) 492-8280
dalexander@golder.com
- 4^C - Geosynthetic Institute (116 tests)
George Koerner -- (610) 522-8440
gkoerner@dca.net
- 8^B - Propex, Ringgold (19 tests)
Todd Nichols -- (800) 258-3121
todd.nichols@propexinc.com
- 9^B - Lumite (10 tests)
Rebecca Kurek -- (770) 869-1700
rpage@lumiteco.com
- 13^A - Precision Laboratories, CA (95 tests)
Cora Queja -- (714) 520-9631
cqueja@precisionlabs.net
- 14^A - Geotechnics (57 tests)
J. P. Kline -- (412) 823-7600
JPkline@geotechnics.net
- 20^A - GeoTesting Express, MA (46 tests)
Gary Torosian -- (978) 635-0424
gtt@geotesting.com
- 22^B - CETCO Hoffman Estates (13 tests)
Jim Olsta -- (847) 392-5800
jim.olsta@cetco.com
- 23^B - CETCO Cartersville (10 tests)
Chris Cunningham -- (706) 337-5316
christopher.cunningham@cetco.com

- 24^B - CETCO Lovell (10 tests)
Roger Wilkerson -- (307) 548-6521
roger.wilkerson@cetco.com
- 25^B - Ten Cate, Pendergrass (11 tests)
Beth Wilbanks -- (706) 693-2226
b.wilbanks@tencate.com
- 26^B - Agru America Inc. (17 tests)
Grant Palmer -- (843) 546-0600
gp@agruamerica.com
- 29^E - FITI Testing and Research Institute (86 tests)
Hong-Kwan Kim -- 82-2-3299-8071
hoganKim@fiti.re.kr
- 31^D - NYS Dept. of Transportation (9 tests)
John Remmers -- (518) 457-4104
Jremmers@dot.state.ny.us
- 32^A - Geo-Logic Inc. (6 tests)
Ken Criley -- (530) 272-2448
criley@geologic.com
- 34^B - GSE Richey Road (34 tests)
Jane Allen -- (281) 230-6726
Jallen@gseworld.com
- 37^B - GSE Chile (21 tests)
Mauricio Ossa -- 56-2 6010153
Mossa@gseworld.com
- 38^C - Sageos/CTT Group (91 tests)
Eric Blond -- (450) 771-4608
eblood@groupectgroup.com
- 40^B - GSE Lining Technology Inc. (17 tests)
Vicki Parrott -- (843) 382-4603
Vparrott@gseworld.com
- 41^A - SGI Testing Service, LLC (19 tests)
Zehong Yuan -- (770) 931-8222
ZYuan@interactionspecialists.com
- 42^C - NPUST (GSI-Taiwan) (69 tests)
Chiwan Wayne Hsieh -- 011-886-8-7740468
CWH@mail.npust.edu.tw
- 43^A - Ardaman & Associates (18 tests)
George DeStafano -- (407) 855-3860
gdestafano@ardaman.com
- 44^B - Fiber Web, Inc. (9 tests)
Adam Lyons -- (615) 847-7575
adam.lyons@fiberweb.com
- 45^B - Ten Cate Malaysia SDN Bhd. (23 tests)
C. P. Ng -- (603) 519 28568
cp.ng@tencate.com
- 46^B - TAG Environmental Inc. (13 tests)
Colin Murphy -- (705) 725-1938
colin_murphy@tagenv.com
- 47^B - Syntec LLC (9 tests)
Jeffrey Hicks -- (410) 327-1070
jhicks@synteccorp.com
- 49^B - Engepol Geosinteticos (19 tests)
Carolina Polomino -- (55) 11-4166 3001
carolina@engepol.com
- 50^B - ADS, Inc. Hamilton (7 tests)
Terry McElfresh -- (513) 896-2065
mcelfresh@ads-pipe.com
- 51^B - Solmax International Inc. (20 tests)
Simon Gilbert St. Pierre -- (450) 929-1234
simonGSP@solmax.com
- 53^B - Polytex Inquique (13 tests)
Cristian Valdebenito -- 011 56 57 42 90 00
cvaldebenito@polytex.cl
- 54^B - ADS, Inc. Finley (9 tests)
David Gonso -- (419) 424-8377
davegonso@ads-pipe.com
- 55^B - Atarfil Geomembranes (20 tests)
Iganacio Garcia Arroyo -- 34 958 439 278
ngarcia@atarfil.com
- 56^B - Polytex Santiago (11 tests)
Jamie Morales -- 56-2-627-2054
Jmorales@polytex.cl
- 57^B - Ten Cate Cornelia (15 tests)
Melissa Medlin -- (706) 778-9794
m.medlin@tencate.com

- 58^B - Propex Nashville (9 tests)
Tim Smith -- (229) 686-5511
Timothy.Stark@propexglobal.com
- 59^B - Firestone (9 Tests)
Janie Simpson -- (864) 439-5641
SimpsonJanie@firestone.com
- 60^B - Polytex Lima (11 tests)
Elias Jurufe -- 51 16169393
Ejarufe@polytex.cl
- 61^B - Raven Industries (17 tests)
Justin Norberg -- (605) 335-0288
Justin.Norberg@ravenind.com
- 62^B - Solmax International Asia (14 tests)
Marie Andre Fortin -- (450) 929-1234
mafortin@solmax.com
- 63^A - TRI Environmental, Inc.; DDRF (4 tests)
Joel Sprague -- (864) 242-2220
JSprague@tri-env.com
- 64^B - Agru America (NV) (14 tests)
Chris Adams -- (775) 835-8282
ca@agruamerica.com
- 65^C - Bombay Textile Rsearch Assoc. (BTRA) (24 tests)
Riyaz Shaikh
(0) 022-25003551
btra@vsnl.com
- 66^B - Rowad International Geosynthetics Co. Ltd (14 tests)
Asad Ullah Khan -- +966-3-812-1360
usad@rowadplastic.com
- 67^A - MicroBac Hauser Division (8 tests)
Steve Ferry -- (720) 406-4806
steve.ferry@microbac.com
- 68^B - Glen Raven Technical Fabrics LLC (3 tests)
Edmund Gant -- (336) 229-5576
egant@glenraven.com
- 69^B - GSE Lining Technology Co. Ltd. (12 tests)
Siriporn Chayaporenlerit -- 6638-636638
siriporna@gseworld.com
- 70^A - RSA Geo Lab LLC (48 tests)
Raza Ahmed -- (908) 964-0786
geolab13@yahoo.com
- 71^B - Plásticos Agrícolas y Geomembranas S.A.C. (14 tests)
Jhoana Carolina Diaz Martinez -- 6370 (20 110811)
calidad@pqaperu.com

^AThird Party Independent ^CInstitute
^BManufacturers QC ^DGovernment

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

George R. Koerner

The annual GAI-LAP meeting was held in San Diego, CA in conjunction with ASTM D35 on June 27, 2012. Thirteen people attended representing 22% of the 51 active GAI-LAP labs. Attendance was off at this meeting as with all the ASTM meetings that I attended in San Diego. This meeting was held directly after the GCL symposium. We are grateful that ASTM allowed us the venue. I want to thank all that were in attendance for their time and effort.

Sam Allen – TRI Environmental
Chris Athanassopoulos – CETCO
Tim Bauders – Golder
Eric Blond – Sageos/CTT Group
James Brown – Thrace-LINQ

J. P. Kline – Geotechnics
Cora Queja – PGLI
Joel Sprague – TRI Environmental
Gary Torsoian – Geotesting Express
Jan Wildman – Ardaman & Associates
Jimmy Youngblood – GSE
Carmelo Zantra - PGLI

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 17th year of operations.
 - a. Program started in 1995
 - b. Accredited only geosynthetic labs
 - c. ISO 17025 is our model
 - d. On-site audits (Years, 1, 5, 10, etc...)
 - e. Proficiency tests every year
 - f. Our goal is $C_v < 5$ for each test
2. The Demographics of the current GAI-LAP organizations are summarized as follows.
 - 17 independent labs
 - 29 manufacturer QC labs
 - 5 centers (research or government)
 - 51 total**

Also

- 33 are GSI members
- 18 nonmember labs
- (19 are international labs)
- The newest members are:
 - RSA Geo-LAB LLC
 - PAG SAC Peru

This demograph shows an ever increasing interest in the program particularly from international laboratories. There are 230 possible tests for accreditation (168 ASTM, 1 FTM, 8 GRI, 53 ISO). The number of accredited tests per lab varies as follows; 4 min., 27 ave. 128 max.

There has been a rapid rise of new test methods, with a near tripling of methods covered in a seventeen year period since the inception of program. 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.

3. Proficiency testing is still the hallmark of GAI-LAP. Of the 1821 proficiency test results submitted this year, only 7 first submittals were outliers representing 0.3% 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 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.

It should be noted that GAI-LAP has a new effort in Europe that allows labs to participate in the proficiency portion of the program only, for \$1,250 USD plus postage and handling. Two labs made use of this service this year.

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

- TenCate Inc. for geotextiles
- GSE Lining Technology Inc. for geomembranes
- CETCO Inc. for GCLs
- ADS Inc. for Pipe
- GSE Inc. for geonets and geocomposites

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

22% return; the following are results (5 best to 1 poorest)

- (a) Information exchange = 4.1
- (b) Conflict resolution = 4.3
- (c) Proficiency testing = 4.7
- (d) Directory and internet = 3.4

Overall = 4.1

Overall results to date: 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 2012 and look forward to expanding our outreach in Asia going forward.

In addition to the above items we had a frank discussion about outsourcing auditing service at the meeting. 37% of George Koerner's time is spent on the GAI-LAP and the GSI BoD thinks that this is too much. Therefore in 2011, TRI's proposal was approved by the BoD as a subcontractor. In 2012 TRI successfully audited a lab in Peru after GeoAmericas. This practice will continue knowing that GAI-LAP will honor all conflict of interest concerns and continue to audit all 3rd party labs.

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;

- a. ASTM D6392, fPP Shear & Peel exhibiting SIP; (This resulted in a GSI white paper)
- b. ASTM D6693, Tensile, (nick in die influencing break elongation)
- c. ASTM D5397, Stress crack, (improper notching with respect to stress calculation)

- d. ASTM D4595, WWT GT, (preload issues were cause of variability)
- e. ASTM D5994, Core thickness, (search technique influences results)
- f. ASTM D7003, R-GM strip, (3/8" scrim spacing on 1" specimen width results in either 2 or 3 yarn bundles across the roll width of the specimen. This will obviously have a great effect on the tensile strength and elongation of the particular specimen. Therefore one should report the number of yarn bundles in a specimen.

After this lively discussion we had a heart-to-heart discussion on the topic of laboratory ethics and responsibilities. We talked about defining the "client" and the relationship with them. Results versus analysis were discussed from both an engineering and scientific perspective. We talked about cameras in the lab and who owns rights to photos and videos in this new world of Skype, YouTube, Facebook, Twitter, etc. In short, we reemphasized that a lab report cannot be reproduced without consent as per ISO 17025.

5. The open discussion portion of the meeting was highlighted by the following housekeeping items:

- a. The next GAI-LAP annual meeting will be held in June 2013 in conjunction with ASTM D-35.
- b. GAI solicited manufacturers for geosynthetic materials for 2013 proficiency testing.
- c. Note that 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 (gkoerner@dca.net)

Activities within GCI (Certification)

GSI now has two separate inspector certification programs. One (begun in 2006) is focused on QA/QC of field inspection of waste containment geosynthetics and compacted clay liners. The other (begun on Dec. 1, 2011) is focused on MSE Wall, Berm and Slope field inspection. See our website at www.geosynthetic-institute.org under "certification" for a description and information on both of them. They are both similar in that a perspective candidate must...

- Be recommended by a professional engineer who knows, and can attest to, at least six months of acceptable experience performing CQA activities with either geosynthetic liner or cover systems or

MSE walls, berms, or slopes using geosynthetic reinforcement.

- Submit a completed application and be approved by the Geosynthetic Certification Institute to take the exam.
- Must successfully pass a written examination (70% of the questions is the passing grade) proctored by GCI or a GCI designated organization and graded by the Geosynthetic Certification Institute to become a certified inspector.
- Must pay a one-time fee which covers a five-year period upon completion of the above items. The fee is \$500 for five-years of certification.

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

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

Inspector Certification Test Results
2006 – 2012

Year	Geosynthetic Materials		Compacted Clay Liners		Commentary No. of people failing both exams
	No. of people taking exam	No. of people failing exam	No. of people taking exam	No. of people failing exam	
2006	141	5 (3%)	128	12 (9%)	2 (1.5%)
2007	82	11 (13%)	73	12 (16%)	7 (8.5%)
2008	95	25 (26%)	89	20 (22%)	13 (14%)
2009	36	7 (19%)	36	2 (5%)	2 (6%)
2010	59	12 (20%)	54	7 (13%)	5 (8%)
2011	54	6 (11%)	53	3 (6%)	1 (2%)
2012	27	1 (4%)	21	0	0
TOTAL (to date)	494	67 (14%)	454	55 (12.5%)	30 (6%)

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

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

The official launch of the program was on December 1, 2011 with a course and the examination afterward. More recently a somewhat revised second course on June 14, 2012 was well received. As a result there are now thirteen persons certified by GCI for the inspection of MSE Walls, Berms and Slopes.

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

- Kent von Maubeuge – NAUE Group
- Mohammed Karim – Virginia DEQ
- Bob Sabanas – NTH Consultants

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

Our thanks go to them in this regard.

While a field inspector cannot require proper design or instruct a contractor how to build the wall, flaws can be identified for possible design modification or mitigation action. Furthermore, and at minimum, construction practices can be observed and corrected if inadequate or improper. Please contact George Koerner at gkoerner@dca.net or Jamie Koerner at jrkoerner@verizon.net for questions or additional information.

The GSI Affiliated Institutes

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

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

FITI is a 30-year old testing organization located in Seoul focusing on interlaboratory proficiency; environmental protection; safety and flammability; hazardous substances; in-house quality control; consumer protection; complaint analysis; quality marking; procurement; household and industrial applications; and materials approval. The geosynthetics testing group within FITI has twelve people (two with doctoral degrees) and 10 engineers. The geosynthetic laboratory is GAI-LAP accredited for 70 geosynthetic test methods. Dr. Jeonghyo Kim is

the general manager within FITI's geosynthetics activities.

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.

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

Items of Interest

1. The Most Dynamic Cities of 2025

This paper lists the top 75 cities in 2025 with respect to population growth and GDP growth with the data drawn from the McKinsey Global Institute report. In it, 29 cities are in China, 13 in the USA and 3 in Europe. It is eye-opening to say the least. A copy is yours for the asking.

(ref. *Foreign Policy*, Sept./Oct. 2012)

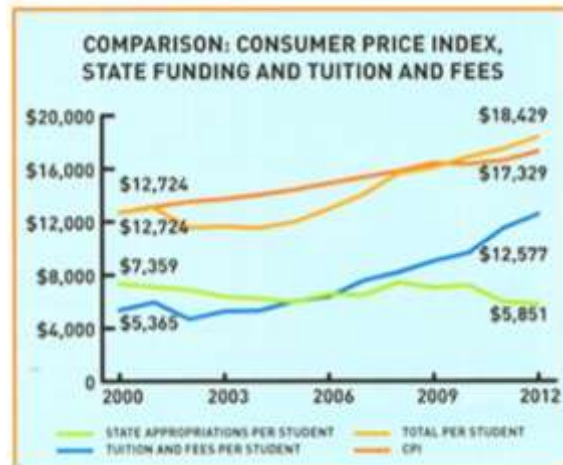
2. New Jersey Reservoir Features Floating Solar Panels Designed to Withstand Winter



(ref. *Civil Engineering*, Dec. 2012)

3. The Path for Higher Education

Dr. Dave Daniel, President of Univ. Texas at Dallas and a GCL pioneer and expert, writes of the changing financial landscape for public colleges and universities. His data on the following graph shows state appropriations slightly falling, while tuition per student is on a steep upward slope.



Ed Note. This compounds the increase in textbook costs as described below.

(ref. *Foundation Drilling*, March/Apr., 2012)

A Teaching Guide to Accompany an Inexpensive Geosynthetics Textbook by Bob Koerner

Within my faculty career, which began in 1968, the teaching of technical subjects like geotechnical and geosynthetics engineering has gone from (a) chalk writing on a blackboard, to (b) prepared overhead transparencies, to (c) prepared 35 mm slides, and now (d) prepared PC-based power point presentations. The following table attempts to capture the pros and cons of each in a classroom setting, where it is seen that the PC power point method far outweighs the others and one has to actually stretch to find disadvantages. Perhaps the main issue in this regard is that one (I am often guilty) tends to present too much information and also do it much too fast. To somewhat alleviate this, the instructor can always give the students his/her presentation before the class over the internet in one of many outlet formats. In such a situation a potential disadvantage turns into an advantage since the students now know what will be presented before the actual class... instructor beware!

Presentation Method	Advantages	Disadvantages
(a) Chalkboard	<ul style="list-style-type: none"> notes easily changed improvisation is easy easy to augment textbook good board technique is appreciated 	<ul style="list-style-type: none"> instructor does not face students writing covered by instructor's body often poorly organized and often disoriented bad board technique is not appreciated no illustrative photos lots of chalk dust all over blood curdling chalk screeches
(b) Overhead Transparencies	<ul style="list-style-type: none"> requires pre-preparation this helps organization instructor faces students room can stay lit easy to add items on transparencies during lecture 	<ul style="list-style-type: none"> mods require new transparencies photos are difficult needs projector and screen written improvisation difficult difficult to give copy to students
(c) 35-mm Slides	<ul style="list-style-type: none"> requires pre-preparation this helps organization instructor faces students photos are doable 	<ul style="list-style-type: none"> mods require new slides needs projector and screen best in darkened room written improvisation not possible difficult to give copy to students
(d) PC Power Point	<ul style="list-style-type: none"> requires pre-preparation this helps organization instructor faces student scanned photos easy to include improvisation can be made during presentation no cost to implement can share lecture before, during or after class 	<ul style="list-style-type: none"> needs PC and screen best in dimly lit room

With the presentation vehicle now established, let's turn to the need and cost of a traditional hard-copy textbook on the subject matter. Technical textbook costs have not only kept pace with college/university tuitions they have "percentage-wise" actually exceed them. For example, the previous 5th edition of "Designing With Geosynthetics" published in 2005 by a major technical book publisher now costs from \$155-to-\$378! As a result of such high textbook costs students buy used copies, or use older editions, or go without. Fortunately, I was released from my contract with my former publisher and shopped around eventually finding an on-demand publisher. Their forte' is publishing biographies, autobiographies and coffee-table books. They had only published three other

technical textbooks in their history and when I questioned their respective authors I got recommendations of good, moderate and bad. Undaunted (perhaps foolishly) I signed a contract requiring \$3800 up-front cost which ended up doubling since I needed a two volume set. The original manuscript (which was in really good shape) was submitted in January, 2011 and after five complete and agonizing reviews was published a year later in January, 2012. Everything was done electronically and it was mind-numbing to guide and correct the nontechnical editors (who never saw an equation, Greek notation, intricate curves and tables, numeric examples, etc., etc.) to finally get it into final publication form. I am sorry to say that there are still some (hopefully not too many?) smallish errors but to compensate, it is inexpensive; see the following booksellers listings.

Version	GSI Bookstore	Xlibris	Amazon	Barnes & Noble
Volume 1				
Hardback	35.00	34.99	34.99	33.43
Softback	24.00	22.97	22.74	22.97
e-Book	n/a	3.99	3.39	3.39
Volume 2				
Hardback	35.00	34.99	30.61	33.08
Softback	24.00	23.99	23.99	22.97
e-Book	n/a	3.99	3.39	3.39

Finally, let's juxtapose the modern method of lecturing, i.e., by PC Power Point, with the above e-book version of the 6th Edition of "Designing With Geosynthetics". Students should certainly be able to afford \$6.78 for the two-volumes and all of them already have their own PC's. What's left in this scenario is for you, the instructor, to have your presentation(s) on power point. In this regard, I wish to inform you that the entire 914-page two volume "Designing With Geosynthetics" book now has an accompanying slide set of approximately 750 power point screens for your use. Furthermore, it is completely free. Still further, it is non-encrypted so you can change, modify, add, or subtract at your desire. Send me an e-mail at robert.koerner@coe.drexel.edu and include your postal address and I'll send you the CD.

With this combination most of you can readily teach geosynthetics; you with your set of power point slides and the students with the e-books on their computer. They even have a hand free to take miscellaneous notes in the tradition manner. I feel that it is about time that more than a select few colleges/universities are teaching geosynthetics to our graduating students. By my count only 12 out of 600+ colleges/universities in North America teach a stand-alone course on geosynthetics. Thus, each year we fall behind in producing geosynthetics-smart graduating students. Let's have more of you (present faculty and indeed practitioners) get on-board by offering to teach geosynthetics even as adjunct faculty at your local university/college. You might be pleasantly surprised that your offer is accepted... Best wishes in this regard!

Upcoming GSI Events

- **ASCE Webinars**
November 18, 2012 – Analysis and Design of Veneer Cover Soils for Landfills and Related Waste Containment Systems
December 14, 2012 – Use of Geosynthetics for Waterproofing Critical Hydraulic Structures
December 20, 2012 – Geosynthetic Reinforced Mechanically Stabilized Earth Walls
January 17, 2013 – Geosynthetic Applications Accompanying Shale Gas Drilling Operations
February 21, 2013 – An Overview of Geosynthetics and Their Major Applications
March 11, 2013 – Design of Geomembranes for Surface Impoundments (Ponds, Reservoirs, etc.)
Contact: www.asce.org/webinars
- September 12, 2012
Shale Gas and Geosynthetics
Tyson's Corner, VA
Contact: vmerida@geostructures.com
- September 16-19, 2012
EuroGeo 5 Conference
Valencia, Spain
Contact: www.igs.org
- October 1-3, 2012
Global Waste Mgmt. Symp.
Contact: www.wastesymposium.com
- October 24-26, 2012
26th Central PA Geotech Conf.
Hershey, Pennsylvania
Contact: cbeenenga@gfnet.com
- **GSI Courses in Folsom, PA**
 1. MSE Wall Failures and Remediation
November 28, 2012 and March 13, 2013
 2. Inspection of MSE Walls, Slopes and Berms
November 29, 2012 and March 14, 2013
(Optional exam follows)
 3. Waste Containment Liner and Cover Design
December 5, 2012 and March 20, 2013
 4. QA/QC of Geosynthetics
December 6, 2012 and March 21, 2013
(Optional exam follows)
Contact: mvashley@verizon.net
- October 18, 2012
GSE Technical Seminar
Contact: bramsey@gseworld.com
- March 3-6, 2013
GeoCongress 2013
San Diego, CA
Contact: www.asce.org/conferences
- April 2-4, 2013
Geosynthetics 2013 and GRI-25
Long Beach, CA
Contact: www.ifai.com/conferences

GSI's Member Organizations

We sincerely thank all of our sponsoring organizations. Without them, GSI simply could neither happen nor exist. The current GSI member organizations and their contact members are listed below. **Our newest members are ThermaGreen with Tim Walter/Blu Alexander/Ken vander Velden, Milliken & Co. with Randy Kohlman, Maccaferri with Massimo Ciarla and Pietro Rimoldi, and Jones and Wagener (Pty) Ltd. with Anton Bain as contact persons. Thanks to all and welcome to GSI.**

GSE Lining Technology, Inc.

Boyd Ramsey [BoD]

AECOM

Kevin McKeon/Ken Bergschultz/John Trast

U.S. Environmental Protection Agency

David A. Carson

E. I. DuPont de Nemours & Co., Inc.

John L. Guglielmetti/David W. Timmons

Federal Highway Administration

Silas Nichols/Daniel Alzamora

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Geosyntec Consultants

Steve Poirier

Syntec Corp.

Aigen Zhao

LyondellBasell Industries

Fabio Ceccarani/Melissa Koryabina

TenCate Geosynthetics

John Henderson/Chris Lawson

CETCO

James T. Olsta/Chris Athanassopoulos/

Tim Rafter [BoD]

Huesker, Inc.

Steven Lothspeich/Dimitar Alexiew

NAUE GmbH & Co. KG

Kent von Maubeuge [BoD]

Propex

Steve Thaxton/Judith Mulcay

Fiberweb, Inc.

Brian H. Whitaker

NTH Consultants, Ltd.

Rick Burns/Robert Sabanas

TRI/Environmental Inc.

Sam R. Allen [BoD]

U. S. Army Corps of Engineers

David L. Jaros [BoD]

Chevron Phillips Co.

Lili Cui [BoD]

URS Corp.

John C. Volk

Solmax Géosynthétiques

Robert Denis

Envirosource Technologies, Inc.

Douglas E. Roberts

CARPI, Inc.

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Agri America, Inc.

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NPUST (GSI-Taiwan)

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Joe Benco/Tony Walker

GSE Europe

Stefan Baldauf/Catrin Tarnowski

InterGEO Services Co.

Archie Filshill

Raven Industries, Inc.

Gary M. Kolbasuk

CTI and Associates, Inc.

Te-Yang Soong/Kevin Foye

Advanced Earth Sciences, Inc.

Kris Khilnani/Suji Somasundaram

Carlisle Syntec, Inc.

Randy Ober/Krista Gonzalez/Julie Sitch/

Matt Leathermann

EPI, The Liner Co.

Daniel S. Rohe/Mark Wolschon

Geo-Logic Associates

Monte Christie

Weaver Boos Consultants, Inc.

Mark Sieracke [BoD]

Aquatant (Pty) Ltd.

Piet Meyer

Jones Edmunds, Inc.

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The Mannik & Smith Group, Inc.

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Plasticos Agrícolas y Geomembranes, S.A.C.

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Afitex-Textel

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Bombay Textile Research Institute

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BASF Corporation

Joseph J. Fay/Ralph Maier

ClosureTurf

Michael Ayers

ThermaGreen

Tim Walter/Blu Alexander/Ken vander Velden

Milliken & Co

Randy Kohlman

Maccferri

Massimo Ciarla/Pietro Rimoldi

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Anton Bain

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Vahe Hovsepian

Oak Ridge National Laboratory

(c/o Savannah River Remediation LLC)

Amit Shyam

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
- "Geosynthetics and Coal Combustion Residuals"
- GSI's Member Organizations