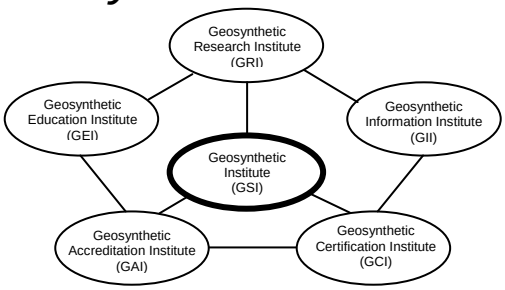
The GSI Newsletter/Report

Geosynthetic Institute



Vol. 20, No. 2 **June 2006**

This quarterly newsletter, now in its 20th 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.

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.

Activities of the Institute Directors & GSI Board of Directors

A number of topics were discussed during a recent teleconference call; a summary follows:

1. The status of GRI Specifications was discussed and in particular the possibility of eliminating warranty's which accompany the geomembrane specs. A questionnaire to the membership is working.
2. The GAI-LAP program was reviewed and in light of the required travel of George Koerner in doing on-site audits, the possibility of co-opting associate auditors was suggested. We will take advantage of this possibility as the need arises.
3. The GCI-PCP was reviewed and after consideration of the nominal acceptance of the program, a questionnaire to the viability of this program was developed and is presently working. The program is over 5-years old and only one company (and one pending) are involved. More later.....
4. The GCI-ICP program is extremely active. Since January 2006, 96 candidates are certified as Geosynthetic Materials Inspectors and 84 are certified as Compacted Clay Liner Inspectors. The Steering Committee is active in updating and upgrading the program in anticipation of new courses and examinations in the Fall.
5. All systems are go for GRI-20 on January 17, 2007 in Washington, DC. Our theme is "Use of Geosynthetics to Mitigate or Prevent Acts of Terrorism and/or Natural Disasters". If you have ideas, its not too late to get involved... please do!
6. A listing of your GSI Board of Directors follow. Please don't hesitate to contact any of them with respect to GSI activities and programs.

Term Ends 2006
Tony Eith - Waste Management Inc. (Owners and Operators)
Boyd Ramsey (Chairman) - GSE Lining Technology, Inc. (Geotextiles and Geogrids)
Sam Allen - TRI/Environmental, Inc. (At-Large)
Term Ends 2007
David Jaros - Corps of Engineers (Government Agencies)
Rex Bobsein - Chevron/Phillips Co. (Resin Producers)
Kent von Maubeuge - Naue Fasertechnik GmbH (International)
Term Ends 2008
Dick Stulgis - GeoTesting Express (Consultants and Testing Laboratories)
Gary Kolbasuk - Raven (Geomembranes and GCLs)
Mark Sieracke - Weaver Boos Consultants, Inc. (At-Large)

IN THIS ISSUE

Overview of GRI Projects (Research)

Each issue of our Newsletter/Report provides a brief glimpse and update of current GRI research projects. 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 short "in-progress" 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*** - Dr. Grace Hsuan is project manager of our ongoing efforts to evaluate stress cracking of geomembrane resins, sheets and seams. In addition to her ongoing evaluations of HDPE geomembranes, Grace is now 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 in generic specifications.
2. **Durability and Lifetime Prediction*** - This project is based on our previous study on the lifetime prediction of HDPE geomembranes which is essentially complete. We are now focusing on 1.5 mm thick LLDPE geomembranes. George Koerner has set up 20 replicate columns each of which is subjected to a compressive stress equivalent to a 50-m high landfill. Temperatures are being maintained at 85, 75, 65 and 55ºC and the samples are being removed regularly for subsequent testing. White Paper #6 on HDPE is available. HDPE pipe is also being evaluated in a similar manner.
3. **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.
4. **In-Situ Temperature Monitoring of Liner and Cover Geomembranes in Dry and Wet Landfills*** - Dr. George Koerner is measuring the in-situ temperature behavior of geomembranes and has installed 60± thermocouples for long term measurements in both a wet and dry municipal solid waste landfill in Pennsylvania. Presently data for 10-years is available. This is clearly the longest in-situ measurement project in all of geosynthetics.
5. **Bioreactor (aka, Wet) Landfill Behavior and Properties*** - The above temperature monitoring has segued into a major effort under sponsorship of GSI and Waste Management, Inc. The wet cell under investigation is at field capacity, hence it is a true anaerobic bioreactor. Dr. George Koerner is in charge of considerable monitoring 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 quarterly basis. The timeline of the project calls for monitoring for 5 to 10 years. This activity will now extend to an adjacent landfill to see how reproducible the data is with a slightly different waste mass.
6. **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 approximately 1-year old and is at a landfill in the Philadelphia area.
7. **Hydrostatic Creep Puncture of Geomembranes*** - The effect of sustained long-term hydrostatic and geostatic pressures on the puncture strength of geomembranes is an ongoing project. A series of tests using 600 g/m^2 protection geotextiles on 1.5 mm thick HDPE geomembranes is being evaluated; the time is currently 9-years. The four-test setups use truncated cone simulations of coarse subgrade stones against the geotextile protecting the underlying geomembrane. The behavior of the geomembranes under these tests is a combination of creep and stress relaxation. The purpose of these tests is to better define the creep reduction factors used in the design method.
8. **Long-Term Benefits of Geotextile Separators*** - A full-scale field database of using geotextile separators on firm soil subgrades is being developed and maintained by Dr. George Koerner. Monitoring is proposed for up to 20-years. The target sites are paved highways, driveways, parking lots, etc., where control sections without geotextiles are also available for comparison purposes. This database will be national and perhaps even international in scope. Included are sites which meet the following criteria:
   - sites must have both geotextile and nongeotextile control sections
   - known type of geotextile(s)

- known soil conditions
- known traffic conditions
- available hydrologic and environmental conditions
- capability of quantifying the original condition of the pavement surface vs. the aged condition… this will be accomplished visually as well as by using falling weight deflectometers.

There are currently 14-sites included in this program. If you have additional sites to add, please contact George at (610) 522-8440.

9. UV Exposure of Geomembranes* - GSI is using its Xenon Arc device along with its two existing UV-fluorescent devices to evaluate the simulated outdoor lifetime of nine different types of geomembranes; HDPE, LLDPE, 4 fPPs, PVC, EPDM and PE-R. The effort is considered as part of GSI's Center for Polymers in Hydraulic Structures (CPHyS), but has relevancy in many other applications as well.

10. Generic Specifications - A major effort is ongoing with respect to the development of generic geosynthetic specifications. The current status of these specifications is as follows, with the fPP spec being revised using weatherometer testing as opposed to OIT testing for the endurance criteria.

Completed

GM13 – HDPE Geomembranes*
GM17 – LLDPE Geomembranes*
GM18 – fPP Geomembranes (Temporarily Suspended as of May 3, 2004)
GM21 – EPDM Geomembranes
GM19 – Geomembrane Seams
GT10 – Geotextile Tubes
GT12 – Geotextile Cushions
GT13 – Geotextile Separators
GCL3 – Geosynthetic Clay Liners

*An important note regarding textured geomembranes was recently added to the effect that direct interface shear testing should always be performed to assure against slope instability.

Working Within Focus Groups

GMXX – Exposed Temporary Covers
GCXX – TRMs for Erosion Control

Delayed or Off in the Distance

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

The completed 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.

These specifications are also available as a separate power point CD which shows photos of the test devices and can be used as a presentation to your clients and customers, as well as being an in-house training vehicle… don't hesitate to use and share this information which is on the open part of our Web Site.

11. Technical Guidance Document on QC/QA of Waste Containment Facilities - Drs. Dave Daniel and Bob Koerner have completed the Second Edition of this Technical Guidance Document by greatly updating the original 1993 EPA report. Its publication will be through the ASCE Press and will be available this summer. If members want a preliminary copy on CD (~ 390 pages) contact us accordingly.

12. Various Power Point Presentations - To date we have distributed about 500 copies of three different CDs;

- Introduction to Geosynthetics
- Selected Lectures I (SRWs, LF Expansions, and Dam Waterproofing)
- Selected Lectures II (Bioreactor LFs, GCL Test Plots, and Erosion Control)

Every screen has a short voice-over and each lecture can be presented in about 50-minutes. They are ideal for classroom use or for "brown-bag" seminars, and the like. Ask if you want copies; no charge.

13. Summary of Power Point Presentations - We currently have many presentations which are given on a regular basis to the members at their facilities, or at their annual meeting, etc. Following is a current listing with the number of screens in parenthesis. Please contact us if you have interest in any of them.

Geocomposite Related
1. Erosion Control using TRMs (61)

Geosynthetic Clay Liners
2. GCL Cincinnati test plots (53)
3. GCL Creep and lifetime prediction (30)
4. GCL Fiber degradation and lifetime (21)
5. GCL Needles breaking (GSI) (28)
6. GCL Panel Separation (39)

GG Related
7. GG Creep using TTS and SIM (53)
8. GG junction strength (49)

Geomembrane-Related
9. GM-dams and lifetime prediction (75)
10. GM-heap leach pads (63)
11. GM-history of liners (69)
12. GM-IAGI and quality methods (6)
13. GM-wave management (55)
14. GM-ELLS (liner leakage) (38)

Geopipe
15. GP-Stress crack and specifications (52)

Geosynthetic-General

16. GS Challenges in general (38)
17. GS General overview for "beginners" (68)
18. GS Lifetime-Durability (74)
19. GS Product Certification in 3-steps (22)
20. GS Quality Issues (28)

GSI Stuff

21. GSI Course Overview (260)
22. GSI GAI-lab accreditation program (33)
23. GSI Overview of programs (45)

GT Related

24. GT tubes for erosion control and dewatering (79)

Landfill Related

25. LF-Post closure beneficial uses (121)
26. LF-Cover design: veneer stability (102)
27. LF-Expansions: lateral and vertical (98)
28. LF-LCRS: Geo K. thesis (58)
29. LF-LCRS: WMI project (24)
30. LF-Stability design (Qian) (82)
31. LF-Stability design (Baton Rouge) (33)
32. LF-Wet-complete bioreactor lecture (146)
33. LF-Wet-concept of bioreactors (42)
34. LF-Wet-GS issues regarding bioreactors (25)
35. LF-LCRS (24)

Miscellaneous

36. Probability of Failure-DwG cases (35)
37. Probability of Failure-theory (43)
38. Koerner Symposium
39. Koerner Garage Mural

Specifications

40. Spec-EPDM geomembrane (35)
41. Spec-fPP geomembrane (40)
42. Spec-geomembrane seams (34)
43. Spec-GT cushions (26)
44. Spec-GT separation (24)
45. Spec-GT tubes (38)
46. Spec-HDPE geomembrane (48)
47. Spec-LLDPE geomembrane (45)
48. Spec-GN2 drainage (working) (36)
49. Spec-GC8 guide (working) (13)
50. Spec-overview of development (29)
51. Spec-GCL3 (38)

Walls and Slopes

52. SRW Complete lecture (146)
53. SRW Drainage-long (81)
54. SRW Drainage-short (34)
55. SRW GSI wall (70)
56. SRW pH-values from FHwA study (34)
57. SRW Repair of failed walls (135)
58. SRW at GSI

Activities within GII (Information)

We are currently supporting 2-Home Pages. The first is the GRI Home Page which is accessed as follows:

<<http://www.drexel.edu/gri>>

This home page is very introductory as far as geosynthetics knowledgeable people are concerned, and is meant to be promotional (for prospective students and potential institute members). It is probably only of nominal interest to most readers of this Newsletter/Report.

The second home page is the primary GSI Home Page and is accessed as follows:

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

It has been reconfigured 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 15,000 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 that we (and others we are told) use the most in our entire website.

Progress within GEI (Education)

The following 1-day long course will be offered in the Fall, 2006.

Quality Control/Quality Assurance of Geosynthetics

Goal: This one-day course is focused on the quality control and quality assurance of geosynthetics as placed in permanent and/or critical applications. Specifications and testing are emphasized. It focuses on both the manufactured geosynthetics and on the installation processes. Applications are mainly in the waste containment area, i.e., landfills and surface impoundments, but applicability to walls, slopes, dams, canals, etc., will also be discussed. Included are the following geosynthetics:

- geomembranes,
- geosynthetic clay liners,

- geosynthetic drainage systems (geonets and geocomposites),
- vertical cutoff walls,
- ancillary materials & appurtenances.

All of these courses come with a set of notes, are fast-paced, extremely current, and are very interactive with the participants. The course is very well positioned for those intending to take the CQA-Inspectors Certification Test for Geosynthetic Materials administered by the Institute.

- September ___, 2006 in Boston, MA
- September ___, 2006 in Syracuse , NY
- September ___, 2006 in Austin, TX
- December 8, 2006 at GSI in Folsom, PA
- Other locations are being pursued

Activities within GAI (Accreditation)

The Geosynthetic Accreditation Institute's (GAI) current mission is focused on a Laboratory Accreditation Program (LAP) for all 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.

It should be made clear, however, 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. 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. There are currently 161 GAI-LAP methods available for accreditation. Please consult our home page for a current listing.

As of June 2006, 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. (117 tests)
Sam Allen -- (512) 263-2101

3[A] - Golder Associates (43 tests)
Henry Mock -- (770) 496-8280

4[C] - Geosynthetic Institute (121 tests)
George Koerner -- (610) 522-8440

5[A] - NTH Consultants, Ltd. (52 tests)
Debra Klinger -- (610) 524-2300

6[A] - GeoSystems Consultants (27)
Craig Calabria -- (215) 654-9600

8[B] - Synthetic Industries Inc., Ringgold (19 tests)
Toni Ruppert -- (800) 258-3121

9[B] - Synthetic Industries, Inc., Alto (10 tests)
Melvin Wallace -- (770) 532-9756

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)
Rick Lacey -- (412) 823-7600

18[A] - EMCON/OWT (55 tests)
Rasheed Ahmed -- (845) 492-3170

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

20[A] - GeoTesting Express, MA (58 tests)
Gary Torosian -- (978) 635-0424

22[B] - CETCO Arlington Heights (13 tests)
Jim Olsta -- (847) 392-5800

23[B] - CETCO Cartersville (10 tests)
Derek Reece -- (706) 337-5316

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

25[B] - Ten Cate Nicolon (10 tests)
Beth Wilbanks -- (706) 693-2226

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

29[C] - FITI Testing & Research Institute (70 tests)
Moon-Hyun Jeong -- (011-82-2-960-8034)

31[D] - NYS Dept. of Transportation (9 tests)
James Curtis -- (518) 457-4735

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

34[B] - GSE Richey Road (16 tests)
Jane Allen -- (281) 230-6726

37[B] - SL Limitada (16 tests)
Mauricio Ossa -- 56-2 6010153

38[C] - Sageos/CTT Group (76 tests)
Eric Blond -- (450) 771-4608

40[B] - GSE Lining Technology Inc. (14 tests)
Charles Miller -- (843) 382-4603

41[A] - SGI Testing Service, LLC (18 tests)
Zehong Yuan -- (770) 931-8222

42[C] - NPUST (GSI-Taiwan) (39 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] - Polyfelt Geosynthetics SDN Bhd. (23 tests)
C. P. Ng -- (603) 519 28568

46[B] - Bentofix Technologies (13 tests)
Pat Thiffault -- (705) 725-1938

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

48[B] - Tenax Corporation (9 tests)
Tim Bauters -- (410) 522-7000

49[B] - Engepol Geossinteticos (20 tests)
George Nastas -- (55) 11-4166 3001

50[B] - Advanced Drainage Systems, Inc. (7 tests)
Terry McElfresh -- (513) 896-2065

51[B] - Solmax International Inc. (14 tests)
Guy Elie -- (450) 929-1234

52[A] - Geosyntec (1 test)
James Fleck -- (513) 266-6949

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

54[B] - Hancor (9 tests)
David Gonso -- (419) 424-8377

54[B] - Atarfil Geomembranes (21 tests)
Isabel Merida Fernandez -- 34 958 439 278

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

NOTE
The 2006 annual GAI-LAP meeting will be held in Toronto Canada in conjunction with ASTM D35 on June 15, 2006 at 7:30 PM.

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

TESTING TIPS

The geomembrane dog-bone tensile test ASTM D 638 is not ASTM D 6693. The respective test methods are from committee D-20 (plastics) and from D-35 (geosynthetics). The basic difference is the use, or lack thereof, of an extensometer. D 638 requires the use of an extensometer where D 6693 measures deflection from cross head movement. An extensometer set at 33 mm (1.3 inches) will pick up much less elongation, and therefore strain, than the gross movement picked up by cross head movement. When comparing the results the following are typical for some smooth HDPE geomembranes.

	Yield Strain	Break Strain
D 638	14 ± 2%	400 ± 50%
D 6693	18 ± 4%	575 ± 100%

Of note is the D 638 with an extensometer records less strain and has less variation in strain measurement.

While using D 6693, the geosynthetic industry has decided to forego use of an extensometer out of simplicity. The GAI-LAP community should be aware of the difference and educate their clients accordingly. Hopefully D638 will start disappearing for geomembrane specifications.

Activities within GCI

(a) Inspectors Certification Program

This new venture for GCI was initiated in January, 2006 and presently consists of a certification program for Construction Quality Assurance field inspectors for installation of geosynthetic materials and for compacted clay liners. It is focused on landfill liner and cover systems, as well as surface impoundments, waste piles, and related geoenvironmental applications.

The requirements are as follows:

1. Candidate must be recommended by a Professional Engineer (or equivalent) who knows and can attest to at least six months of acceptable field experience performing CQA activities with geosynthetic materials and/or compacted clay liners.
2. Pay a one-time $400 fee for either geosynthetic materials or compacted clay liners, or $500 for both material systems each of which covers a 5-year period upon successful completion of an examination.
3. Successfully pass a written examination proctored by GCI or a GCI designated individual and subsequently graded by the Geosynthetic Certification Institute.

There are separate examinations for both geosynthetic materials and compacted clay liners. To date, 97 people have taken the Geosynthetics Materials Examination (1-failed) and 94 have taken the Compacted Clay Liner Examination (10-failed). The examinations are currently under review with possible modifications to be made this summer.

The GCI Steering Committee is as follows:

Jeff Blum of STS
Maria Tanase of Earth Tech
Rick Thiel of Vector
Jeff Fassett of Golder
Sam Allen of TRI
Mark Sieracke of Weaver Boos
Jim Olsta of CETCO
Boyd Ramsey of GSE
Te-Yang Soong of CTI
Steve Wintheiser of CTI
Dan Rohe of EPI
Jim Goddard of ADS

(b) Product Certification Program

We have an ongoing product certification program for all geosynthetics which have a generic specification. The program has as its target, conformance to a specific GRI specification such as GRI-GM13 for HDPE geomembranes. This specification has been in use for approximately 5 years with generally good reviews and considerable exposure. The specification is seen referenced in many project plans, specifications and quality assurance documents around the world.

The GCI certification program using this specification is based on ISO 9000 audits conducted on a 6-month cycle wherein the manufacturer's quality control plan and statistical data base are evaluated, along with sampling of the product. Upon testing by an accredited laboratory, the results are assessed and certification is granted, postponed or rejected. Certification carries with it the right to identify products as "GRI- Certified"; in this case “GRI-GM13 Certified”. We are delighted to report that GSE Chile, S.A. continues to be approved and can mark its HDPE geomembrane.

GRI-GM13 Certified

Our sincere congratulations go to the following who is the principal involved:

Mauricio Ossa - Technical Manager

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 many 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. We introduce these institutes to you in this Newsletter/Report and will present ongoing details of their respective activities.

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. It employs 120 people (8 with doctoral degrees) and 42 engineers. The geosynthetics testing group within FITI has 12 people (2 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 (50 km west of Seoul) 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. The ongoing efforts of both FITI and INHA will be described in future Newsletter/Reports.

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 Director of the Computer Center. 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 32 geosynthetic test methods. Dr. Hsieh has 10-students working on geosynthetic-related projects and is extremely active nationally and internationally. The ongoing efforts of GSI-Taiwan will be described in future Newsletter/Reports.

The Geosynthetic Institute Centers-of-Excellence

1. The Center for Polymeric Reinforced Structures (CPReS) was formed on Dec. 27, 2002 for the purpose of proper use of geosynthetics in walls, slopes, and foundation reinforcement. It involves Dov Leshchinsky of Delaware, Grace Hsuan of Drexel and George Koerner of GSI as Co-Directors. The mission statement and goals are available on the GSI Home Page at <geosynthetic-institute.org>. Ongoing projects are the following:

   (a) Dov Leshchinsky is modifying and incorporating two important aspects of reinforced walls into his widely-used computer program "MSEWall". They are; design to accommodate short reinforcement lengths when full space is unavailable, and the incorporation of drainage geocomposites in accommodating low permeability backfill soils. The first topic was presented at GRI-17 and a paper is available. The second topic will be presented at GRI-19 in December, 2005.

   (b) Grace Hsuan is utilizing the Stepped Isothermal Method (SIM) for assessing the long-term behavior of various geosynthetic reinforcements including geofoam. Graduate student Sang-Sik Yeo, is performing the requisite research. A paper will be presented at GRI-19 in the Student Paper Session.

   (c) George Koerner has supervised the construction of a segmental retaining wall at GSI which has 3-different masonry block types. He is measuring the pH-values directly between block surfaces and will do so for many years into the future… the following photograph is of the "GSI Wall". Data is currently available. [As a comment, this wall has geogrid reinforcement between every block layer and is backfilled completely with AASHTO #57 stone. It will not collapse or even deform]!

2. The Center for Polymers in Hydraulic Structures (CPHyS) was formed on June 20, 2003 for the purpose of proper use of geosynthetics in dams, canals, reservoirs, tunnels, pipes and related hydraulic systems. Jorge Zornberg of the University of Texas at Austin, Grace Hsuan of Drexel, and George Koerner of GSI are Co-Directors. The mission statement and goals are available on the GSI Home Page at <<geosynthetic-institute.org>>. Initial projects are being decided upon, but two are certain.

   (a) Grace Hsuan is focusing on exposed geomembrane durability and lifetime. (See Item 10 previously). This issue is critically important to gain confidence regarding polymer lifetime in the minds of owners, regulators, designers and specifiers in the focused application areas.
   (b) Jorge Zornberg's activity, via a GSI funded graduate student, Christine Weber, will focus on drainage behind exposed geomembranes on dams.
   (c) George Koerner's activities are within GSI and focus on the Xenon Arc and UV fluorescent devices.
3. In both CPReS and CPHyS, Bob Koerner will act in an advisory manner and as quality assurance! In both centers existing GSI Members and Associate Members are fully entitled to the information that is developed and their interaction is encouraged. No additional funding is anticipated. We will keep the membership advised as to progress in this regard. We sincerely hope that the membership is supportive of these initiatives and your comments/suggestions are always solicited.
4. There is a distinct possibility for additional centers of this type. In particular we are looking to team with a university specializing in CAFO's, i.e., large-scale agricultural operations. Please contact Bob Koerner with suggestions and ideas.

Items of Interest

1. Estimated Annual Use of Geomembranes in China

Application	Est. annual geomembrane use
Hydraulic and hydroelectric projects	52.5 million m^2
Environmental protection	37.5 million m^2
Transportation	27 million m^2
Construction	18 million m^2
Mining plants	6 million m^2
Miscellaneous	9 million m^2

(ref. Industrial Fabric Products Review, March 2006)

2. Phytoremediation in the City

Joseph Hagerman, a Columbia University graduate student in the Fu Foundation School of Engineering and Applied Science, has been named co-winner of *Metropolis* magazine's high-profile design competition. Hagerman proposed an interlocking concrete block system called Biopaver. The pavers use a patent-pending three layer design--precast concrete, time-released seed delivery layer, and a biodegradable formwork--and incorporate phytoremediating plants. Not only aesthetic, these pavers can help remove stormwater pollutants. Hagerman's configurations allow custom fabrication (e.g., plant growth from boutique-shaped holes); and target common urban hardscapes, from ordinary use in pavers around park benches to sidewalk-roadway crosswalks with nearby inlets. Images and details are available online at *www.biopaver.com.able* online at *www.biopaver.com*.

Urban hardscapes can benefit greatly from phytoremediating pavers.

(ref. Industrial Fabric Product Review, Sept. 2005)

3. Road Construction Funding Increases at All Levels

Federal, state, and local spending on road construction rose 12 percent in the first nine months of 2005 and is expected to reach a record $66.3 billion for the year, according to data from the U. S. Census Bureau. Over the past several years, spending on road construction has been stagnant, failing to outpace inflation. From 1994 to 2004, road construction lagged behind other projects in state legislatures. During that period, road spending increased at a 4.7 percent annual rate. During those 10 years, the average amount of time a drive spent in traffic rose 17 percent annually, according to the College Station--based Texas Transportation Institute. The recent increase in funding has been designated for a variety of road projects including extending Interstate 69 from Indianapolis to Evansville in Indiana, upgrading the FDR Drive and Henry Hudson Parkway in New York City, and rebuilding sections of I-70 and I-71 in Columbus, Ohio. In such states as Washington and New York, the projects are being funded in part by taxes and loans approved by voters who just a few years ago rejected such measures for transportation improvements.
(ref. USA Today)

4. Harmonization

"Harmonization is a word that means different things to different people. At ASTM International, our committee members know that if their goal is to develop a standard through global participation intended for global use, that goal will be supported by the proper tools, by staff, and by policy."
(ref. ASTM Standardization News, March)

5. Steel Price Hikes Higher Than Geosynthetics

A leading supplier of steel market information, MEPS International, reports hikes in price between February 2003 and February 2004 as high as 65.5 percent. Reinforcing bars, which averaged $249 per ton a year ago is up to $412 per ton. Medium sections and steel beams that sold last year for $336 per ton are now selling for $941 per ton. Wire mesh, which averaged $257 per ton last year is now at $403 per ton.
(ref. CM News, May 2004)

European CE Marking and Background

We regularly report GSI's efforts in developing generic specifications for various geosynthetic applications, e.g., HDPE geomembranes per GRI-GM13, Geotextile cushions per GRI-GT12, etc., etc. These specifications list required properties, test methods, minimum (sometimes, maximum) values, and minimum testing frequencies. The latter is required since the specifications fall under the general heading of manufacturing quality control (MQC).

The European approach toward such specifications has both similarities and differences. Regarding similarities, the CE Marking approach lists properties and test methods for two general classes of geosynthetics; geotextiles/geogrids and geomembranes/GCLs. Regarding differences, there are specific application areas, no specified numeric values, and no required testing frequencies.

The CE Marking template for geotextiles (GTs) and geogrids (GGs) follows. There are, or will be, ten different charts for the ten applications listed. In the chart are letters for required (H), relevant to all conditions (A), and relevant to specific conditions (S). The applicable functions listed are filtration, separation, and reinforcement.

CE Marking Template for GTs & GGs

Property	Test Method	Applicable Function		
		Filtration	Separation	Reinforcement
(1) Tensile strength	EN ISO 10319	H	H	H
(2) Elongation at maximum load	EN ISO 10319	A	A	H
(3) Tensile strength of seams and joints	EN ISO 10321	S	S	S
(4) Static puncture (CBR test)	EN ISO 12236	S	H	H
(5) Dynamic perforation resistance (cone drop test)	EN 918	H	A	H
(6) Friction characteristics	prEN ISO 12957-1: 1997 and prEN ISO 12957-2: 1997	S	S	A
(7) Tensile creep	EN ISO 13431	--	--	S
(8) Damage during installation	ENV ISO 10722-1	A	A	A
(9) Characteristic opening size	EN ISO 12956	H	A	--
(10) Water permeability normal to the plane	EN ISO 11058	H	A	A
(11) Durability	According to annex B	H	H	H
(11.1) Resistance to weathering	ENV 12224	A	A	A
(11.2) Resistance to chemical ageing	ENV ISO 12960 or ENV ISO 13438, ENV 12447	S	S	S
(11.3) Resistance to microbiological degradation	ENV 12225	S	S	S

Notes: H = required for harmonization, i.e., required,
A = relevant to all conditions of use, and
S = relevant to specific conditions of use

Comment: There will be 10 such charts for different uses

1. Roads	6. Reservoir/dams
2. Railways	7. Canals
3. Earthworks	8. Tunnels
4. Erosion Control	9. Waste
5. Drainage	10. Liquid waste

The CE Marking template for geomembranes (GMs) and geosynthetic clay liners (GCLs) follows. In this regard GM-P is for polymeric GMs, GM-B is for bituminous geomembranes, and GCLs speak for themselves. Again, the H, A, and S designations are associated with the various materials, but with no specific numeric values.

CE Marking Template for GMs and GCLs

		Geosynthetic Barrier			Test Methods		
Nr	Property to be tested	GM-P	GM-B	GCL	GM-P	GM-B	GCL
	Physical properties						
1	Thickness	A	A	A	EN 1849-2	EN 1849-1	EN 964-1
2	Mass per unit area	A	A	A	EN 1849-2	EN 1849-1	EN 14196
	Hydraulic properties						
3	Water permeability (liquid tightness)	H	H	H	prEN 14150:2001	prEN 14150:2001	ASTM D5887
4	Gas permeability (gas tightness)	H	H	S	ASTM D1434	ASTM D1434	Annex C of this standard
5	Swell Index	-	-	A	-	-	ASTM D5890
	Mechanical properties						
6	Tensile strength	H	H	H	ISO 527-1 and -3 or -4	EN 12311-1	EN ISO 10319
7	Elongation	A	A	A	ISO 527	EN 12311-1	EN ISO 10319
8	Static puncture	H	H	H	EN ISO 12236	EN ISO 12236	EN ISO 12236
9	Bursting strength	S	S	S	prEN 14151:2001	prEN 14151:2001	prEN 14151:2001
10	Tear strength	S	S	-	ISO 34	34	-
11	Friction direct shear	S	S	S	prEN ISO 12957-2:2004	prEN ISO 12957-S;2004	prEN ISO 12957-S;2004
12	Friction inclined plane	S	S	S	prEN ISO 12957-2:2004	prEN ISO 12957-S;2004	prEN ISO 12957-S;2004

CE Marking Template for GMs and GCLs - cont.

		Geosynthetic Barrier			Test Methods		
Nr	Property to be tested	GM-P	GM-B	GCL	GM-P	GM-B	GCL
	Thermal properties						
13	Low temp behavior (flexure)	S	S	-	EN 495-5	EN 1109	-
14	Thermal expansion	A	A	-	ASTM D696	-	-
	Durability and chemical resistance						
15	Weathering	H	H	S	En 12224	En 12224	EN 12224
16	Micro organisms	A	A	A	EN 12225	EN 12225	EN 12225
17	Oxidation	H	H	H	pr EN 14575	pr EN 14575	pr EN ISO 13438:2004
18	Environmental stress cracking	H	-	S	ASTM D5397 (appendix)	-	ASTM D5397 (appendix)
19	Leaching (water soluble)	A	A	A	EN 14415	EN 14415	EN 14415
20	Chemical resistance	A	A	A	EN 14415	EN 14415	EN 14415
21	Wetting/drying	-	-	S	-	-	prCEN/TS 14417:2004
22	Freezing/thaw	-	-	S	-	-	prCEN/TS 14418:2004
23	Root penetration	S	S	S	prCEN/TDS 14416:2004	prCEN/TDS 14416:2004	prCEN/TDS 14416:2004

The amount of detail and the effort expended by the writers of these CE Marking templates is enormous. The individuals involved should be congratulated in this regard. Insofar as adding numeric values, however, the decision is left to the site-specific specifier or regulatory body. While this might seem to be somewhat unwieldy, efforts by both the European Geotextile Manufacturers and the European Geomembrane Manufacturers are ongoing to provide specific values where appropriate. In this regard, our GSI/GRI specifications are always available to be co-opted entirely, or in part, for providing such numeric values as desired or needed.

Upcoming Events

- June 14-16, 2006
  ASTM D35 on Geosynthetics
  Toronto, Canada
  Contact: <csierke@asmt.org>
- Sept. 8-22, 2006 8th
  8th Intl. Conf. on Geosynthetics
  Yokohoma, Japan
  Contact: <www.8icg-yokohama.org>
- October 12, 2006
  GSE Seminar on Geosynthetics
  Princeton, New Jersey
  Contact: <bramsey@gseworld.com>
- November 2-3, 2006
  PennDOT/PA-ASCE Geotech Conf.
  Hershey, Pennsylvania
- December 4, 2006
  CTI Seminar on Landfill Design
  Detroit, Michigan
  Contact: <tsoong@cti-assoc.com>
- December 8, 2006
  QA/QC course at GSI
  Folsom, PA
  Contact: <mvashley@verizon.net>
- January 16-19, 2007
  GMA/GSI/NAGS Conference
  Washington, DC
  Contact: <jmrutledge@ifai.com>
- January 31, February 1-2, 2007
  ASTM D35 on Geosynthetics
  Costa Mesa, California
  Contact: <csierke@asmt.org>

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. The newest member organizations are Pétromont (Sylvie Coulange-Suarex and Nathalie Legros), EPI (Daniel S. Rohe and Mark Wolschon), Vector Engineer (Vince Suryasasmita and Richard Thiel), and Weaver Boos Consultants, Inc. (Mark Sieracke). A sincere thanks to all and welcome!

GSE Lining Technology, Inc.
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IN THE NEXT ISSUE

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