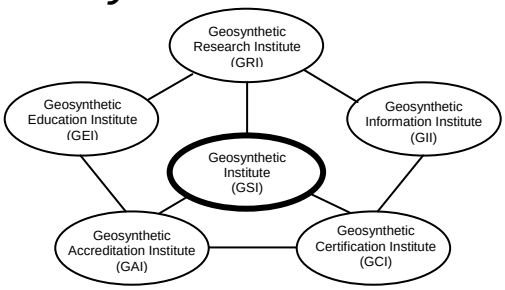
The GSI Newsletter/Report

Geosynthetic Institute



Vol. 25, No. 1 **March, 2011**

This quarterly newsletter, now in its 24th 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 Robert M. Koerner or Marilyn Ashley at phone (610) 522-8440; fax (610) 522-8441 or e-mail at robert.koerner@coe.drexel.edu or mvashley@verizon.net.

25th Anniversary Year for the GSI Newsletter/Report

Activities of GSI's Directors and Board of Directors

1. At its successful Annual Meeting in Dallas, Texas on March 15, 2011 there were 65 people in attendance along with six observers. The notes are available on the GSI website.
2. At its Board of Directors meeting in Dallas, Texas on March 15, 2011 it was decided to;
   - congratulate Paul Oliveira of Firestone for his service over the past three years; see following photo.
   - have only a BoD meeting in 2012 (it will be in February in Atlanta in conjunction with ASTM D35 meetings),
   - have our GSI-25 Conference with IFAI (and probably NAGS) in 2013 at a location to be decided,
   - to continue with ASCE webinars and to add new webinars on behalf of Geosynthetica,
   - to continue with GSI one-day courses,
   - to continue with the GSI Fellowship program, and
   - to reaffirm that Tony Eith continues as Chairman of the GSI Board of Directors
3. The present BoD is as follows, along with their respective term ending dates.

Term Ends 2011

- Dick Stulgis - GeoTesting Express (Consultants and Testing Laboratories)
  e-mail: rstulgis@geocomp.com
- Gary Kolbasuk - Raven (Geomembranes and GCLs)
  e-mail: gary.kolbasuk@ravenind.com
- Wayne Hsieh - GSI-Taiwan (International-2)
  e-mail: cwh@mail.npust.edu.tw

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

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Term Ends 2013

- David Jaros - Corps of Engineers (Government Agencies)
  e-mail: dave.l.jaros@usace.army.mil
- Rex Bobsein - Chevron Philips (Resin Producers)
  e-mail: bobserl@cpchem.com
- Kent von Maubeuge - NAUE GmbH & Co. KG (International-1)
  e-mail: kvmaubeuge@naue.com

(Bob Koerner congratulates Paul Oliveira with GSI Board of Directors in background)

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. (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) 522-8440 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 in this regard.

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

   - waste moisture content
   - waste temperature
   - leachate chemical analysis
   - waste gas analysis
   - perched leachate within the waste

   Data is being collected on a monthly 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 systems consist of both natural soils and geosynthetic drains. The project is now in its third year and is at a landfill in the Philadelphia area.
4. **UV Exposure of Geomembranes*** - GSI is using 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 just started on 1/1/2010. Ongoing data is being reported to manufacturers and resin producers.
5. **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 used in the formulations. In this regard we have been evaluating various European formulations for four years and the results are very impressive. The studies are for a GSI member organization.
6. **UV Exposure of Geogrids** - The UV-fluorescent exposure of four different biaxial geogrids which are used at the exposed surfaces of welded wire mesh retaining walls is ongoing. The various geogrids are now up to 35,000 light hours and

data is being generated and sent to the respective manufacturers. As with the geomembranes, replicate samples will now be incubated at 60°C for eventual use in Arrhenius Modeling and lifetime prediction. The last set at 80°C has just begun incubation.

7. **UV Exposure of TRM Fibers** - We are also using UV-fluorescent exposure of several turf reinforcement mat fibers to assess their lifetime capabilities. They are presently being incubated at 70°C and 80°C. Communication between manufacturers is ongoing.
8. **UV Exposure of Geotextiles** - We have initiated a UV study of a specific geotextile used for three dimensional cell structures which are exposed to the atmosphere. This data (eventually at 60°, 70° and 80°C) will be compared to the other exposed geosynthetics.
9. **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 a acceptable formulation.
10. **Retaining Wall Failure Evaluation -** We currently have GRI Reports 38, 39, and 40 addressing mechanical stabilized earth (MSE) walls using geosynthetic reinforcement which document 82-failures. They are either excessive deformation or collapses. Since the initial report was published we have information on six more failures. Our present dilemma has to do with future activities. Contact Bob Koerner if you have suggestions in this regard.
11. **pH Between Masonry Block Wall Units*** - George Koerner has been measuring the pH between three types of masonry blocks over four years to monitor the values. Concern here is over PET geogrids which can be sensitive to high alkalinity environments. The values started high, but over time are now down to eight and lower. George Koerner has a paper in this regard.
12. **Landfill Failure Analysis** - Since our originally reported paper on ten landfill failures in a 2000 publication, we have accumulated six more. All 16-failures are being reanalyzed by Dr. Connie Wong using the ReSSA Code and will be available in due course.
13. **GCL Design Guide** - We have just completed a 35-page design guide for geosynthetic clay liners. The draft provided by NAUE and CETCO is appreciated in this regard. The final document is available for GSI members on our website.
14. **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 and Regularly Updated

    GM13 – HDPE Geomembranes
    GM17 – LLDPE Geomembranes
    GM18 – fPP Geomembranes
    GM21 – EPDM 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 Groups

    GCXX – TRMs for Erosion Control
    GTXX – High Strength Reinforcement Geotextiles
    Delayed or Off in the Distance

    GGXX – Bidirectional Geogrids
    GGXX – Unidirectional Geogrids
    GNXX – Geonet Drainage Composites
    GCXX – Other Drainage Geocomposites

    The complete 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. Copies of the above listed draft specification tables are also available to members and associate members.
15. **Other GRI Standards** - There are several GRI Standards in various forms of preparation. One involves spray-on geomembranes and the other vapor barriers. Contact George Koerner for the status of these efforts.

Activities within GII (Information)

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

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

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

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

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. Please note that original passwords have recently been changed. Marilyn can be reached by e-mail at mvashley@verizon.net. When you get into this section, the following information is presented. This includes:

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

The Keywords Section contains about 30,000 citations of all 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 various 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. To date, she has focused on the following; all of which are available. Note that we are open to suggestions to other survey-related topics.

- State adoption of AASHTO M288 geotextile specification (GRI Report #31)
- State liner and cover regulations for solid waste disposal (GRI Report #32)
- International liner and cover regulations for solid waste disposal (GRI Report #34)
- Allowable leachate head in landfill sumps (White Paper #13)
- Allowable leakage rates for waste ponds (White Paper #15)
- Professional development hours (PDH's) required by the various states for continued licensure.
- Status of state environmental regulators with respect to conformance testing and levels of CQA at landfills and surface impoundments.
- Survey of LLRW and UMT at U. S. Defense establishments so as to assess the potential area for final covers.
- Survey of Landfill Fires. (This effort is just beginning.)

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.

GRI Reports

To date, we have 40 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:

- #36 – Inadequate Performance of Geotextile Filters Under Different and Challenging Field Conditions
- #37 – Geosynthetic Supported Base Reinforcement Over Deep Foundations
- #38 – A Data Base and Analysis of Geosynthetic Reinforced Wall Failures
- #39 – Methods of Stabilizing Excessively Deformed MSE Walls
- #40 – On the Preventon of Failures of Geosynthetic Reinforced MSE Walls and Recommendations Going Forward (available July, 2010)

Courses

We have scheduled the following sequence of courses:

- December 1, 2011 and February 9, 2012
  MSE Wall Failures and Remediation (New Course)
- December 6, 2011 and March 6, 2012
  Design of Geosynthetics in Waste Containment Systems
- June 8, 2011, December 7, 2011, March 7, 2012
  Quality Assurance/Quality Control of Geosynthetics Manufacturing and Installation

The above will be held at:
Geosynthetic Institute
475 Kedron Avenue
Folsom, PA 19033
(approx. 4.5 miles from Phila. International Airport)
Course Registration and Fee:
$300/person for each one-day course (up to one month prior to course)
$350/person thereafter
$200/person – GSI Members
Contact: Marilyn Ashley (mvashley@verizon.net)

GSI Fellowships

We are pleased to announce the third class of GSI Fellows for the academic year 2010-2011. The basic criteria are as follows:

1. Student must have completed his/her doctoral candidacy examinations.
2. Student must be researching an innovative topic involving geosynthetics.
3. Student must express an interest and desire to teach and/or research in the geosynthetic field.

Four of the new proposals contained excellent projects which have been awarded. These four plus two first class students and one second class student (continuing their research projects) have been sent stipend checks accordingly. The status this year, i.e., the third class is as follows:

GSI Fellows – Academic Year 2010-'11

Class 1 (c) - Continuation

Number	Student	Advisor	University	Topic
3-08	Axel Ruiken	Martin Ziegler	RWTH Aachen	Geogrid behavior used in walls and slopes
4-08	Eleni Kapogianni	Michael Sakellairou	U. of Athens	Geosynthetic reinforcement of soil slopes under seismic conditions

Class 2(b) - Continuation

Number	Student	Advisor	University	Topic
4-09	Majid Khabbazian	Victor Kaliakin	U. of Delaware	Geosynthetic Reinforced stone columns and embankment stabilization

Class 3(a) - New Funding

Number	Student	Advisor	University	Topic
1-10	Tanay Karademir	David Frost	Georgia Tech	Experimental and numerical studies of elevated temperature effects on GS interface shear behavior
2-10	Jing Ni	Buddhima Indraratna	U. of Wollongong	Application of GS-PVD vertical drain under cyclic loads in stabilizing rail tracks
3-10	Bret Lingwall	Steven Bartlett	U. of Utah	Application of GSs to protect buried pipes at fault crossings
4-10	Carmen Franks	Ahmet Aydilek	U. of Maryland	GS filters for water quality improvement of urban stormwater runoff

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 211 GAI-LAP test methods available for accreditation. Please consult our home page for a current listing.

As of March, 2011, 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)
Jonathan Ellingson -- (770) 492-8280
Jellingson@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 Page -- (770) 869-1700
rpage@lumite.com

13^{A} - Precision Laboratories, CA (95 tests)
Ron Belanger -- (714) 520-9631
rbelanger@precisionlabs.net

14^{A} - Geotechnics (57 tests)
J. P. Kline -- (412) 823-7600
JPkline@geotechnics.net

19^{A} - HTS Consultants Inc. (42 tests)
Larry McMichael -- (713) 692-8373
LMcMichael@htshouston.com

20^{A} - GeoTesting Express, MA (46 tests)
Gary Torosian -- (978) 635-0424
gtorosian@geotest.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
chris.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
beth_wilbanks@rtcusa.net

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

29[e] - FITI Testing and Research Institute (86 tests)
Dong-Whan Kim -- 82-2-3299-8071
HKKim@fiti.com.re.kr

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

32[A] - Vector Engineering (6 tests)
Ken Criley -- (530) 272-2448
criley@vectoreng.com

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

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

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

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

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

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

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

44[B] - Fiber Web, Inc. (9 tests)
Kim Cox -- (615) 847-7575
k.mclain@fiberweb.com

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

46[B] - Bentofix Technologies (13 tests)
Colin Murphy -- (705) 725-1938
cmurphy@gseworld.com

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

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
larroyo@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
mmedlin@tencase.com

58[B] - Propex Nashville (9 tests)
Tim Smith -- (229) 686-5511
TimSmith@propeinc.com

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

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)
Erin Hensley – (720) 406-4806
ehensley@microbac.com

68[B] - Glen Raven Technical Fabrics LLC (3 tests)
David Seagroves -- (336) 229-5576
dseagraves@glenraven.com

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

70[A] - RSA Geo Lab LLC (48 tests)
Rasheel Ahmed – (908) 964-0786
www.rsaglobal.com

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

If you are interested in this program and would like a copy of the GAI-LAP directory, please advise accordingly. A directory is published annually in December of each year, and is also kept current on GRI's Home page at http://www.geosynthetic-institute.org. For additional information on the GAI-LAP program contact:

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475 Kedron Avenue
Folsom, PA 19033-1208
Telephone: (610) 522-8440
Fax: (610) 522-8441
E-mail: gkoerner@dca.net

Commentary on Geotextile Tensile Strength

by Dr. George R. Koerner

There are several features regarding tensile strength of geotextiles that require some discussion. The GAI-LAP is regularly asked to explain why there are so many tensile tests in Geosynthetics, how they relate to one another and where to use any given tensile test results. The discussion centers around grab tensile, wide width tensile, and tension creep tests. The three geotextile tensile test procedures vary greatly in the time required to perform each test, how well the tests measure true tensile strength, and the form of the test results. These three test methods were specifically established by ASTM Committee D35 on Geosynthetics for use on geotextiles. However, they each provide differences and only pieces of the overall geotextile tension testing picture.

The grab tensile test (ASTM D4632) is the basic tensile test used within the geotextile industry for quality control and conformance testing of geotextiles to a given specification. The test provides an index strength of the specimen at failure. As an index test it provides an accepted guide to the strength of products but should not be used in design. For example, nonwoven geotextiles exhibit significantly more grab strength than they would in a plane strain condition like strip or wide width tensile tests. The test geometry is only used because it yields results with good repeatability and reproducibility. In the test, each specimen is clamped by one inch jaws in the center of the four inch width and pulled quickly at a rate of 12 in/min. The test results are expressed in units of total load (lbs). Elongation is not measured in this test. The test is easy to perform, inexpensive, and quick, taking only minutes to complete. As such, it is an excellent index strength test for verifying the quality and consistency of products in accordance with manufacturer's specifications or during construction quality control. Almost all of the geotextile manufacturers use this method for statistical process control.

The wide width tensile test (ASTM D4595) is a performance test. It takes longer to perform than grab and is a much more intricate test. In the wide width tensile test each specimen is gripped across its full width (8 in.) and pulled slowly at a rate of 10%per minute (typically 0.4 in/min). Unlike the grab tensile test, the wide width strength results are expressed as a load per unit width (lb/in. or lb/ft). The wide width tensile test is rarely used for quality control applications because of the time and expense involved in testing. However, the wide width test provides a better measure of tensile strength for all types of geotextiles. In addition, the test data can be presented on a stress vs. strain curve, from which modulus values can be calculated. The wide width ultimate strength and modulus values should be used for design.

The tension creep tests (ASTM D5262) is performed by sustaining a load on a test specimen for up to 10,000 hours (417 days). The specimen is gripped across its full width exactly like the wide width test. The creep deformation or elongation (strain) of the sample is monitored over the full test period. From the results, a creep limit (usually 10% elongation) or the time to rupture at various load levels are determined and ultimately a creep reduction factor calculated. Eventually this reduction factor is used with others to compute the strength available for allowable long term strength in various reinforcement applications. The allowable strength is determined by reducing the ultimate strength (obtained in the D4595 test above) by various reduction factors. Reduction factors for creep as indicated herein, installation damage and durability are typical multiplied together to decrease the ultimate strength to an appropriate value. Reduction factors are based on product specific testing, environmental exposure, risk, and design life.

I can't help but think many of these questions on tensile strength stem from the interrelationship of AASHTO M288, NTPEP and the Standard Practice T 925 (now AASHTO PP6610). I hope this brief explanation of the interrelationship of geotextile tensile strength tests helps the reader envision why we do these different tests and why each is needed…George

Activities within GCI (Certification)

Due in part to the active interest by many GSI members and associate members we present a tabular summary of the Inspectors Certification Program. The table gives the pass/fail statistics by year as well as insight as to the impact of taking a course before the written examination. In looking at the data it appears as though the exam is reasonably difficult and is at an appropriate level for today's CQA personnel.

Inspector Certification Test Results
2006 – 2011

Year	Geosynthetic Materials		Compacted Clay Liners		Commentary
	No. of people taking exam	No. of people failing exam	No. of people taking exam	No. of people failing exam	No. of people failing both exams
2006	141	5 (3%)	128	12 (9%)	2 (1.5%)
2007	82	11 (13%)	73	12 (16%)	7 (8.5%)
2008	95	25 (25%)	89	20 (23%)	13 (14%)
2009	36	6 (17%)	36	2 (6%)	2 (6%)
2010	59	12 (20%)	54	7 (13%)	5 (8%)
2011	9	1 (11%)	8	1 (12%)	0 (0%)
TOTAL (to date)	422	61 (14%)	388	53 (14%)	

With the onset of 2011, we will be in our fifth year of operation and the existing certifications are for 5-years. Thus, decisions must be made. In concert with the program's steering committee it presently appears that

(i) there will be no follow-up testing required for presently certified people,
(ii) there will be a required performance report required of presently certified people,
(iii) there will be a review and maintenance fee but the amount and time period are still under discussion... more later

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.

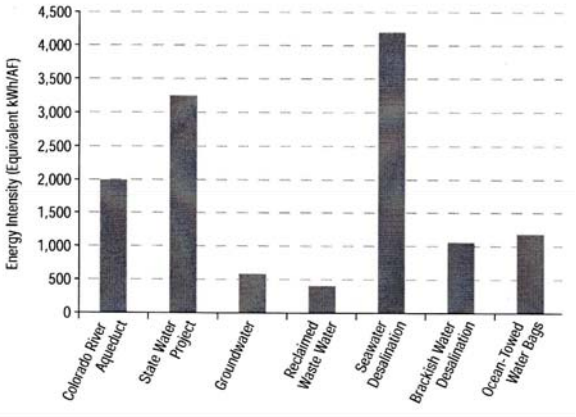
INHA University is located in Incheon and the geosynthetics laboratory is led by Professor Han-Yong Jeon. Dr. Jeon has 10-students working on geosynthetic-related projects and is extremely active both nationally and internationally.

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 conferences to date and is now embarking on a much broader one, namely, GSI-Asia. It is set for November 16-18, 2010 in Taichung, Taiwan. See "Upcoming Events" for details.

Items of Interest

1. Alternatives to Seawater Desalination

Desalinated seawater has reliability and water-quality advantages that must be weighed against its higher cost and potential environmental impacts. Because desalinated seawater is an energy-intensive water source (see the following figure), relying on it creates or increases the water supplier's exposure to energy price variability and energy price increases over time. In viewing the graph note the ocean towed geomembrane bags.



Energy Intensity of Water Sources in San Diego County
(Source: Wolff et al. 2004)

2. Geomembrane Tubes to Seal Levee Breaches

The humble sandbag has a rival in the fight against floods; i.e., 400-ton water filled tube that plugs holes in levees like a giant wad of chewing gum.

Sandbags are used to shore up the thousands of miles of levees—man-made earthen barriers that shield people and property from swelling floodwaters. When a levee is breached, even the biggest sandbags can only slow the erosion of the structure.

Now comes the Portable Lightweight Ubiquitous Gasket, or PLUG, the first tool designed to repair a breach while powerful floodwaters are still coursing through it.

Developed by the U.S. Army Corps of Engineers, the 104-foot long, vinyl-coated tube can be transported by helicopter to a failing levee and filled with floodwater on the spot using pumps. The resulting sausage-shaped behemoth gets sucked into the breach by the force of escaping water, sealing off the flow until permanent repairs can be made.

Dan Schnaars, president of AmeriGlobe Inc., a Lafayette, La., make of 1.5 ton bags that can be used in flood fighting, said he thinks the PLUG should be deployed the next time there's a levee breach.

(ref. Wall Street Journal, December 23, 2010)

3. **Civil Engineering Jobs and Pay Scale**

Money Magazine reported that the median pay for a civil engineer is $80,000, while the top pay is $120,000, with a total of 170,000 jobs currently in the profession. On a scale with A being the best and F the worst, civil engineers gave a grade of B for personal satisfaction with their job, job security, benefit of their profession to society, and the flexibility of their jobs. With regard to future growth in the profession they awarded an A, and in the stress department they gave a C. Environmental engineers reported a median salary of $81,000 and a top salary of $113,000, with a total of just 35,000 current jobs in the field.

In similar fashion, structural engineers can expect a median salary of $83,000 and top pay of $114,000, with 70,000 jobs in the market. Project engineers earn the highest salaries of all construction related engineers--$100,000 as a median and $148,000 at the top.

Transportation engineers seem to like their jobs most, even though their median salaries are the lowest among construction related engineers. With a median salary of $78,000 and a top salary of $114,000, transportation engineers vie for just 25,000 total jobs in the United States.

For the article, job growth potential was estimated for the years 2008 through 2018, and pay data were collected by PayScale.com. Median pay refers to that of an experience worker with two to seven years in the field, while top pay represents the 90th percentile.

(Laurie A. Schuster, Civil Engineering Magazine, January 2011)

The GRI-24 Conference on "Optimizing Sustainability Using Geosynthetics"

This, our 24th annual conference, was a great success according to the 160 persons in attendance on March 16, 2011 in Dallas, Texas. Inasmuch as it was the last day of the GeoFrontiers Conference, the topic kept interest high thanks to the twenty authors making presentations of their respective papers.

While the topic of sustainability, per se, was on our minds as a theme for years, it was the issuance and distribution of a report from the United Kingdom under the acronym of WRAP which opened the door to the relative ease of calculating carbon footprints of various construction projects. This report was distributed to GSI members and twelve of them responded with calculation papers comparing the CO_2 generated from a traditional (soil related) solution with that of the equivalent geosynthetic solution. The other eight papers were sustainability projects in their own right, all of which are based on a major use of geosynthetics.

Regarding papers with CO_2 comparisons; *Russell Jones of Golder* opened the conference describing the background and details of the WRAP report. In it there were several wall, slope and bund case histories with detailed analyses. *Thomas Egloffstein of ICP Engineering Co.* compared a traditional road base with one having geogrid reinforcement which resulted in a profound CO_2 decrease footprint. *Richard Goodrum of Colbond* presented CO_2 calculations with turf reinforcement mats being the lowest of three levee armoring alternatives. *Garry Gregory of Gregory Geotechnical and Oklahoma State University* showed a low carbon footprint case history involving fiber reinforced soil. *George Koerner of the Geosynthetic Institute* reported on the carbon footprint of five different drainage pipe materials. *Sam Allen of TRI Environmental Inc.* evaluated carbon footprints of two channel erosion control designs. River dike comparisons were presented via a case history in Taiwan by *Wayne Hsieh of the National Pingtung University.* Seven different storm water retention systems were compared for their carbon footprints by *Archie Filshill of CETCO Contracting Services Co. Don Hullings of Jones Edmunds Inc.* compared an exposed geomembrane landfill cover to a traditional soil-related one with excellent results. *Doug Brown of Tensar International Inc.* used the CO_2 model to compare earth versus geogrid reinforced landfill berms. *Christos Athanassopoulos of CETCO* compared compacted clay liners to geosynthetic clay liners with results that were highly dependent on natural clay borrow sources. *Bob Koerner of GSI* revisited exposed geomembrane landfill covers with results similar to those of Don Hullings.

The net effect of these twelve papers was to make 25 comparisons of traditional versus geosynthetic solutions arriving at the outstanding conclusion shown in the following table. Here it is seen that the geosynthetics solutions represent an average 63% reduction in CO_2 generated in comparison to traditional soil-related solutions. That's profound!

Application	No. Cases	CO_2 Savings
Walls	6	69%
Embankments	4	65%
Armoring	4	76%
Covers	3	75%
Liners	2	30%
Retention	3	61%
Drainage Pipe	3	40%
TOTALS	25	63%

That said, sustainability goes further than making a comparison with traditional systems since geosynthetic allow for entirely new and different applications. In this regard, there were eight papers, each unique and fascinating, as reported by their respective authors.

Michael Samuelson of TenCate Mirafi Co. described the use of recycled fibers in textile itnerlayers for asphalt road resurfacing. *Kent von Maubeuge* of NAUE described the reduction of climate damaging gases on the environment using geosynthetic solutions. *Archie Filshill of CETCO Contracting Services Co.* used nanocomposites to improve the physical and mechanical properties of recycled polyethylene materials. *Allan Wingfield of Colbond* described the optimization of sustainability by way of several interesting green roof examples. *Paul Oliveira of Firestone* selected several small, but unique, projects to exemplify the favorable use of geomembranes. *Boyd Ramsey of GSE Lining Technology* illustrated the reduced CO_2 emissions and energy consumption during geosynthetic installation situations. *Michael Ayers of Closure Turf* gave several case histories of developing final landfll covers using structured geomembranes and sand-ballasted synthetic turf. Lastly, *Grace Hsuan of Drexel University* illustrated the possible use of geomembranes in algae production (for production of diesel fuel) at landfills.

All twenty written papers stemming from this GRI-24 Conference are available on CD from IFAI. Contact <www.ifai.com/publications> for information in this regard. In closing, perhaps the following graphic from Christos Athanassopoulos' paper on CCL (150 trucks)-to-GCL (1 truck) transportation comparison should become the "poster child" for the use of geosynthetics in the reduction of carbon footprint as we hopefully move into a more sustainable future.

150 Truckloads of Clay = 1 Truckload of GCLs

Conference Organizers
George R. Koerner Robert M. Koerner Y. Grace Hsuan

Upcoming GSI Events

- March 31-April 1, 2011
  Central PA Geotechnical Conference
  Hershey, PA
  Contact: www.central-pa-asce-geotech.org
- May 1-4, 2011
  Solid Waste & Recycling Conference
  Sagamore, (Lake George) NY
  Contact: www.nyfederation.org
- April 12, 2011
  ESD Waste Conference
  Lansing, Michigan
  Contact: www.esd.org
- December 2, 2010 & Feb. 29, 2012
  MSE Wall Failures and Remediation
  GSI, Folsom, PA
  Contact: mvashley@verizon.net
- December 6, 2011 & March 6, 2012
  Waste Containment Design and Behavior
  Contact: mvashley@verizon.net
- June 8, 2011, December 7, 2011 & March 7, 2012
  Geosynthetics QC and QA
  Contact: mvashley@verizon.net
- September 25-29, 2011
  Dam Safety Conference
  Aberdeen, MD
  Contact: www.damsafety.org/conferences
- Various Dates (see website)
  Geosynthetics Webinars via ASCE
  Contact: www.asce.org/webinars
- Various Dates (see website)
  Geosynthetics Webinars via Geosynthetica
  Contact: www.geosynthetica.net

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. Recent member organizations are; the Bombay Textile Research Institute with Dr. A. N. Desai and BASF Corporation with Chris Fabouri and Ralph Maier as contact persons. Thanks to all and welcome to GSI.

GSE Lining Technology, Inc.
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IN THE NEXT ISSUE

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- Overview of GRI (Research) Projects
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- Progress within GEI (Education)
- Activities within GAI (Accreditation)
- Activities within GCI (Certification)
- The GSI Affiliate Institutes
- The GSI Centers-of-Excellence
- Items of Interest
- Workshop on Low Level Radioactive Waste and Uranium Mill Tailings Disposal
- GSI's Member Organizations