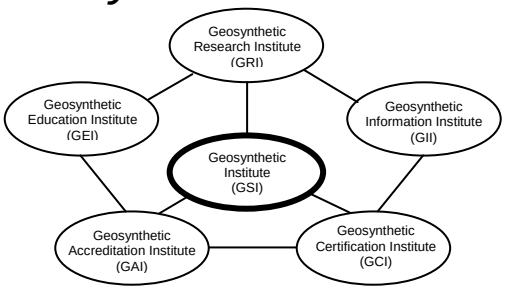
# The GSI Newsletter/Report

## *Geosynthetic Institute*




**Vol. 23, No. 4** **December 2009**

This quarterly newsletter, now in its 21th 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.

*Happy Holidays and a Healthy and Prosperous New Year*

## Activities of GSI's Directors and Board of Directors

1. Our first GSI Webinar, to be hosted by ASCE, is set for March 2, 2010. The topic is "An Overview of Geosynthetics and Their Major Applications". If successful, a series of more advanced topics will follow. The time is around the noon-hour, so do plan for an in-house activity of your newer personnel.
2. GSI's next big series of events are coincident with ASTM in San Antonio on January 27-29, 2010. Our Annual Meeting will be on the evening of January 28, 2010 after the ASTM task group meetings ends. The BoD meeting will be on the same evening after the conclusion of the Annual Meeting. There will also be a geogrid focus group meeting co-hosted by GMA. See our Website for timing and details on these events.
3. The ASTM/GRI Workshop is set for January 29, 2010 in San Antonio and will be an all-day event with over twenty papers being presented. George Koerner and Sam Allen are finalizing the program presently. Contact either of them for details and/or information.
4. The New York Federation of Solid Waste will hold its annual meeting at Sagamore, New York (a wonderful event) on May 17-19, 2010. This year it will have sessions on (i) solar panels on exposed geomembranes, and (ii) new horizons in geosynthetic materials, among many others.

NOTICE: **Due to the increasing cost of printing, shipping and handling, this Newsletter/Report will be made available on our Home Page at www.geosynthetic-institute.org. It is in the open section under the heading "Newsletter/Report". Please share it with your friends and colleagues.**

5. GeoFrontiers II is set for Dallas, Texas March 13-16, 2011 and we will have our GRI-24 conference embedded within it. Our theme will be "Implementing Sustainability Using Geosynthetics". It's a "big-picture" topic and we are hoping for a nice set of GSI member papers and presentations.
6. Elections for the 2010-2013 Board of Directors is presently ongoing. Details will be announced by e-mail in early January 2010.
7. Your Board of Directors is as follows. Do contact any of these with regard to GSI matters.

**IN THIS ISSUE**

Term Ends 2009
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)
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Term Ends 2010
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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

## 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. (Note that short projects are usually given to design firms or testing laboratories which 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>.

1. **Stress Cracking of Geomembranes and Geopipe*** - In addition to Grace Hsuan's ongoing evaluations of HDPE geomembranes, she is presently focusing on HDPE drainage and duct pipe mainly for the Florida DOT. The goal for both geomembranes and geopipe is to include technically viable test methods and limiting values for inclusion in generic specifications.
2. **Durability of Polypropylene Geotextile Fibers** - Incubation at temperatures of 75, 65 and 55°C in high oxygen pressure containers is ongoing using PP-woven geotextile fibers. This study periodically measures changes in density, dimensions, mass, morphology, strength, elongation, modulus, melt index, OIT and carbonyl content. Dr. Hsuan is in charge of the project.
3. **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 14$^{th}$-year and has resulted in an extremely authoritative set of real-life data.
4. **Bioreactor (aka, Wet) Landfill Behavior and Properties*** - One of the landfill cells mentioned in Item 3 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 for 5 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.
5. **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.
6. **UV Exposure of Geomembranes*** - GSI is using UV-fluorescent devices to evaluate the projected exposed lifetime of many different types of geomembranes. Presently being incubated are HDPE, LLDPE, 5 fPPs, PVC, EPDM, PE-R and LLDPE-R. Exposure times of 40,000 light hours are now realized at 70°C and a replicate set of samples are now being incubated at 60°C. These will take at least 60,000 light hours (≈ 8-years). The third sequence will be at 80°C. Ongoing data is being reported to manufacturers and resin producers.
7. **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 25,000 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 will be at 80°C.

8. **UV Exposure of TRM Fibers** - We are also using UV-fluorescent exposure of several turf reinforcement mat fibers to assess their lifetime capabilities. Contact Bob Koerner if you have materials for inclusion into this effort.
9. **UV Exposure of Repair Tape** - We have found that a particular type of polyethylene repair tape has been successfully used to repair an exposed geomembrane at a Delaware landfill. After five-years it appears very durable. Original samples are being evaluated in one of our fluorescent tube weatherometers per ASTM D7238 at 70°C.
10. **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
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
GMXX – LLDPE-R Geomembranes

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 available to members and associate members.

## Activities within GII (Information)

Our GSI Home Page and 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. 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 (Summaries)**
- **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 25,000 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. (See later description in this Newsletter/Report).
- Status of state environmental regulators with respect to conformance testing and levels of CQA at landfills and surface impoundments.

# Progress within GEI (Education)

**Free CD**

We sent a broadcast e-mail to everyone on February 25, 2008 stating that many power point presentations were available and would be sent upon request. About 20 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 37 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

**Courses**

We have scheduled the following sequence of courses:

- Wednesday, January 6, 2010 and Wednesday, March 31, 2010
  *Design, Analysis, and Failures (i.e., Lessons Learned) of Geosynthetically Reinforced Retaining Walls and Steep Soil Slopes"*
  (with Professor Dov Leshchinsky of University of Delaware)
- Monday, March 22, 2010
  *Geosynthetics Design in Waste Containment Systems*
- Tuesday, March 23, 2010
  *Quality Control/Quality Assurance of Geosynthetics*

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:
$275/person for each one-day course (up to one month prior to course)
$325/person thereafter
$175/person – GSI Members

Contact: Marilyn Ashley (mvashley@verizon.net)

**GSI Fellowships**

We are pleased to announce the second class of GSI Fellows for the academic year 2009-2010. 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 proposals contained excellent projects which have been awarded. These four plus four second year students (continuing their research projects) have been sent stipend checks accordingly.

Class 1 - Continued Funding for 2nd Year

| Number | Student | Advisor | University | Topic |
|---|---|---|---|---|
| 1-08 | Michael McGuire | George Filz | Virginia Tech | Geosynthetic reinforced pile supported embankments |
| 2-08 | Connie Wong | Grace Hsuan | Drexel Univ. | Durability specification development for HDPE transmission and drainage pipes |
| 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 1 - New Funding this Year

| Number | Student | Advisor | University | Topic |
|---|---|---|---|---|
| 1-09 | Anil Bhandari | Jie Han | U. of Kansas | Geogrids in pavements under dynamic loading |
| 2-09 | Brent Robinson | Mo Gabr | N. C. State | GT/GG behavior in lime stabilized subgrade soils |
| 3-09 | Ioanna Tzavara | Yianns Tsompanakis | U. of Crete | Seismic design for geogrid reinforced walls |
| 4-09 | Majid Khabbazian | Victor Kaliakin | U. of Delaware | Geosynthetic Reinforced stone columns and embankment stabilization |

# Activities within (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 conformance 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 usually ASTM or ISO 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 191 GAI-LAP methods available for accreditation. Please consult our home page for a current listing.

As of December, 2009, the following laboratories are accredited by the GAI-LAP for the number of test methods listed in parenthesis. Contact personnel and telephone numbers are also listed.

1[A] - TRI/Environmental Inc. (118 tests)
Sam Allen -- (512) 263-2101

3[A] - Golder Associates (45 tests)
Jonathan Evingson -- (770) 492-8280

4[C] - Geosynthetic Institute (116 tests)
George Koerner -- (610) 522-8440

8[B] - Propex, Ringgold (19 tests)
Todd Nichols -- (800) 258-3121

9[B] - Lumite (10 tests)
Rebecca Page -- (770) 869-1700

11[A] - STS Consultants Ltd. (13 tests)
Bill Quinn -- (847) 279-2500

13[A] - Precision Laboratories, CA (95 tests)
Ron Belanger -- (714) 520-9631

14[A] - Geotechnics (61 tests)
J. P. Kline -- (412) 823-7600

19[A] - HTS Consultants Inc. (42 tests)
Larry McMichael -- (713) 692-8373

20[A] - GeoTesting Express, MA (46 tests)
Gary Torosian -- (978) 635-0424

22[B] - CETCO Hoffman Estates (13 tests)
Jim Olsta -- (847) 392-5800

23[B] - CETCO Cartersville (10 tests)
Chris Cunningham -- (706) 337-5316

24[B] - CETCO Lovell (10 tests)
Roger Wilkerson -- (307) 548-6521

25[B] - Ten Cate, Pendergrass (11 tests)
Beth Wilbanks -- (706) 693-2226

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

31[D] - NYS Dept. of Transportation (9 tests)
John Remmers -- (518) 457-4104

32[A] - Vector Engineering (6 tests)
Ken Criley -- (530) 272-2448

34[B] - GSE Richey Road (28 tests)
Jane Allen -- (281) 230-6726

37[B] - GSE Chile (21 tests)
Mauricio Ossa -- 56-2 6010153

38[C] - Sageos/CTT Group (91 tests)
Eric Blond -- (450) 771-4608

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

41[A] - SGI Testing Service, LLC (19 tests)
Zehong Yuan -- (770) 931-8222

42[C] - NPUST (GSI-Taiwan) (59 tests)
Chiwan Wayne Hsieh -- 011-886-8-7740468

43[A] - Ardaman & Associates (18 tests)
George DeStafano -- (407) 855-3860

44[B] - BBA Fiber Web, Inc. (9 tests)
Ken McLain -- (615) 847-7575

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

46[B] - Bentofix Technologies (13 tests)
Colin Murphy -- (705) 725-1938

47[A] - Precision Laboratories, TX (13 tests)
Mike Bishop -- (866) 522-0843

48[B] - Tenax Corporation (9 tests)
Andrew Barker -- (410) 522-7000

49[B] - Engepol Geossinteticos (19 tests)
Carolina Polomino -- (55) 11-4166 3001

50[B] - ADS, Inc. Hamilton (7 tests)
Terry McElfresh -- (513) 896-2065

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

53[B] - Polytex Inquique (13 tests)
Cristian Valdebenito -- 011 56 57 42 90 00

54[B] - ADS, Inc. Finley (9 tests)
David Gonso -- (419) 424-8377

55[B] - Atarfil Geomembranes (20 tests)
Iganacio Garcia Arroyo -- 34 958 439 278

56[B] - Polytex Santiago (11 tests)
Jamie Morales -- 56-2-627-2054

57[B] - Ten Cate Cornelia (15 tests)
Melissa Medlin -- (706) 778-9794

58[B] - Propex Nashville (9 tests)
Tim Smith -- (229) 686-5511

59[B] - Firestone (9 Tests)
Janie Simpson -- (864) 439-5641

60[B] - Polytex Lima (11 tests)
Elias Jurufe -- 51 16169393

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

62[B] - Solmax International Asia (14 tests)
Marie Andre Fortin – (450) 929-1234

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

[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, 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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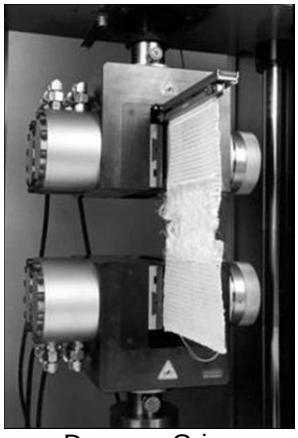
E-mail: gkoerner@dca.net

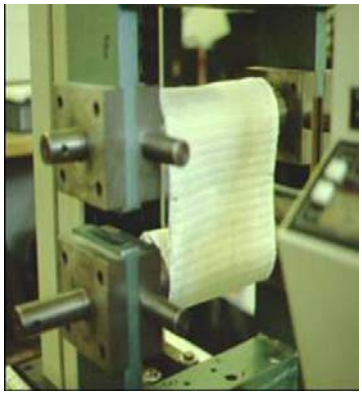
We have had a reoccurrence of Wide Width Tensile arbitrations. They have occurred three times in 2009 and all are related to ASTM D4595 WWT testing of geotextiles. They involve the testing of textiles with an ultimate strength greater than 300 ppi. We are currently recommending that such textiles be tested with either Demgen or Capstan Type grips as shown in Figure 1. In the process of arbitrating these conflict resolutions we learned of a very ingenious new clamping method from Dr. Zehong Yuan of SGI. His technique is illustrated in the photos of Figure 2. The GSI technique involves a rod-keeper-glue roller grip configuration. The nice things about it include the following:

1. Shorter specimen length i.e., 25" not 50".
2. Uniform loading because rod and keeper are glued in place perpendicular to the yarn bundles being strained
3. Due to the omission of wrapping around the rollers, less slippage and a smoother stress strain curves are generated
4. Less messaging of sample during preload

We highly recommend that you give this technique a try if you have roller or Capstan grips.



Demgen Grips



Capstan Grips

Figure 1 – ASTM D4595 grips for greater than 300 ppi ultimate tensile strength geotextiles.

Rod-Keeper Hot melt glue

Specimen is 25" long by 8" wide

Figure 2 – Photographs of SGI technique for roller grips (Capstan)

**www.geosynthetic-institute.org**

It is a pleasure working with all of you and thanks for participating in the GAI-LAP program. If you have questions, please contact accordingly.

*George Koerner*

## 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 at an appropriate level for today's CQA personnel.

Inspector Certification Test Results
2006 – 2009

| 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 | 26 | 6 (23%) | 24 | 2 (8%) | 2 (8%) |
| TOTAL (to date) | 344 | 47 (14%) | 314 | 46 (15%) | 24 (7%) |

## 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 two very successful conferences to date and has plans for another, followed by a broader conference for Southeast Asia.

## Items of Interest

1. **Geopolymers Continue To Advance As Building Materials, Albeit Slowly**
   The Wired (10/22/Hambling) "Danger Room" blog reports, "The technology of cement-making has been repeatedly lost and rediscovered," with French chemical engineer Joseph Davidovits eventually discovering "the chemistry behind geopolymers and how it can be manipulated." Although "the progress of geopolymers as building materials has been slow" as a rule, there are exceptions. "The U.S. Air Force has been among the more enthusiastic early adopters," and its "laboratory has funded geopolymer research for runways, insulation material, rocket nozzles, and other applications. It's even been developed as special glue for holding satellite components together in the harsh conditions of space." The material has potential in the joining of high-strength geotextiles.
   *(comment: In many respects the word "geopolymers" is a much better description than our presently used "geosynthetics"!)*
2. **We're All in This Together** *(comment: A very nice editorial by Jeffery Kirk, Past Chairman of IFAI, 00.09 Review)*
   At this crucial time, without supporting each other, we are destined for failure. The only folks who have a vested interest in our survival are us. Whether you are an end product manufacturer or supplier, we need each other to survive. We need to support our industry's association because it is central to our opportunities. Not one of us can do what an association can do for any of us.
3. **$8.7 Billion NY-NJ Tunnel Work to Begin**
   Construction on the largest U. S. transportation project, an $8.7 billion tunnel, began on June 8, 2009. The NY/NJ Tunnel is expected to double the number of rail commuters shuttled between New Jersey and Manhattan during peak rush periods. Some commuters will shave fifteen minutes or more off their commute time each way because they no longer will be required to switch trains to reach Manhattan.

The new tunnel will add two more rail lines increasing the number of NJ Transit passenger trains passing under the river during peak rush hours from 23 to 48. The $3 billion Federal Trust Administration contribution to the project is the largest ever by the agency. Officials estimate the project will create 6,000 construction jobs and add another 45,000 new jobs after completion in 2017.
*(ref. Foundation Drilling, August 2009)*

4. **Judge Allows Katrina Lawsuit Against Corps of Engineers**

A federal judge in New Orleans ruled Friday that a groundbreaking civil lawsuit brought by homeowners who suffered damages during Hurricane Katrina could go forward against the Army Corps of Engineers.

In his ruling, Judge Stanwood J. Duval Jr. of Federal District Count denied an effort by the Department of Justice to have the suit dismissed—the fourth such bid in the nearly three-year-old case – and set a trial date of April 20.

The trial will allow homeowners in New Orleans to make their case that the Corps was responsible for the failure of levees along a major navigation channel that inundated parts of the city.

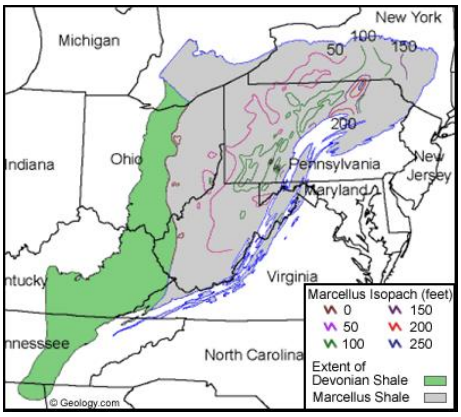
The highest hurdle in such cases is the government's claim of sovereign immunity, which can protect it from certain kinds of lawsuits. A similar suit concerning the failure of the city's drainage canal floodwalls was dismissed by the same judge based on a law that protects the government from lawsuits over the failure of flood-control projects.

The current suit, Robinson v. United States, focuses not on the failure of flood-control structures but on the damage caused by the Mississippi River Gulf Outlet, a navigation canal on the city's east side.
*(ref. Philadelphia Inquirer, October 14, 2009)*

## Geosynthetic Opportunities With Respect to Natural Gas Recovery From Shale Rock

Background

The Marcellus Formation, also classified as the Marcellus Subgroup of the Hamilton Group, Marcellus Member of the Romney Formation, or simply the Marcellus Shale, is a unit of marine sedimentary rock found in eastern North America. Named for a distinctive outcrop near the village of Marcellus, New York, it extends throughout much of the Appalachian Basin; see the following map. The shale contains a massive supply of untapped natural gas reserves, and its proximity to the high-demand markets along the East Coast of the United States makes it an attractive target for energy development.

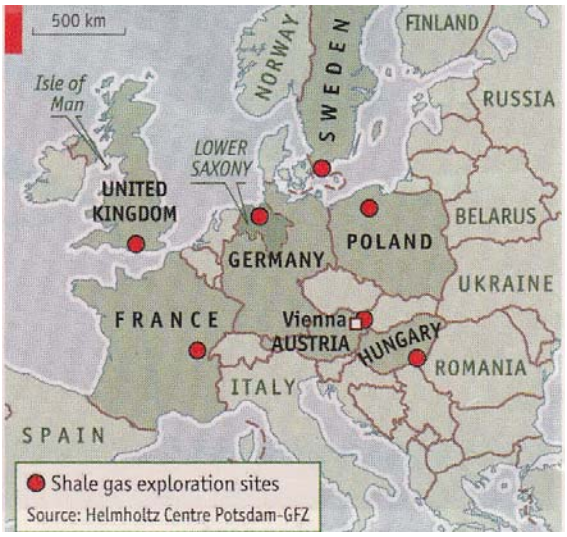



In April 2009, the United States Department of Energy estimated the Marcellus to contain 262 trillion cubic feet of recoverable gas.[1] State University of New York geology professor Gary Lash has calculated that more than 500 trillion cubic feet (14,000 $km^3$) of natural gas may be contained in the Marcellus black shale beds that lie between New York state and West Virginia[2]. In 2008, Terry Engelder, a Pennsylvania State University geosciences professor estimated the amount of natural gas in the Marcellus to be 363 trillion cubic feet of recoverable resource, which would be enough to supply US consumption for at least fourteen years.[3] If the entire formation contained gas, Engelder said the formation could contain 4,359 trillion cubic feet. Assuming a thirty percent recovery rate, this would lead to a 1,307 trillion cubic foot resource.[4] That would be a forty (40) year supply for the entire US!

As the Economist[7] reports, the situation of gas recovery from shale rock is a worldwide phenomenon. For example, across Europe, a stealthy land-grab is under way. Exxon Mobil is drilling in Germany's Lower Saxony. ConocoPhillips has joined 3 Legs Resources, a small firm based on the Isle of Man, to explore a large tract of land in Poland. Austria's OMV is testing geologic formations near Vienna. Shell is targeting Sweden. A host of smaller firms is fanning out across other countries, including France. They are all looking for natural gas trapped in shale as a resource that has transformed the market for gas in America and may have a big impact on Europe, too.

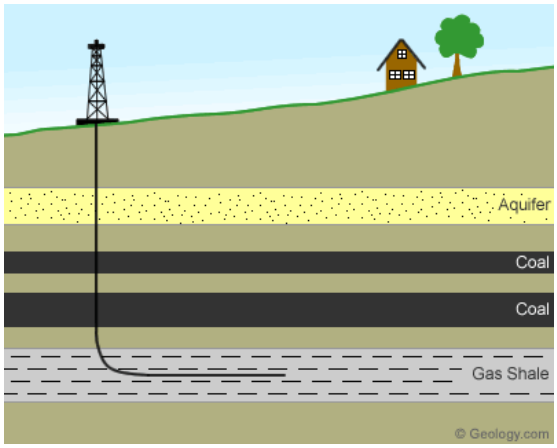
The extent of such "unconventional" gas reserves in Europe is unknown. The International Energy Agency (IEA), which monitors the energy business for rich countries, recently estimated it at 35 trillion cubic meters-far less than in North America or Russia, but about six times the continent's conventional reserves. That would be enough, the IEA calculates, to displace 40 years of gas imports at current levels. Almost half of it is thought to be in shale; the rest comes from coal-bed methane and tight gas. The German Research

Centre for Geosciences is in the midst of a more detailed assessment, backed by oil firms. See the following figure for current exploration sites in Europe.




## Gas Capture

The Marcellus shale formation itself is extremely thick in its central locations, e.g., about 270 m (900 ft.) in Pennsylvania, and it "pinches" out in the west by the Cincinnati Arch and in the north by Canada.[5] Unfortunately, a major factor in the recovery of gas from the formation is that it is deep. It is, for example, 5000 ft. (1500 m) in most locations and one must drill through the upper formations to reach the gas reserves. In order to capture the gas two drilling technologies are used. One is horizontal drilling, in which a vertical well is reoriented to the horizontal so that it penetrates a maximum number of vertical rock fractures and extends a maximum distance within the gas-bearing rock; see the following sketch. The second is "hydrofracing" (or hydraulic fracturing). With this technique, water is pumped into the vertical portion of the well (which is solid casing) and then it continues into the perforated horizontal portion to produce a pressure that is high enough to fracture the surrounding rock. This water contains sand, called a "propant", which prevents the fractured shale from collapsing back to its original tight formation. The result is a highly fractured stratum penetrated by a long length of perforated well bore held open by the sand. Upon release of the water pressure, a backflush of contaminated wastewater comes to the surface along with and followed by the natural gas. It goes without saying, that gas royalties to property owners, state agencies and other related parties is a lucrative and usually quite contentious situation.[6]




## Disposal and Contamination Issues

At least 4,000 new oil and gas wells were drilled in Pennsylvania in 2008, more than in any other state except Texas. This intense activity has forced state regulators to confront a problem that has been overlooked as gas drilling accelerates nationwide; "how will the industry dispose of the enormous amount of wastewater it produces"?

Oil and gas wells generate about nine million gallons of wastewater a day in Pennsylvania, according to industry estimates used by the Department of Environmental Protection (DEP). By 2011 that figure is expected to rise to at least 19 million gallons. That's more than all of the combined state's waterways, can safety absorb, DEP officials say.

Much of the wastewater is the byproduct of the hydraulic fracturing, or simply "fracking", drilling process which pumps at least a million gallons of water per well into the targeted formation in order to break the layers of rock and release gas. When the water is depressurized and brought back to the surface, it contains natural toxins which accumulated during drilling. These including cadmium and benzene.[6] It also can contain small amounts of chemicals added to enhance drilling.

That said, DEP officials say one of the most worrisome contaminants in the wastewater is a gritty substance called total dissolved solids, or TDS, a mixture of salt and other minerals found underground. Drilling wastewater contains so much TDS that is can be five times as salty as sea water. It is generally referred to as "brine". Drilling companies currently dispose of this brine in municipal sewage plants, which then discharge it into rivers and streams.

The U. S. Environmental Protection Agency warns against this practice because sewage plants are not designed to remove TDS or any of the other chemicals the water may contain. Of even more concern, TDS can disrupt the plants' treatment of ordinary sewage by

killing microorganisms that are needed to treat human waste.[5]

Geosynthetic Lined Surface Impoundments

At the minimum, geomembrane, and possibly geosynthetic clay liner, barrier systems can provide for long-term detention of the waste brine. As seen in the following photograph, a relatively small "self-contained" drilling enterprise consists of the drilling operation and ancillary equipment (sometimes including temporary housing) along with a surface impoundment. While each surface impoundment is quite small (typically about 2.5 acres or 1.0 ha), when multiplied by the number of wells there is a very large market for geosynthetics. When an experienced designer considers, however, that geomembranes used to line such surface impoundments are often accompanied by "whales" or "hippos", the situation often requires a drainage system to be located beneath the liner itself. Thus geotextiles, drainage composites, geopipe, etc., can also be readily involved.

Lastly, the issue of how long should the liner system be designed for is a vexing one to all involved, certainly the local regulatory agency. At the heart of the issue is the eventual disposal of the contaminated brine. This is an current question within all state agencies having such gas-bearing geologic formations. GSI has recently been giving one-hour power point presentations to various groups regarding the design of such liner systems. Please advise if you have interest in this regard.

References


1. US Department of Energy (April 2009): *Modern shale gas development in the United States: a primer*, p. 17, PDF file, downloaded 11 June 2009.
2. Bertola, David (2009-02-08). "Researchers: Shale holds vast supply of natural gas". *Business First of Buffalo.* http://buffalo.bizjournals.com/buffalo/stories/2008/02/11story2.html?b=1202706000%5E1587557. Retrieved 2008-04-02.
3. Esch, Mary (2008-11-04). "Estimated gas yield from Marcellus shale goes up". *Philly.com. http://www.philly.com/philly/hp/news_update/20081104_Estimated_gas_yield_from_Marcellus_shale_goes-up.html.*
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5. Harper, J. A. (2008), The Marcellus shale, an old "new" gas reservoir in Pennsylvania, Pennsylvania Geology, Vol. 38, No. 1, Pennsylvania Bureau of Topographic and Geologic Survey.
6. Sapien, J. (2009-10-4), "What can be done with wastewater?", Pittsburgh Post-Gazette.
7. The Economist (2009), "The hunt for shale gas in Europe; 'Bubbling Under'," December 5, 2009, pg.75.


*Bob Koerner*

## Upcoming Events

- January 27-29, 2010 ASTM Committee D35
  San Antonio, TX
  Contact: csierk@astm.org
- January 28, 2009
  GSI Annual Meeting
  San Antonio, TX
  Contact: mvashley@verizon.net
- January 28, 2009
  GSI BoD Meeting
  San Antonio, TX
  Contact: mvashley@verizon.net
- February 3, 2010
  AES Workshop
  Los Angeles, CA
  Contact: kkhilnani@aesciences.com
- March 22-23, 2010
  GSI Courses on Design and QA/QC
  Folsom, PA
  Contact: mvashley@verizon.net
- April 30, 2010
  CETCO Workshop
  Chicago, IL
  Contact: tim.rafter@cetco.com
- May 17-19, 2010
  N.Y. Federation Waste Conference
  Sagamore, New York
  Contact: www.nyfederation.org
- September 15-16, 2010
  GCL Conference Wurzburg, Germany
  Contact: robert.koerner@coe.drexel.edu
- November 16-18, 2010
  GSI-Asia
  Taiwan
  Contact: cwh@mail.npust.edu.tw
- March 1-16, 2011
  GeoFrontiers II
  Dallas, TX
  Contact: tvlindemann@ifai.com

# 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; Plasticos Agricolas y Geomembranes, S.A.C. of Peru with Marino Gomez Montoya as the contact person; Afitex-Texel with Pascal Saunier as contact person; EVAL Americas (Kararay) with Robert Armstrong as contact person and the Philadelphia Water Department with Vahe Hovsepian as the contact person. The newest associate member is Savannah River Remediation LLC with Dr. Amit Shyan as the contact person. Thanks to all and welcome to GSI.

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**AECOM**
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*David A. Carson*
**E. I. DuPont de Nemours & Co., Inc.**
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**Federal Highway Administration**
*Silas Nichols/Daniel Alzamora*
**Golder Associates Inc.**
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*Aigen Zhao/Piergiorgio Recalcati*
**LyondellBasell Industries**
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*John Henderson/Chris Lawson*
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*Georg Heerten/Kent von Maubeuge [BoD]*
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**NTH Consultants, Ltd.**
*Rick Burns/James J. Parsons/Robert Sabanas*
**TRI/Environmental Inc.**
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IN THE NEXT ISSUE

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- 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
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