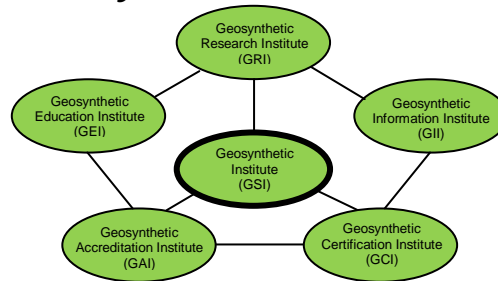


The GSI Newsletter/Report

Geosynthetic Institute



Vol. 32, No. 1

March, 2018

This quarterly newsletter, now in its 31st year, presents the activities of GSI and its related institutes to all who are interested. It is available on the institute's home page at www.geosynthetic-institute.org. It also serves as a quarterly report to its member organizations. Details are available by contacting George R. Koerner or Marilyn Ashley at phone (610) 522-8440; fax (610) 522-8441 or e-mail at gsigeokoerner@gmail.com or mvashley@verizon.net.

Activities of GSI's Officers and Board of Advisors

1. The ASTM-D35 Meeting in New Orleans in January once again contained a GAI-LAP meeting. This arrangement appears to be convenient and allows our lab accreditation members at least one less meeting to attend.
2. The GSI QA/QC course on liner and cover systems has now completely transferred from a one day in-house course to a on-line distance learning course. It is given in six parts (each 1.5 hours) on three consecutive days. The next is scheduled for May 30-June 1.
3. To follow the previous item, we are delighted that TRI Env. Inc. is presenting a similar (but in-person) course in Austin, Texas on a regular basis. Their next course is May 7-11, 2018 and includes electrical leak location surveys.
4. In February, 2017 we offered a webinar on wave/wrinkle management of backfilled geomembranes which attracted 50-sites (most sites had multiple listeners). Although much of the data presented was far from new, it seems to have created considerable controversy. It stimulated a GSI laboratory study to be described later. When a repeat webinar was scheduled for February 14, 2018 we cancelled it awaiting for this and other data to become available. Our apologies for those that registered and they have been refunded accordingly.
5. A new survey of state environmental agencies will be available by mid-March.
6. Your nine person GSI Board of Advisors (BOA) is as follows:

Term Ends 2018

- John Workman - Waste Management Inc. (Owners and Operators)
e-mail: jworkman@wm.com
- Mark Wayne – Tensar Earth Technology (Geotextiles and Geogrids)
e-mail: mwayne@tensarcorp.com
- Sam Allen – TRI Environmental Inc. (At-Large)
e-mail: Sallen@tri-env.com

Term Ends 2019

- Kent von Maubeuge - NAUE GmbH & Co. KG (International-1)
e-mail: kvmaubeuge@naue.com
- A. K. Mukhopadhyay – BTRA & GSI-India (Agencies)
e-mail: btra@vsnl.com/btradirector@gmail.com
- Ashish Sukhadia – Chevron Phillips (Resin and Additives)
e-mail: sukhaam@cpchem.com

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Term Ends 2020

- Tony Eith - CEC Consultants, Inc.
(Consultants and Testing Labs)
e-mail: teith@cecinc.com
- Jimmy Youngblood - GSE Environmental
(Geomembranes and GCL's)
e-mail: jyoungblood@gseworld.com
- Moreno Scotto - Maccaferri
(International - 2)
e-mail: moreno.scotto@gmail.com

Overview of GRI Projects (Research)

The following projects are all funded by GSI membership dues unless specifically noted. Most are long-term projects for which we are well positioned to accomplish. *Those projects marked with an asterisk have written papers available; please ask and we will send them accordingly.* Contact George Koerner (gsigeokoerner@gmail.com), Grace Hsuan (g.hsuan@coe.drexel.edu) or Bob Koerner (rmk27@drexel.edu) for details and/or discussions.

1. **“Farewell to” In-Situ Temperature Monitoring of Liner and Cover Geomembranes in Dry and Wet Landfills*** - For 20-years George Koerner has been monitoring geomembrane temperatures at a landfill close to Philadelphia, our home base. It is the longest single project in GSI's history and has produced excellent and information results. (Papers are available.) However, the thermocouples and readout devices are so corroded that it is not possible to continue. That said, sincere appreciation to the landfill owner/operator for allowing us access over the years.
2. **Field Exposed Lifetime of Geogrids Used at the Facing of Landfill Berms** - The facing of mechanically stabilized earth landfill berms (and other walls and slopes as well) is often using a wrap-around configuration leaving the geogrid exposed to the atmosphere. A project being conducted by George Koerner is presently investigating the behavior of two different geogrids and two erosion control materials over time. These four materials are also being exposed on the roof of the GSI carport. A 50-year time frame is envisioned! The long-term behavior will eventually be compared to UV laboratory predicted data as noted previously.
3. **Laboratory Exposed Lifetime of Geomembranes*** - GSI is using three UV-fluorescent devices to estimate the projected exposed lifetime of six different types of geomembranes. They are HDPE, LLDPE, fPP, EPDM, PVC (N.A.) and PVC (Euro.). They are being incubated at 60, 70, and 80°C until half-life of strength and elongation are measured. The goal is lifetime prediction. Incubation times are now over 60,000 light hours (8.2 years) and are not yet complete. Some will take at least 90,000 light hours (\approx 12.3 years). GRI Report #44 is available on results to date and a webinar is also available. The information was made available to the public on April 6, 2016 at Orlando and was again presented in Peru on March 30, 2017. It has now been republished in the International Geosynthetics Journal. A copy is available. (In this regard it should be noted that we have withheld the information before publication for well over a year which has been our custom.)
4. **HDPE Geomembrane Lifetime as a Function of Thickness** - This often encountered question is being evaluated by exposure at 80°C in a QUV weathering device per ASTM D7238. Formulations are exactly the same and only the sample thicknesses vary. These thicknesses are 2.76, 2.44, 1.58, 1.08, 0.77 and 0.48 mm. Parameters being evaluated in this decades long study are change in thickness and presence of crazing or cracking. Time will tell!
5. **Exposed Lifetime of Creased Geomembranes** - Stemming from a recent webinar on the effect of backfilled GM waves or wrinkles we have seven geomembranes which are purposely creased in double 180° bends being incubated at 80, 65, 55 and 25°C temperatures as of February 10, 2017. They are HDPE, LLDPE, LLDPE-R, fPP, fPP-R, EPDM and PVC. We are focused on if, and where, cracking might occur. The project promises to take many years but should be interesting.
6. **Laboratory Exposed Lifetime of PVC (European) Geomembranes** - We have been evaluating five different European formulations for four years using three dedicated UV-fluorescent devices and the results are very impressive. The study is being conducted for CARPI Tech, a GSI member organization. The project also allows us to distinguish between PVC geomembranes manufactured in North America versus Europe. The differences are in the type of plasticizers used in the formulations as well as thicknesses.
7. **Cable Tied Geonet Evaluations** - A study has been focused on the plastic cable ties used to connect the overlapped ends and edges of geonets and geospacers. The draft of a new GRI Test Standard is available as well as the draft of a technical paper to be published at the IGS Conference in Seoul, Korea.
8. **Retaining Wall Failure Evaluations*** - We have past GRI Reports 38, 39, and 40 addressing mechanical stabilized earth (MSE) walls using geosynthetic reinforcement which document 82-failures. Our data base has now grown to 141, then 171, then 286 and now 312! *Readers, we*

have a very serious situation in this regard! The failures are either excessive deformation or collapses. We have presented one-day courses on this topic along with inspector training and development insofar as a field inspectors certification program; see the certification section of this Newsletter/Report. A paper was published by the Journal of Geotextiles and Geomembranes in October, 2013 and the publisher (Elsevier) reports that 1400 requests have been made to date. It was voted as being the best paper of 2013 by the journal. This was the topic of a GSI course and lecture presented at GeoAmericas in April, 2016. An up-to-date GSI webinar is currently available.

9. **pH Between Masonry Block Wall Units*** - George Koerner has been measuring the pH between three types of masonry blocks for over eight years to monitor the values. Concern here is over PET geogrids which are known to be sensitive to very high alkalinity environments. Indeed, the values started high, but over time they are now down to eight and lower. George has a paper in this regard.
10. **Landfill Failure Analysis** - Since our originally reported paper on ten landfill failures in a 2000 publication, we have accumulated ten more. All 20-failures have been analyzed using the ReSSA Code and are now available to members and associate members as GRI Report #41. There are two recent failures in this regard, both in Pennsylvania, and one resulted in a worker's death! A paper to be published by Dr. Rudy Bonaparte of Geosynthetic/Georgia Tech gives details of two of these failures and more.
11. **Slow Pressurization of HDPE Geomembranes in Axi-Symmetric Testing*** - The ASTM D5716 method of testing geomembranes in a 3-D axi-symmetric mode uses a pressure rate of 6.9 kPa/min (1.0 psi/min). While such a rate is appropriate for most geomembrane types, it is very fast for HDPE which is semi-crystalline and cannot readily stress relax so as to accommodate the applied pressure. To investigate slower rates we have initiated a project with rates as low as 6.9 kPa/month (1.0 psi/month)! The last test, just now begun, is at a rate of 6.9 kPa/six months (1.0 psi/six months) and it will take an estimated five years to conclude. A preliminary paper was presented at Geosynthetics '15 in Portland.
12. **PVD Strengthening of Soft Foundation Soils*** - A new project, conducted over the past summer, addresses the use of PVDs for drainage (as customary) plus tensile reinforcement (never recognized to date). The experimental device was developed and used to assess three different PVDs. This data was then used with the ReSSA soil stability code on an old foundation soil failure that did not have PVDs. The FS-values increased 4% and could go

higher with closer spacing or stronger PVDs. A journal paper is available.

13. **Seams of Reinforced Geomembranes** - There are now five scrim reinforced geomembranes available and the properties are listed in our GRI Specifications. To compliment these sheet products a set of shear and peel tests are have been evaluated. A new specification designated GRI-GM19(b) has been developed... GRI-GM19(a) is presently solely for homogeneous geomembranes.
14. **Methods of Testing Multi-Component Geomembranes** - Co-Extruded geomembranes are becoming commonplace, e.g., white-black-conductive types. As such, testing (e.g., density, OIT, SCR, etc.) is problematic. Our most recent White Paper (#36) summarizes the study and is available at www.geosynthetic-institute/whitepapers.htm.
15. **Generic Specifications** - A major continuing effort is ongoing with respect to the development and updating of GRI's generic geosynthetic specifications. The current status of these specifications is as follows. Incidentally, all 17 are currently presently copyrighted.

Completed and Available on our Website

- GM13 – HDPE Geomembranes
- GM17 – LLDPE Geomembranes
- GM18 – fPP and fPP-R Geomembranes
- GM19a – Geomembrane Seams-Homogeneous
- GM19b – Geomembrane Seams-Fabric Reinforced
- GM21 – EPDM and EPDM-R Geomembranes
- GM22 – Scrim Reinforced PE Barriers
- GM25 – LLDPE-R Geomembranes
- GM28 – CSPE-R Geomembranes
- GM30 – Coated Tape PE Barriers
- GCL3 – Geosynthetic Clay Liners
- GS15 – Geocells using HDPE Strips
- GT10 – Geotextile Tubes
- GT12 (a and b) – Geotextile Cushions
- GT13 (a and b) – Geotextile Separators
- GCL3 – Geosynthetic Clay Liners
- GC14 – Turf Reinforcement Mats
- GC16 – Prefabricated Vertical Drains

Working; Available Upon Request

- GGXX – Bidirectional Geogrids (tabled)
 - GGXX – Unidirectional Geogrids (tabled)
 - GNXX – Geonet Drainage Composites (tabled)
- The complete set of formalized specifications are available to everyone (members and nonmembers) on the open section of our Home Page. Please download and use them accordingly. There is a brief tutorial accompanying each specification. Also note that this is where the latest modification will always be available. They are updated/modified on an as-required basis.

16. **Guides and Practices** - GSI also develops standard guides and practices and these are

available free on our website. There are 11 guides and 6 practices. They are modified on a regular basis demand and the latest version is updated regularly.

17. **Test Methods** - Since 1987 when we published our first test method on geogrid junction strength until the present we have developed 25 test methods which are still current.

2 - geotextile	2 - GCL
1 - geonet	11 - geocomposite
4 - geomembrane	5 - geosynthetics

Additionally, 31 have been co-opted by ASTM and we have depreciated our version. Incidentally, our test methods are for members only and are in the password protected portion of our website.

18. **Other GRI Standards** - There are several GRI Standards in various forms of preparation. These include the following:

- A practice on field seaming inspection emphasizing the electrical leak location system (ELLS).
- Three standards on GCL joining so as to prevent/monitor panel separation.
- A standard on GN joining with plastic cable ties... see Item #8.
- A guide as to recommended testing of drainage geocomposites.
- A practice explaining the use of MARV for geotextiles
- A transverse rib bending test for homogeneous geogrids

Progress within GII (Information)

Our GSI Home Page is accessed as follows:

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

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

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

To go further one needs a members-only password. Your contact person (see the last section of this Newsletter/Report if you do not know who it is) must get a password from Marilyn Ashley. Marilyn can be reached by e-mail at mvashley@verizon.net. When you

get into this section, the following information is available. This includes:

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

The Keywords Section contains about 35,000 citations which is the majority of the geosynthetics literature published in English. It is updated as each published paper is received. Citation retrieval is quite easy provided that you have a specific topic, or area, in mind. This is the section of the website that we (and others we are told) use the most in our daily activities.

Important Note: This keyword search is now available to everyone. It is on the open section of our website, however, there is a charge to non-GSI members, (www.geosynthetic-institute.org/keywordpay.html). The duplicate information is in the password protected section and is free for GSI members.

In addition to the information provided in our home page as just mentioned, Jamie Koerner (Special Projects Coordinator) performs various surveys on pertinent topics in geosynthetics. The latest is a survey on waste containment procedures from a state regulators perspective. It will be a White Paper shortly. Also, if you have topics in need of the current status please advise accordingly.

Progress within GEI (Education)

GRI Reports

To date, we have 45 GRI Reports available to members and associate members. These reports vary in length from 30 to 200 pages and beginning with Report #25 they are on the password protected section of our home page. Prior to that date only the abstract is available online. All of them, however, are available in hard copy. Our most recent report is:

- #46 - Utilizing PVDs to Provide Shear Strength to Saturated Fine-Grained Foundation Soils

GSI Webinars (90 minutes long)

11:30 AM – 1:00 PM (Eastern Time Zone)

Registration at

www.geosynthetic-institute.org/webinar.htm

1.5 Professional Development Hours

Nonmembers Cost - \$250; Members Cost - \$200

Commentary on Webinars: Never in Bob K's long career has he "reached out" to so many people than when giving these webinars. For the single cost of \$250 or \$200 a feed is delivered over Adobe Connect

to the requested site. This can be anywhere, e.g., office, conference room, hotel room, auditorium or even sent to additional offices and sites. For example, NY-DEC had the feed going into their Albany auditorium and then into the 13-regions of New York State. Clearly, hundreds of participants were involved! *Dear readers we feel that on-line distance learning, aka, webinars, is the way to communicate information to masses of people in an inexpensive and time efficient manner. Indeed, the future of distance learning is here!* The remaining 2018 schedule of GSI Webinars is as follows:

Date	GSI No.	Title
March 14	W-9	Behavior and Analysis of Twenty Solid Waste Landfill Failures
March 28	W-11	Lateral and Vertical Expansions Over Old and Existing Landfills
April 11	W-6	Geosynthetic Applications Used in Heap Leach Mining
April 25	W-12	Landfill Covers: Past-Present-Emerging
May 9	W-14	Lifetime Predictions of Covered and Exposed Geosynthetics
May 23	W-24	Geotextile Filters; Concerns and Issues
June 13	W-15	In-Situ Stabilization of Soil Slopes Using Nailed (or Anchored) Geosynthetics
July 11	W-21	A Brief Overview of Geosynthetics and Their Major Applications
August 15	W-16	Sand Drains-to-Wick Drains-to-Sand-Columns (Including a Major Failure Case History)
September 12	W-17	Geosynthetics in Erosion Control
October 10	W-1	A Data Base and Analysis of 301 Failed MSE Walls With Geosynthetic Reinforcement
October 24	W-25	Disposal of Coal Combustion Residuals (CCRs)
November 14	W-26	Soil Consolidation using Wick Drains, aka PVDs
November 28	W-27	Applications and Design of Geotextile Tubes
December 12	W-28	Stability Design of Landfill Cover Soils

Courses

We are now abandoning our in-house, one-day, courses (which have been given for the past 30-years) and delivering two of them in six segments over three consecutive days, one each morning and then afternoon. They are the following:

1. Quality Assurance/Quality Control of Geosynthetic in Waste Containment Facilities (scheduled for May 30-June 1, 2018)
2. Construction Inspection of Mechanically Stabilized Earth (MSE) Walls, Berms and Slopes (scheduled to be announced)

The third and newest of these courses is an On-Line "Designing With Geosynthetics (DwG)" course. Please go to <http://www.geosynthetic-institute.org/courses.htm>

and scroll down to Course #3. Here you will see the requisite details. The course itself is completely coordinated with the 6th Edition of the DwG textbook. It consists of 1540 slides with \approx 18 hours of voice over; about one minute for each slide. See the special writeup in this Newsletter/Report.

Contact Jamie Koerner at jrkoerner@verizon.net if you want information and details.

GSI Fellowships

A major change over previous years has been quite successful again this past year. We now offer fellowships for masters and doctoral students. The stipend is \$5000 for a single year, rather than three multiple years. This change resulted in 20-proposals which were reviewed and graded by the GSI-BoD and ourselves. Eleven were accepted. The accepted proposals for the 2017-'18 A.Y. are as follows. Proposals for the 2018-'19 A.Y. are due on June 11, 2018. If a specific proposal is of interest please contact Jamie Koerner at jrkoerner@verizon.net.

No.	Name	University	Advisor	Topic
1-17	Cengiz, Cihan	TC Bogazici U Turkey	Erol Guler	Seismic behavior of soft clay foundations under embankments using geosynthetic encased columns
2-17	Dutta, Susom	U of Massachusetts - Lowell USA	Pradeep Kurup	Novel geotextiles for energy harvesting
3-17	Kermani, Behnud	Penn State USA	Ming Xiao	Numerical investigation on the effectiveness and durability of geotextiles against migration of subgrade soil to overlying granular layer in pavement systems
4-17	Lieske, Wolfgang	Ruhr-Universitat Bochum Germany	Tom Schanz	Polymer-modified bentonite for the application in geosynthetic Clay Liners (GCL)
5-17	Lin, Chuang	Missouri U of Science and Tech USA	Xiong Zhang	Analysis of wicking fabrics used to remove capillary water in road embankments
6-17	Morsy, Mohamed	Queen's University Canada	Kerry Rowe	Selection of a realistic and representative stress crack resistance for use in design
7-17	Robey, Nicole	U of Florida USA	Tim Townsend	Landfill EGS wind uplift research: complementary field and wind tunnel assessments
8-17	Vahidi, Siavash	Drexel University USA	Grace Hsuan	Evaluation of wrinkle induced strains in geomembranes using a finite element method (FEM)
9-17	Valente, Rodrigo Borela	Georgia Inst. of Technology USA	David Frost	Numerical modeling of aggregate-geogrid composite behavior for multiaxial geogrids in pavement applications
10-17	Wang, Dongfang	U of Massachusetts Amherst USA	Guoping Zhang	Enhancement of geosynthetics with ultra-hydrophobic and long-lasting organogeopolymers
11-17	Williams, Thomas	U of Virginia USA	Craig Benson	Protecting geosynthetic in liner systems from atmospheric exposure by utilizing a surcharge layer

Activities within GAI (Accreditation)

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

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

There have been significant additions to the number of GAI-LAP tests. Presently, there are 252 GAI-LAP test methods available for accreditation. Please consult our home page for a current listing.

As of March, 2018, 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. (155 tests)
Jarrett Nelson -- (512) 263-2101
jnelson@tri-env.com
- 3^A - Golder Associates (43 tests)
Henry Mock -- (770) 492-8280
Henry_Mock@golder.com
- 4^C - Geosynthetic Institute (109 tests)
George Koerner -- (610) 522-8440
gkoerner@dca.net
- 8^B - Propex Operating Co., Ringgold (11 tests)
Todd Nichols -- 438-553-3757
todd.nichols@propexglobal.com
- 9^B - Lumite (16 tests)
Rebecca Kurek -- (770) 869-1187
rkurek@lumiteco.com
- 13^A - Precision Geosynthetic Labs (TRI Env.) (86 tests)
Cora Queja -- (714) 520-9631
cqueja@tri-env.com
- 14^A - Geotechnics (51 tests)
J. P. Kline -- (412) 823-7600
JPKline@geotechnics.net
- 20^A - GeoTesting Express, MA (60 tests)
Gary Torosian -- (978) 635-0424
gtt@geotesting.com
- 22^B - CETCO Hoffman Estates (11 tests)
Barbara Gebka -- (847) 851-1500
barbara.gebka@cetco.com
- 24^B - CETCO Lovell (10 tests)
Stuart Yates -- (307) 548-6521
stuart.yates@colloid.com

- 25^B - Ten Cate, Pendergrass (13 tests)
Darrell Scoggins -- (706) 693-2226
d.scoggins@tencate.com
- 26^B - Agru America Inc. (27 tests)
Maria Coffey -- (843) 325-6119
mcoffey@AgruAmerica.com
- 29^E - FITI Testing and Research Institute (84 tests)
Dong Whan Kim -- 82-2-3299-8071
dwhKim@fitiglobal.com
- 31^D - NYS Dept. of Transportation (9 tests)
Tom Burnett -- (518) 457-4704
tburnett@dot.ny.gov
- 32^A - Geo-Logic Inc. (6 tests)
Ken Criley -- (530) 272-2448
kcriley@geo-logic.com
- 34^B - GSE Environmental Richey Road (29 tests)
Debra Gortemiller
Dgortemiller@gseworld.com
- 38^C - Sageos/CTT Group (123 tests)
Eric Blond -- (450) 771-4608
eblond@GCTTG.com
- 40^B - GSE Environmental (14 tests)
Mauricio Osso -- (843) 382-4603
Mosso@gseworld.com
- 41^A - SGI Testing Service, LLC (18 tests)
Zehong Yuan -- (770) 931-8222
ZYuan@interactionspecialists.com
- 42^C - NPUST (GSI-Taiwan) (71 tests)
Chiwan Wayne Hsieh -- 011-886-8-7740468
CWH@mail.npust.edu.tw
- 43^A - Ardaman & Associates (22 tests)
George DeStafano -- (407) 855-3860
gdestafano@ardaman.com
- 44^B - Fiberweb, a Berry Global Inc. Co. (9 tests)
Mitchell Clendenin -- (615) 847-7193
mitchellclendenin@berryglobal.com
- 45^B - Ten Cate Geosynthetics Malaysia SDN Bhd. (24 tests)
Boon Kean Tan -- (603) 519 28576
b.k.tan@tencate.com
- 46^B - TAG Environmental Inc. (13 tests)
Colin Murphy -- (705) 725-1938
colin_murphy@tagenv.com
- 49^B - Engepol Geossinteticos (15 tests)
Patricia Ferreira -- (55) 51 3303-3901
patricia@engepol.com
- 50^B - ADS, Inc. Hamilton (7 tests)
Terry McElfresh -- (513) 896-2065
terry.mcelfresh@ads-pipe.com
- 51^B - Solmax International Inc. (22 tests)
Simon Gilbert St. Pierre -- (450) 929-1234
simonGSP@solmax.com
- 53^B - Polytex Autofagasta (19 tests)
Maria Teresa Ortiz Lopez -- 011 55-2883308
mortiz@polytex.cl
- 55^B - Atarfil Geomembranes (21 tests)
Gabriel Martin Sevilla -- 34 958 439 200
gmartin@atarfil.com
- 56^B - Polytex Santiago (13 tests)
Maria Teresa Ortiz Lopez -- 011 56-2-677-1000
mortiz@polytex.cl
- 57^B - Ten Cate Cornelia (22 tests)
Melissa Medlin -- (706) 778-9794
m.medlin@tencate.com
- 58^B - Propex Operating Co. Hazelhurst (16 tests)
Victoria Shoupe -- (912) 375-5406
Victoria.Shoupe@propexglobal.com
- 59^B - Firestone (8 Tests)
Janie Simpson -- (864) 439-5641
SimpsonJanie@firestonebp.com
- 60^B - TDM Geosintéticos S.A. (14 tests)
Roberto Diaz -- 051-1-6300330
rdiaz@tdmgeosinteticos.com.pe
- 61^B - Raven Industries (18 tests)
Clint Boerhave -- (605) 335-0288
Clint.Boerhave@ravenind.com

- 62^B - Solmax International Asia (14 tests)
Pei Ching Teoh – (450) 929-1234
pcteoh@solmax.com
- 63^A - TRI Environmental, Inc.; DDRF (4 tests)
Jay Sprague -- (864) 346-3107
Jesprague@tri-env.com
- 64^B - Agru America (NV) (14 tests)
Ryan Steele -- (775) 835-8282
RSteele@AgruAmerica.com
- 65^C - Bombay Textile Research Assoc. (BTRA) (23 tests)
Riyaz Shaikh
(0) 022-25003551
btra@vsnl.com
- 66^B - Rowad International Geosynthetics Co. Ltd (13 tests)
Asad Ullah Khan -- +966-3-812-1360
asad@rowadplastic.com
- 68^B - Glen Raven Technical Fabrics LLC (4 tests)
Andrea Saurage -- (336) 229-5576
asaurage@glenraven.com
- 69^B - GSE Environmental (13 tests)
Siriporn Chayaporenleret – 6638-636638
Siriporn@gseworld.com
- 70^A - RSA Geo Lab LLC (47 tests)
Rasheed Ahmed – (908) 964-0786
geolab13@yahoo.com
- 71^B - Plasticos Agrícolas y Geomembranas S.A.C. (24 tests)
Manuel Constantino Olivares Espinoza –
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Cesar Augusto Arcila (669) 954-8202
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- 91^B - Techfab (India) Industries Ltd. - Rakholi (3 tests)
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^AThird Party Independent ^CInstitute
^BManufacturers QC ^DGovernment

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

The next GAI-LAP semi-annual meeting will be held in June, 2018 in conjunction with ASTM D-35 in Sa Diego, CA. It is a pleasure working with you. We appreciate your participation and congratulate you on your success! If you have questions, please contact me accordingly.

The semi-annual GAI-LAP meeting was held in New Orleans Louisiana U.S.A., in conjunction with ASTM D35, on January 25th 2018. Twenty-two people were in attendance at this meeting which was held from 7 to 8 AM before Task Group meetings began. This attendance represents 29% of the 76 active GAI-LAP labs. We are grateful that ASTM allowed us the venue. I also want to thank all that were in attendance for their time and effort.

The activities at the meeting were as follows. A brief introduction and background of the GAI-LAP program was discussed. Please note that we are in our 23rd year of operation. The program started in 1995. We accredit only geosynthetic labs and model the program after ISO 17025. On-site audits are conducted every five years and proficiency tests every year with a goal of the coefficient of variation less than five for each test.

The demographics of the current GAI-LAP labs are summarized as follows: 20 independent labs, 51 manufacturer QC labs, and 5 centers (research or government) for 76 total. 38 of these labs are GSI members and 20 are international labs from 18 different countries. It appears that this program is gaining traction internationally. There are 247 possible tests for accreditation (185 ASTM, 1 FTM, 8 GRI, and 53 ISO). The number of accredited tests per lab varies greatly, e.g., from 4 min.-27 ave.-128 max.

There has been a rapid rise of new test methods. New tests added appear to be outside the ASTM D35 arena. The international arm of testing is very strong. We particularly see this in Europe, South America and Asia. Proficiency testing is still the hallmark of GAI-LAP. Of the 4112 proficiency test results submitted this year, only 21 first submittals were outliers representing 0.5% of the total. All outliers were resolved. Results of the proficiency tests were shared at the meeting and also distributed electronic via e-mail and CD. Congratulations to the GAI-LAP members on a job well done. Several other certification and accreditation programs around the world are now requiring proficiency test data per ISO 17025. All GAI-LAP labs easily comply with this requirement. It should be noted that going forward ISO 17025-17 will be followed. It has been twelve years since this norm has been revised. Changes to the document are as follows; impartiality via ISO 17011 is emphasized, complaint/feedback mechanism must be in place to assure that the client's needs are being met, validation/verification per IRMs is mandatory for all accredited tests, interlaboratory and intralaboratory comparison by way of proficiency testing are required on a regular basis, and there is renewed effort in regard to sustainability of power, resources and space within the lab.

The GSI is embarking on a new "Laboratory Technician Certification" program. This effort was suggested by its Board of Advisers (BOA) and is being requested in many RFP's that cross our desk presently. This program will model itself after existing programs like the following; ASCP-ABB Medical, CCNA- IT computer and NICET- Soils. It is the institute's intent to have the program initiated by years end. There is much work to be done in preparing a standards and practice workbook/study guide and companion exam. We will probably be asking many for their help and insight in review these documents in the coming months prior to putting the program on-line.

There were 11 GAI-LAP on-site audits conducted in 2017. They were as follows; TDM, Peru, GeoMetric, Columbia, Tehmco, Chile, Tech Fab, India Daman, Tech Fab, India Rakholi, Tech Fab, India Khadoli, Garware Rope, India, AL Hoty Stanger, UAE, Mexichem (PAVCO), Columbia, Tensar, China and TUV SUD, Singapore. In total, 110 thousand miles were traveled to facilitate these audits. As per the five

year GAI-LAP audit calendar listing, the following laboratories are due for an on-site audit in 2018. We would like to schedule the audit for the Spring of 2018.

1. NYSDOT, Albany, NY (Geo. Koerner of GSI will audit in May or June of 2018)
2. GeoLogic, Grass Valley, CA (Geo. Koerner of GSI will audit in May or June of 2018)
3. SGI, Norcross, GA (Geo. Koerner of GSI will audit in May or June of 2018)
4. Engepol, Nortene, Brazil (to be audited by TRI-Environmental)
5. Raven, Sioux Falls, SD (to be audited by TRI-Environmental)
6. Solmax, Malaysia (to be audited by TRI-Environmental)
7. TRI DRRF, Greenville, SC (Geo. Koerner of GSI will audit in May or June of 2018)
8. PQA, Mexico (to be audited by TRI-Environmental)
9. Texel, Canada (to be audited by TRI-Environmental)
10. GSE, Germany (to be audited by TRI-Environmental)

Please note that this is the time to voice any concerns with "conflict of interest" with TRI-Environmental as your prospective auditor. GSI has again subcontracted TRI-Environmental to conduct six of the ten audits this year. We have the greatest confidence in TRI-Environmental. This is due to the admirable job of auditing that they have done for GAI-LAP over the past three years.

The GAI-LAP proficiency test program would not function without samples to test. In this regard we would like to thank the following organizations for their generous contribution of geosynthetics to this cause. TenCate Inc. for geotextiles and erosion control TRMs, GSE Lining Technology Inc. for geomembranes, NAUE for geogrids, CETCO for GCLs, ADS Inc. for plastic pipe and Maccaferri for geocomposites

The GAI-LAP Customer Survey was again sent out to all program participants and the findings were reviewed at the meeting. There was a 27% return. The following are results (5 best to 1 poorest) (a) Information exchange = 4.1, (b) Conflict resolution = 4.4, (c) Proficiency testing = 4.6, (d) Directory and internet = 3.7, Overall = 4.2 Overall results to date: 2016 (4.2), 2015 (4.3), 2014 (4.2), 2013 (4.2), 2012 (4.1), 2011 (4.1) 2010 (4.3), 2009 (4.4), 2008 (4.4), 2007 (3.9), 2006 (4.0), 2005 (4.0), 2004 (4.1), 2003 (4.1), 2002 (4.2) We feel that the program has had a very good year and look forward to expanding our outreach going forward.

As usual at these annual meetings we had a lively discussion regarding the conflict resolution cases addressed by the GAI-LAP this year. They are summarized below;

1. ASTM D4595, modulus calculation and preload
2. ASTM D6637-11, old standard with conflicting gauge length
3. ASTM D6364, 20 kPa (2.9 psi) preload
4. ASTM D5199, thickness and continuity EVOH
5. ASTM D4632 and D4533 waiting
6. ASTM D5321 DS, DAQ problem, bearing damage and strain hardening residual

The next GAI-LAP annual meeting will be held in June 2018 in conjunction with ASTM D-35 in San Diego, CA U.S.A. GAI is pleased to work with you in regards to laboratory accreditation. If you need additional information or have questions please contact me at Phone 610-522-8440 or email gsigeokoerner@gmail.com. Thank you for participating in the GAI-LAP. Current listing of all GAI-LAP pertinent information can be found on the GSI website www.geosynthetic-institute.org.

*George R. Koerner
Director*

Activities within GCI (Certification)

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

- Be recommended by a professional engineer who knows, and can attest to, at least six months of acceptable experience performing professional services within the specific application area.
- Submit a completed application and be approved by the Geosynthetic Certification Institute to take the exam.
- Must successfully pass a written examination (70% of the questions is the passing grade) proctored by GCI or a GCI designated organization and graded by the Geosynthetic Certification Institute to become a certified inspector or engineer.
- Must pay a one-time fee which covers a five-year period upon completion of the above items. The fee is \$500 for five-years of certification.

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

This program now in its twelfth year has been recommended, and in some cases required, by solid waste owners, state regulators, and design consultants for proper QA/QC in field installation of both geosynthetic materials and compacted clay liners. The statistics to date are as follows. The examination has been greatly revised attesting to the changes occurring over the past years.

Inspector Certification Test Results for Waste Containment Inspectors 2006 – 2017

Year	Geosynthetic Materials		Compacted Clay Liners	
	No. of people taking exam	No. of people failing exam	No. of people taking exam	No. of people failing exam
2006	141	5 (3%)	128	12 (9%)
2007	82	11 (13%)	73	12 (16%)
2008	95	25 (26%)	89	20 (22%)
2009	36	7 (19%)	36	2 (5%)
2010	59	12 (20%)	54	7 (13%)
2011	54	6 (11%)	53	3 (6%)
2012	34	5 (15%)	28	3 (11%)
2013	32	4 (12%)	30	1 (3%)
2014	45	1 (3%)	42	3 (7%)
2015	56	6 (11%)	51	6 (12%)
2016	36	3 (10%)	35	4 (14%)
2017	78	5 (6%)	66	3 (5%)
2018	5	0	4	0
TOTAL (to date)	753	90 (12%)	689	76 (11%)

The 5-year renewal periods for those having taken the exam before 2010 is ongoing and about 60% have renewed accordingly. This is felt to be encouraging from our perspective.

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

While a field inspector cannot require proper design or direct a contractor how to build a wall, flaws can be identified for possible design modification or mitigation action. Furthermore, and at minimum, construction practices can be observed and corrected if inadequate or improper.

The official launch of this inspection program was on December 1, 2011 with a course and the examination afterward. More recently a somewhat revised course on November 29, 2012 was presented. Presently, the corresponding course for this certification program has been transferred into a series of six presentations over a consecutive three-day period. Contact Jamie Koerner at jrkoerner@verizon.net for details and arrangements.

The status of the program is shown in the following table.

Inspector Certification Test Results for
MSE Walls and Berms Inspectors
(2011-2017)

Year	Course Location	MSE Wall And Berms	
		No. of People Taking the Exam	No. of People Failing the Exam
2011	GSI Course	7	0
2012	GSI Course	6	0
2013	GSI Course	2	0
2014	GSI Course	3	0
2015	GSI Course	4	0
2016	GSI On-Line Course	2	2
2017	GSI On-Line Course	0	0
TOTAL		24	0

Program #3 - Geosynthetic Designer Certification

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

- be a graduate of an accredited engineering program,
- have six-months geosynthetic designer experience,
- complete the application form,
- pay the \$500 fee for 5-years certification, and
- take a 45-question examination with \geq 70% passing.

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

The on-line courses for preparation of all three of these certification programs is available in a series of six-90 minute webinars. Contact Jamie Koerner at jrkoerner@verizon.net for details and arrangements.

Lastly, please spread-the-word within your organization and to others as well. We sincerely hope that one, or all three, of the above programs will be beneficial in upgrading the technical base of geosynthetic design and installation so as to properly

utilize all of our geosynthetic materials in all of their many applications. All three programs are on-going and if you have questions and/or comments please contact us accordingly.

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The GSI Affiliated Institutes

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

GSI-Korea was formed on February 9, 1998 as a collaborative effort between FITI Testing and Research Institute (a quasi-government organization) and INHA University (through its Geosynthetics Research Laboratory). It is presently in the transition of being held entirely within INHA University.

INHA University is located in Incheon and the geosynthetics laboratory is led by Professor Han-Yong Jeon. Dr. Jeon has 10-students working on geosynthetic-related projects and is extremely active both nationally and internationally. His active participation at conferences worldwide is very admirable. He has provided research and development in many geosynthetic subjects including geotextiles, geomembranes, geocells, additives for GCLs, recycled plastics for improved formulations, etc.

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

GSI-India under the new direction of Dr. A. K. Mukhopadhyay (who succeeds Dr. A. N. Desai) was formed in 2015. The hosting organization is the Bombay Textile Research Association (BTRA) which is world known for its excellence in textile R & D and is currently branching out into all forms of geosynthetics. We are delighted in this regard and, as a side-note, Dr. Mukhopadhyay has replaced Dr. Desai on GSI's Board of Directors to fill out his term.

MSE Backfill Drainage Using Geocomposites

The 301 geosynthetically reinforced mechanically stabilized earth (MSE) wall failures that GSI has collected and evaluated over the past 18-years have been largely backfilled with fine-grained silt and clay soils, see Figure 1. This is obviously done for economic reasons (estimates are that use of such soils represents a 40%-70% wall cost saving versus using imported sand or gravel) and seems to be continuing at least in the private sector.

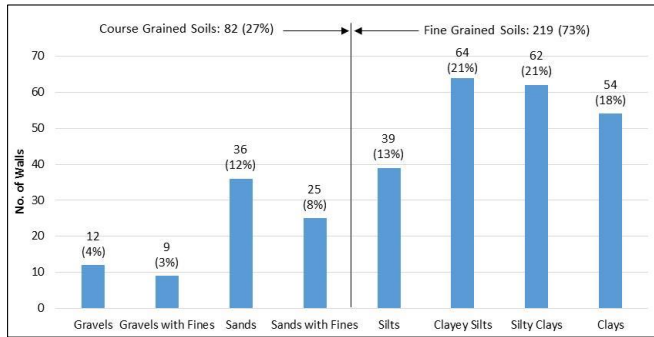


Figure 1. Backfill soils used in 301 (100%) MSW wall failures.

This situation being the case, a prudent designer has to assess where internal or external water is coming from and potentially interacting the facing. There are indeed many possibilities as listed below:

- | | |
|---|---|
| <p>Internal Water (111 Case Histories)</p> <ul style="list-style-type: none"> • drainage pipe leakage • catch basin leakage • pressure pipe breakage • perched water • saturated backfill | <p>External Water (80 Case Histories)</p> <ul style="list-style-type: none"> • retained soil seepage • tension crack pressure • surface infiltration • elevated phreatic surface • soil erosion at wall toe |
|---|---|

Upon making such an assessment, one could make the reinforcement sufficiently strong to resist the hydrostatic pressure or to remove the water so as not to induce such pressures against the wall or slope facing. The two choices for water removal are the following, which are shown in Figure 2.

- Intercept the water behind the reinforced soil zone and then exit it beneath the structure or at the wall ends
- Transmit the water through the reinforced soil zone to the front drainage zone and away from the toe of the structure

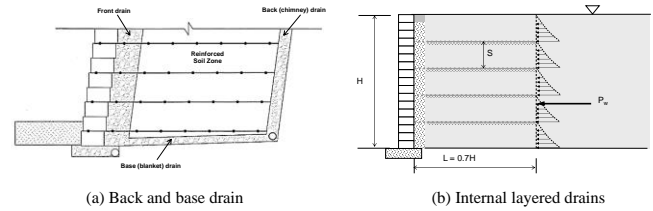


Figure 2. Alternative choices of removing layered water from reinforced soil zone of MSE walls.

That said, our GSI writings and webinars have favored the former, but the latter is also a possible alternative, see reference list. It requires layers of geosynthetic drainage materials which can be juxtaposed onto the reinforced layers or be separate in and of themselves, albeit in layers. Various geosynthetic drainage materials in this regard are needle punched nonwoven geotextiles (NP-NW-GTs), prefabricated vertical drains (PVDs), small diameter perforated drainage pipes, or specially manufactured geogrids with internal drainage capability. See Figure 3 for various commercially available products.

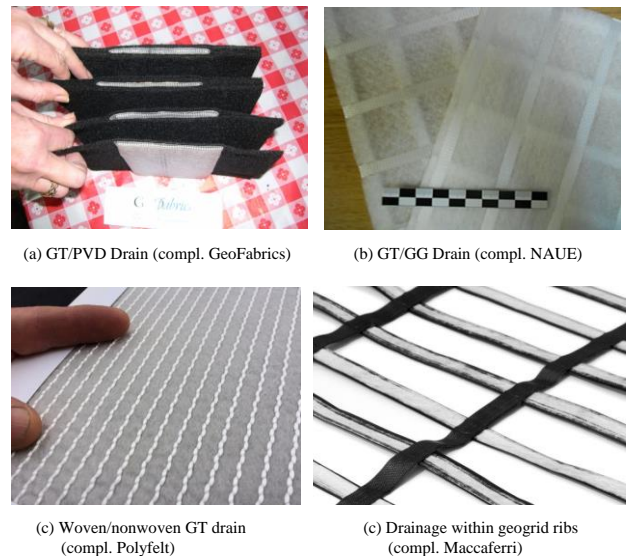


Figure 3. Drainage composite options for MSE walls and slopes... there are others.

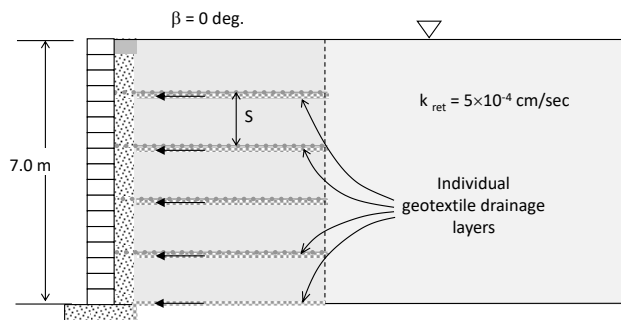
The next challenge to any wall drainage scheme is to calculate or estimate the amount of water to be drained and for its duration. As noted in the ten bulleted items of water sources, these are critical and most difficult decisions.

A dissertation by C. W. Kim in 2001 provided an interesting theoretical design for internal layered

drainage using the finite different method, which resulted in the required flow rate (or transmissivity) at each level of drainage. Comparing such values to the flow rates of different needle punched nonwoven geotextiles (250, 500, 1,000 g/m²) allowed for the calculation of flow rate factor-of-safety values, see Figure 4 for an illustrative example problem and resulting flow rate FS-values. A caution is necessary, however, in that this is clearly a worst-case situation of a continuously fully saturated backfill soil in the reinforced zone. In essence, this assumption was one of convenience since most of the listed water sources mentioned earlier are very unwieldy to estimate in a design scenario and are felt, for the most part, to be significantly lower than illustrated.

In summary, there are undoubtedly situations where internal drainage within the reinforced soil zone of MSE walls and slopes may be preferable to external back and base drains. The decision is obviously site-specific but the designer should be aware that both options certainly exist.

Example Internal Drainage Using Nonwoven Geotextiles attached to or separate from reinforcement GG's



Given: 1000 g/m² nonwoven GT with $q_{ult} = 4.0 \times 10^{-5} \text{ m}^3/\text{sec-m}$
 500 g/m² nonwoven GT with $q_{ult} = 2.0 \times 10^{-5} \text{ m}^3/\text{sec-m}$
 250 g/m² nonwoven GT with $q_{ult} = 1.0 \times 10^{-5} \text{ m}^3/\text{sec-m}$

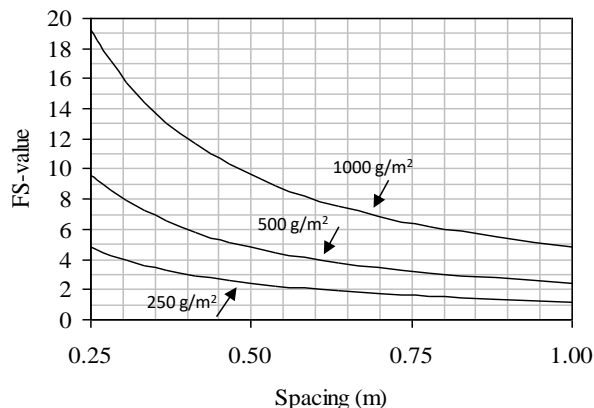


Figure 4. Flow rate FS-values for different NP-NW geotextiles, at various spacings under full saturation assumption, Kim, 2001.

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Bob and George Koerner

GSI's Member Organizations

We sincerely thank all of our sponsoring organizations. Without them, GSI simply could neither happen nor exist. The current GSI member organizations and their contact members are listed below. **Our newest members INOVA Geosynthetics/AERO Aggregates with Archie Filshill; Sotrafa Agrualura y Geosinteticos of Spain with Jose Miguel Munoz Gomez; Kaytech Fabrics Co. of South Africa with Garth James; Interwrap Inc. with Clive Mills/Martin Vido, Bourge Pte. Ltd. of Singapore with Mohamed Ali Jaber/Peter Malmros/Rick Cui, and Thrace Group with Steven Lothspeich/Stella Karavasili. Thanks to all and welcome to GSI!!!**

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