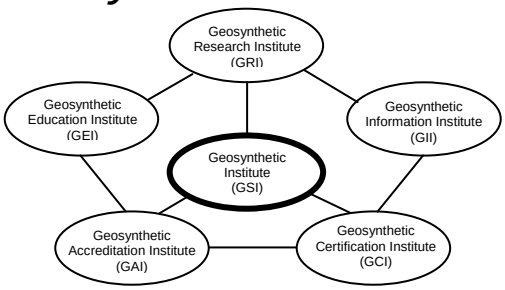
The GSI Newsletter/Report

Geosynthetic Institute



Vol. 23, No. 2 **June, 2009**

This quarterly newsletter, now in its 23rd 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 by phone (610) 522-8440; fax (610) 522-8441 or e-mail at robert.koerner@coe.drexel.edu or mvashley@verizon.net.

Activities of GSI's Director and your Board of Directors

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.**

1. The GSI Bylaws have been amended to include a "sole proprietorship" category which can be activated if, and when, we so decide. Presently we have no plans in this regard.
2. Membership is surprisingly good with four new organizations having been added since the last Newsletter/Report. Philadelphia Water Company (as an associate member), Afitex-Texel of Canada, manufacturers of geotextiles and drainage geosynthetics, EVAL Americas (Kuraray) manufacturers of low diffusion geomembranes and Plasticos Agricolas of Peru manufacturers of polyethylene geomembranes.
3. Flexible solar panels on exposed geomembrane covers are a "hot topic" presently. Republic's San Antonio landfill has sparked significant interest. We have a power point presentation for those interested and please advise if you want a copy.
4. GSI's next big event is coincident with ASTM in San Antonio on January 27-29, 2010. We are in the planning stage for focus group meetings. Also our Annual Meeting will be on the evening of January 28, 2010 after the ASTM task group meetings ends. The BoD meeting will be on January 29, 2010 after the conclusion of the Durability Workshop.
5. The ASTM/GRI Durability Workshop set for January 29, 2010 is soliciting extended abstracts presently. There is no formal paper required. Contact Sam Allen or George Koerner (or ASTM) for information and details.
6. Our initial webinar presentation to be hosted by ASCE is still being discussed. It seems we have two people at ASCE who differ in their opinions about the first presentation. One wants it to be introductory and the other on a specific topic???
7. Our revised GSI Website is still not ready for "prime-time". Marilyn, Jamie and Grace are all involved and hopefully in the next few weeks we will have it available.
8. Your Board of Directors is as follows. Do contact any of them with regard to GSI matters.

IN THIS ISSUE

Term Ends 2009
Tony Eith (Chairman) - Waste Management Inc. (Owners and Operators)
Boyd Ramsey - GSE Lining Technology, Inc. (Geotextiles and Geogrids)
Sam Allen - TRI/Environmental, Inc. (At-Large)
Term Ends 2010
David Jaros - Corps of Engineers (Government Agencies)
Paul Oliveira - Firestone bp Inc. (Resin Producers)
Kent von Maubeuge - NAUE GmbH & Co. KG (International-1)
Term Ends 2011
Dick Stulgis - GeoTesting Express (Consultants and Testing Laboratories) - Re-elected this year
Gary Kolbasuk - Raven (Geomembranes and GCLs) - Re-elected this year
Wayne Hsieh - GSI-Taiwan (International-2) - Newly-elected this year

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 either short "in-progress" papers or complete papers.*** Grace can be reached by phone at (610) 522-8440 or e-mail at <grace.hsuan@coe.drexel.edu>.

1. **Stress Cracking of Geomembranes and Geopipe*** - In addition to Grace Hsuan's ongoing evaluations of HDPE geomembranes, she is presently focusing on HDPE drainage and duct pipe mainly for the Florida DOT. The goal for both geomembranes and geopipe is to include technically viable test methods and limiting values for inclusion in generic specifications.
2. **Durability of Polypropylene Geotextile Fibers** - Incubation at temperatures of 75, 65 and 55°C in high oxygen pressure containers is ongoing using PP-woven geotextile fibers. This study periodically measures changes in density, dimensions, mass, morphology, strength, elongation, modulus, melt index, OIT and carbonyl content. Dr. Hsuan is in charge of the project.
3. **In-Situ Temperature Monitoring of Liner and Cover Geomembranes in Dry and Wet Landfills*** - Dr. George Koerner is measuring the in-situ temperature behavior of liner and cover geomembranes and has installed 60± thermocouples for long term measurements in both wet and dry municipal solid waste landfills in Pennsylvania. The project has been updated into its 14th-year and has been presented at the Global Waste Conference in September, 2008.
4. **Bioreactor (aka, Wet) Landfill Behavior and Properties*** - One of the landfill cells mentioned in Item 3 is at field capacity, hence it is a true anaerobic bioreactor. Dr. George Koerner is in charge of considerable monitoring at this cell which includes the following

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

   Data is being collected on a monthly basis. The timeline of the project calls for monitoring for 5 to 10 years. This activity will now extend to an adjacent landfill to see how reproducible the data is with a slightly different waste mass. It was also presented at the Global Waste Conference in September.
5. **Flow Behavior of Fully Degraded Waste*** - A field project under sponsorship of GSI and Waste Management investigates the drainage of highly degraded MSW placed directly on leachate collection systems. The leachate collection systems consist of both natural soils and geosynthetic drains. The project is now in its third year and is at a landfill in the Philadelphia area. We gave our third paper on the topic at the Global Waste Conference in September.
6. **Hydrostatic Creep Puncture of Geomembranes*** - This ten-year creep puncture project has just been dismantled and an analysis of the findings has been concluded. A short version is available as GSI White Paper #14 on our website and a complete paper has been submitted to the Journal of Geotextiles and Geomembranes for review and possible publication. Contact us if you are interested in the draft paper.
7. **UV Exposure of Geomembranes*** - GSI is using UV-fluorescent devices to evaluate the projected exposed lifetime of many different types of geomembranes. Presently being incubated are HDPE, LLDPE, 5 fPPs, PVC, EPDM, PE-R and LLDPE-R. Exposure times of 40,000 light hours are now realized at 70°C and a replicate set of samples are now being incubated at 60°C. These will take at least 60,000 light hours (> 8-years). The third sequence will be at 80°C.
8. **UV Exposure of Geogrids** - The UV-fluorescent exposure of four different biaxial geogrids which are used at the exposed surfaces of welded wire mesh retaining walls is ongoing. The geogrids are now up to 18,000 light hours and data is being generated and sent to the respective

manufacturers. As with the geomembranes, replicate samples will now be incubated at 60°C for eventual use in Arrhenius Modeling and lifetime prediction. The last set will be at 80°C.

9. **UV Exposure of TRM Fibers** - We are also using UV-fluorescent exposure of several turf reinforcement mat fibers to assess their lifetime capabilities. Contact Bob Koerner if you have materials for inclusion into this effort.
10. **UV Exposure of Repair Tape** - We have found that a particular type of polyethylene repair tape has been successfully used to repair an exposed geomembrane at a Delaware landfill. After five-years it appears very durable. Original samples are being evaluated in one of our fluorescent tube weatherometers per ASTM D7238 at 70°C.
11. **Geomembrane Chalking** - With the reinstatement of the flexible polypropylene geomembrane specification, i.e., GRI-GM18, we are in need of a test method to assess the degree of geomembrane caulking. This type of degradation has been experienced on several exposed geomembrane sites and on laboratory weatherometer samples while being incubated.
12. **Geomembrane Flaking** - In addition to possible cracking and chalking of flexible polypropylene geomembranes, our first instance of thin flakes being removed from the geomembrane's surface is being investigated. More later.
13. **Generic Specifications** - A major effort is ongoing with respect to the development and maintenance of generic geosynthetic specifications. The current status of these specifications is as follows:

Completed and Regularly Updated

GM13 – HDPE Geomembranes
GM17 – LLDPE Geomembranes
GM18 – fPP and fPP-R Geomembranes
GM21 – EPDM Geomembranes
GM22 – Exposed Temporary Covers
GM19 – Geomembrane Seams
GT10 – Geotextile Tubes
GT12 – Geotextile Cushions
GT13 – Geotextile Separators
GCL3 – Geosynthetic Clay Liners

Working Within Focus Groups

GCXX – TRMs for Erosion Control
GTXX – High Strength Reinforcement Geotextiles
GMXX – LLDPE-R Geomembranes

Delayed or Off in the Distance

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

The complete specifications are available to everyone (members and nonmembers) on the open section of our Home Page. Please download and use them accordingly. Also note that this is where the latest modification will always be available.

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 GSI members and associate members 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)**
- **GSI Publications**
- **GRI Specs, Guides, White Papers**
- **GSI Fellowships and Projects**
- **Contact Us**
- **Laboratory Accreditation**
- **Answers to Your Questions**
- **Newsletter/Reports**
- **Geosynthetics Links**
- **GSI Annual Meeting**
- **GSI Focus Group Meeting**
- **GSI Short Courses**
- **Inspector Certification Exams**

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

The keywords section contains about 25,000 citations of all of the geosynthetics literature published in English. It's quite easy to use provided that you have a specific topic, or area, in mind. This is the section of the website that we (and others we are told) use the most in our various activities.

In addition to the home page just mentioned, Jamie Koerner (Special Projects Coordinator) is performing surveys of pertinent topics in geosynthetics. To date she has focused on the following; all of which are available.

- State adoption of AASHTO M288 geotextile specification (GRI Report #31)
- State liner and cover regulations for solid waste disposal (GRI Report #32)
- International liner and cover regulations for solid waste disposal (GRI Report #34)
- Allowable leachate head in landfill sumps (White Paper #13)
- Allowable leakage rates for waste ponds (White Paper #15)

Progress within GEI (Education)

Free CD

We sent a broadcast e-mail to everyone on February 25, 2008 stating that many power point presentations were available and would be sent upon request. About 20 persons replied asking for all of them. Therefore, we put all 63 presentations on a CD which was sent to all GSI contact persons. That said, we have many copies still available so do ask and we will mail it to you immediately. Topic areas are all types of geosynthetics, plus walls/slopes, landfills, specifications, and miscellaneous.

GRI Reports

To date, we have 37 GRI Reports available to members and associate members. These reports vary in length from 30 to 200 pages and beginning with Report #25 they are on the password protected section of our home page. Prior to that date only the abstract is available online. All of them, however, are available in hard copy. The most recent reports are as follows:

- #36 – Inadequate Performance of Geotextile Filters Under Different and Challenging Field Conditions
- #37 – Geosynthetic Supported Base Reinforcement Over Deep Foundations

Courses

We have scheduled the following sequence of courses:

- Monday, December 7, 2009 and Monday, March 22, 2010
  Geosynthetics Design in Waste Containment Systems
- Tuesday December 8, 2009 and Tuesday, March 23, 2010
  Quality Control/Quality Assurance of Geosynthetics

The above courses will be held at:

Geosynthetic Institute
475 Kedron Avenue
Folsom, PA 19033
(approx. 4.5 miles from Phila. International Airport)

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

Contact: Marilyn Ashley (mvashley@verizon.net)

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. In addition, the program uses the GSI lab as the reference test lab and operates it as an ISO 17011 enterprise. In short, this means that the GSI lab does not conduct outside conformance testing for a fee.

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. 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. There are currently 180 GAI-LAP methods available for accreditation. Please consult our home page for a current listing.

As of December, 2008, the following laboratories are accredited by the GAI-LAP for the number of test methods listed in parenthesis. Contact personnel and telephone numbers are also listed.

1[A] - TRI/Environmental Inc. (118 tests)
Sam Allen -- (512) 263-2101
3[A] - Golder Associates (44 tests)
Henry Mock -- (770) 492-8280
4[C] - Geosynthetic Institute (116 tests)
George Koerner -- (610) 522-8440
8[B] - Propex, Ringgold (19 tests)
Todd Nichols -- (800) 258-3121
9[B] - Lumite (10 tests)
Rebecca Page -- (770) 869-1700
11[A] - STS Consultants Ltd. (13 tests)
Bill Quinn -- (847) 279-2500
13[A] - Precision Laboratories, CA (95 tests)
Ron Belanger -- (714) 520-9631

14[A] - Geotechnics (61 tests)
J. P. Kline -- (412) 823-7600
19[A] - HTS Inc. (42 tests)
Larry McMichael -- (713) 692-8373
20[A] - GeoTesting Express, MA (46 tests)
Gary Torosian -- (978) 635-0424
22[B] - CETCO Hoffman Estates (13 tests)
Jim Olsta -- (847) 392-5800
23[B] - CETCO Cartersville (10 tests)
Sid Weiser -- (706) 337-5316
24[B] - CETCO Lovell (10 tests)
Roger Wilkerson -- (307) 548-6521
25[B] - Ten Cate, Pendergrass (11 tests)
Beth Wilbanks -- (706) 693-2226
26[B] - Agru America Inc. (17 tests)
Grant Palmer -- (843) 546-0600
29[C] - FITI Testing & Research Institute (70 tests)
Moon-Hyun Jeong -- (011-82-2-960-8034)
31[D] - NYS Dept. of Transportation (9 tests)
John Remmers -- (518) 457-4704
32[A] - Vector Engineering (6 tests)
Ken Criley -- (530) 272-2448
34[B] - GSE Richey Road (28 tests)
Jane Allen -- (281) 230-6726
37[B] - GSE Chile (21 tests)
Mauricio Ossa -- 56-2 6010153
38[C] - Sageos/CTT Group (82 tests)
Eric Blond -- (450) 771-4608
40[B] - GSE Lining Technology Inc. (17 tests)
Vicky Parrott -- (843) 382-4603
41[A] - SGI Testing Service, LLC (19 tests)
Zehong Yuan -- (770) 931-8222
42[C] - NPUST (GSI-Taiwan) (49 tests)
Chiwan Wayne Hsieh -- 011-886-8-7740468
43[A] - Ardaman & Associates (18 tests)
George DeStafano -- (407) 855-3860
44[B] - BBA Fiber Web, Inc. (9 tests)
Ken McLain -- (615) 847-7575
45[B] - Ten Cate Malaysia SDN Bhd. (23 tests)
C. P. Ng -- (603) 519 28568
46[B] - Bentofix Technologies (13 tests)
Colin Murphy -- (705) 725-1938
47[A] - Precision Laboratories, TX (13 tests)
Mike Bishop -- (866) 522-0843
48[B] - Tenax Corporation (9 tests)
Andrew Barker -- (410) 522-7000
49[B] - Engepol Geossinteticos (20 tests)
George Nastas -- (55) 11-4166 3001
50[B] - ADS, Inc. Hamilton (7 tests)
Terry McElfresh -- (513) 896-2065
51[B] - Solmax International Inc. (17 tests)
Guy Elie -- (450) 929-1234
53[B] - Polytex Inquique (13 tests)
Cristian Valdebenito -- 011 56 57 42 90 00
54[B] - ADS, Inc. Finley (9 tests)
David Gonso -- (419) 424-8377
55[B] - Atarfil Geomembranes (20 tests)
Isabel Merida Fernandez -- 34 958 439 278
56[B] - Polytex Santiago (11 Tests)
Jamie Morales -- 56-2-627-2054
57[B] - Ten Cate Cornelia (15 Tests)
Melissa Medlin -- (706) 778-9794
58[B] - Propex Nashville (9 Tests)
Tim Smith -- (229) 686-5511
59[B] - Firestone (9 Tests)
Janie Simpson -- (864) 439-5641
60[B] - Polytex Lima (11 Tests)
Elias Jarufe – 51-16169393

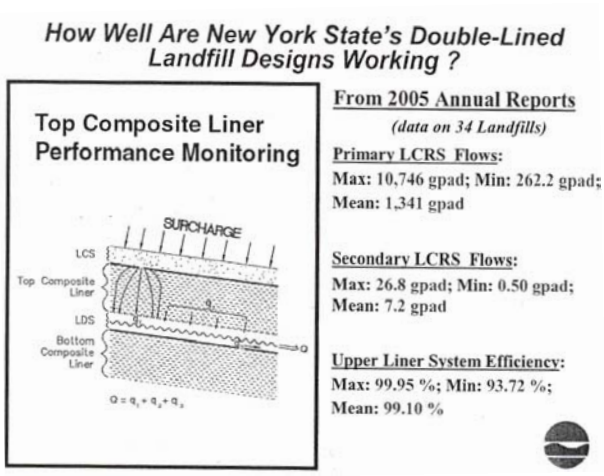
[A]Third Party Independent [C]Institute
[B]Manufacturers QC [D]Government

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

George R. Koerner, Ph.D., P.E., CQA
Geosynthetic Institute
475 Kedron Avenue
Folsom, PA 19033-1208
Telephone: (610) 522-8440
Fax: (610) 522-8441
E-mail: gkoerner@dca.net

Recently we have been asked by several GSI and GAI-LAP members where we see the testing business going forward. Since GSI is the reference test lab for the GAI-LAP (an ISO 17011 not an ISO 17025 type laboratory) we are rather immune to the seasonal variation in the testing business experienced by many third party labs. However, we are fully involved with the GS community and this is what we have heard.

- GS's are use in environmental, geotechnical, transportation and hydraulic applications. As the data below from NY DEC (Robert Phaneuf) shows, liner system: two composite liners (GM/GCL & GM/CCL) with low hydraulic heads work very well. Components of these systems are also the most tested GS's in our industry.



These low leakage rates are obtained by using a system's approach to the overall challenge of protecting the environment. It involves using

- Optimum materials: via HDPE via GM13
- Accredited testing laboratories via the GAI-LAP
- Best Available Installation companies and personnel via CQC-IAGI
- Good and experienced Quality Assurance inspectors via GCI-ICP, and
- LIS prior to commissioning the facility

As you can see, there is testing involved with four of the five bullet items above. Furthermore, we see a host of new opportunities on the horizon. Some may

consider these to be niche testing items, However, one or a combination of several might lead to profitability for a third party lab. The items are as follow;

1. The "Big Three" design tests. This is a way to service an engineering design department. The quintessential equation that defines an appropriate design is the factor of safety equation (1).

$$FS = \frac{\text{Test Property Value}}{\text{Design Required Value}} \qquad (1)$$

Its partner equation, the reduction factor equation, is used whenever the test does not exactly model field condition over the life of the facility.

$$\text{Test Allow Prop.} = \frac{\text{Test Property Value}}{\text{Reduction Factors}} \qquad (2)$$

The methods that are most often required on a case-by-case basis are wide width tensile, direct shear and transmissivity. One could exist by conducting these tests with their accompanying reduction factors. With the onslaught of new products and ever changing field conditions, this work is endless.

2. Accredited Field Lab. It strikes me as backwards when the shipping invoice for a project exceeds the testing charge. On a large project, one could set up an index field lab in an HVAC controlled field trailer for relatively little money. We have had several instances over the past two years where GS's were not verified prior to installation. Such tests on site such as thickness, mass per unit area, and tensile strength could save much time and effort if done quickly on site.

3. In the geomembrane business, Water Departments are getting fed up with exposed geomembranes that do not last. One is now commissioning a QUV device to expose their site specific geomembranes for 20,000 hours. If the GM does not last, the material is replaced by way of a prorated warrant. Since 2.5 years (rather than 7 to 12 years) have elapsed, the owner realizes the greater share of the rebate on the warrant.

In short, we see a great need for good quality GS's testing. The creativity and quality of the GAI-LAP labs are positioned nicely to fill these and other needs of the GS community as they arise.

The 15th annual meeting of the GAI-LAP will meet in Vancouver BC Canada on June 17th in conjunction with D35 committee week. The meeting will be on Wednesday evening at 7:00 PM. The room will be posted on the ASTM schedule of events and at the bulletin board at registration. Please plan to attend.

Regards and thank you for participating in the GAI-LAP.

George Koerner

Activities within GCI (Certification)

Due in part to the active interest by many GSI members and associate members we present a tabular summary of the Inspectors Certification Program as of November, 2008. The table following gives the pass/fail statistics by year as well as insight as to the impact of taking a course before the written examination. In looking at the data it appears as though we are not "teaching-the-exam".

Year	Course Situation	Geosynthetic Materials		Compacted Clay Liners	
		No. of people taking the exam	No. of people failing the exam	No. of people taking the exam	No. of people failing the exam
2006	GSI Course	34	0	27	5 (18%)
	Other Course	59	3 (5%)	57	4 (7%)
	No Course	48	2 (4%)	44	3 (7%)
	TOTAL	141	5 (3%)	128	12 (9%)
2007	GSI Course	46	9 (19%)	38	6 (16%)
	Other Course	18	2 (11%)	18	3 (16%)
	No Course	18	0	17	3 (17%)
	TOTAL	82	11 (13%)	73	12 (16%)
2008 (to date)	GSI Course	23	6 (26%)	20	4 (25%)
	Other Course	44	11 (25%)	43	11 (25%)
	No Course	23	6 (26%)	22	5 (23%)
	TOTAL	90	23 (25%)	85	20 (23%)
2006-2008 (to date)	GSI Course	103	15 (14%)	85	15 (17%)
	Other Course	121	16 (13%)	118	18 (15%)
	No Course	89	8 (9%)	83	11 (13%)
2006/'08	**TOTAL**	**313**	**39 (12%)**	**286**	**44 (15%)**

The GSI Affiliated Institutes

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

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

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

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

GSI-Taiwan was formed on August 18, 2000 and is wholly contained within the National Pingtung University of Science and Technology in Nei Pu, Pingtung (southern Taiwan). It completely parallels GSI in that it has specific units for research, education, information, accreditation and certification. The Director is Dr. Chiwan Wayne Hsieh who is a Professor in the Department of Civil Engineering and 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. GSI Taiwan has hosted two very successful conferences to date and has plans for another, followed by a broader conference for Southeast Asia.

GSI Fellowships

The first class of GSI Fellowships was granted in September 2008 for the academic year 2008-'09. The five student recipients are presently submitting their final reports. Announcements for "requests-for-proposals" for the second class have been published in several magazines. Several proposals have already been received. The basic criteria are as follows:

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

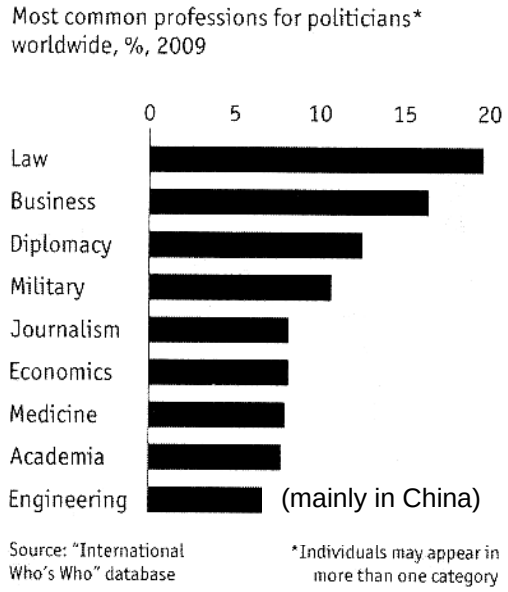
Further details are available on the GSI Website at www.geosynthetic-institute.org.

Items of Interest

1. Shift in Demand of Geomembranes

Aspect Environmental Lining Ltd., Frankton, New Zealand, has seen a decline in demand for decorative pond liners and agricultural manure basins; at the same time, lining installations for heavy construction work and landfill cells remain a strong business. Possible reasons for the demand shifts: in tough economic times, decorative ponds may be expendable, and bio-gas from manure is a possible source of energy recovery, so is managed differently. Meanwhile, waste disposal continues at landfills, both of residential and commercial garbage and ash from waste incinerators. In the U.S., phased regulations requiring better stormwater control during, and runoff management after, construction projects could continue to increase business in that sector.
(ref. ASTM Review, 6/9/09)

2. Most Common Professions for Worldwide Politicians



The presence of so many engineer-politicians in China goes hand in hand with a certain way of thinking. An engineer's job, at least in theory, is to ensure things work, that the bridge stays up or the dam holds. The process by which projects get built is usually secondary. That also seems true of Chinese politics, in which government often rides roughshod over critics. Engineers are supposed to focus on the long term; buildings have no merit if they will collapse after a few years. So it is understandable that an authoritarian country like China, where development is

the priority and spending on infrastructure is colossal, should push engineers to the top.
(ref. The Economist, 4/18/09)

3. Canada

Prime Minister Stephen Harper's government proposes to pour $7 billion into infrastructure as part of an economic stimulus package. Transportation Minister, John Baird, said $5 billion will be spent over two years on provincial and municipal projects that are ready to go, including roads, bridges and sewer systems. About $2 billion will go to repairs, maintenance and construction at colleges and universities, and $1 billion will be spent on green infrastructure.
(ref. Foundation Drilling, Feb. '09)

GMA's Techline and Its 2nd Five-Hundred Q & A's

Introduction

GMA's Techline was initiated on September 1, 2004 as being a free worldwide service to answer questions involving the many aspects of geosynthetic materials. From the outset there were no constraints placed on the questioner or their questions. GMA contracted with the Geosynthetic Institute for answers, and, here again, there were absolutely no constraints placed on the answers that were provided. These answers have been addressed to the best of our ability and have been provided generally by Bob Koerner with noble assists by Grace Hsuan (generally polymer related) and George Koerner (generally laboratory or field related). Jamie Koerner assisted in assembling the data and curves provided in this summary report.

Activity Level

Regarding the activity level, quarterly reports were provided to GMA with various selected Q & A's which very often appeared in IFAI's Geosynthetics Magazine. Most recently we have even had a few questions stemming from the answers that were provided in the magazine; in this regard a second generation set of questions. Shown in Figure 1 is the quarterly trend of good questions. By "good" we mean that solicitation-type questions and non-geosynthetic questions have been culled out of the totals being presented. The trend of Figure 1 clearly shows a slow growth until mid-2007, when the trend increased. A second inflection point occurred a year later with a sharply increased growth rate. Growth appears to be slowing of late, and currently we receive about forty good questions a month.

Information Regarding Questioners

Figure 2 indicates that the vast majority of questioners are from the USA; (about 65%) which is similar to the first set of 500 questions. Regarding the remaining 35%, they were spread around the world with Far East Asia being the most represented (~10%). Other sections of the world make up the remaining 25% of the questions.

Figure 3 presents the occupation of the questioner where designers and consultants are the majority with about 46%. Somewhat behind are manufacturers and their representatives with about 24%. It is interesting to note that regulators and government agencies are next, with faculty and students not far behind. Installer/contractors and owners are both at about 5%.

Analysis of Specific Questions

It can be seen in Figure 4 that geomembranes continue to be the type of geosynthetics that are most frequently questioned; about 35%. General questions on all geosynthetics, or on no specific type of geosynthetic, was next at about 24%, with geotextiles third at about 15%. For some unknown reason there were far fewer questions regarding geotextiles in this second group of 500 questions than in the first group. Geogrids had an increased number of questions, to about 11%, with GCL's, geonet/geocomposites, geo-others (e.g., geofoam, geofibers, geowebs), geopipe (a considerable increase) and geoerosion control materials (GECM) accounting for a combined 15%.

Figure 5 pertains to the category of questions asked. In almost equal percentages the most asked about categories were as follows:

- general information
- design and specifications
- lifetime
- installation

Design questions were extremely broad, some requiring far more time and space than could be provided. Sometimes such questions were (politely) answered by suggesting that the questioner should take a course or hire a geosynthetic expert consultant. The lifetime questions were also very broad; from the usual "how many years?", to effects of pH, chemicals, radioactivity, freeze/thaw, etc. Regarding installation questions, most were answered by opinion or by referencing to a technical paper or design procedure. Temperature (both hot and cold), placement, seaming, and backfilling questions were frequently asked. In such cases our answers were felt to be conservative and often did not satisfy the questioner who came back with follow-up questions. We generally went back-and-forth until one party or the other wore out!

This, of course, leads to the perceived difficulty level of the questions which were very arbitrarily put into five categories. See Figure 6, where "one" is the hardest and "five" is the easiest. In total, there were 12-ones (versus 14-ones in the first 500 questions). There is probably no relevance in this particular statistic. Following are the twelve most difficult questions (for us) and the answers we provided. We sincerely hope that we represented the industry appropriately in this regard as well as for the other 488 questions which were more "doable".

Summary

In closing, we hope to continue to report to GMA at 500 Q & A increments so as to observe trends and, in so doing, to track the technical-aspects of the industry in its totality.

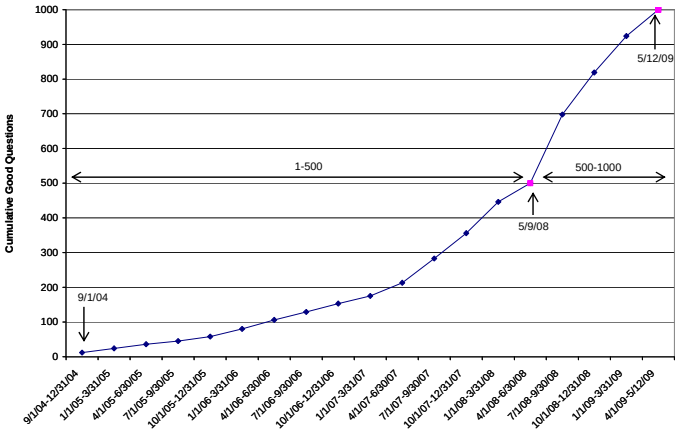


Figure 1 - Q&A Activity of GMA Techline Program

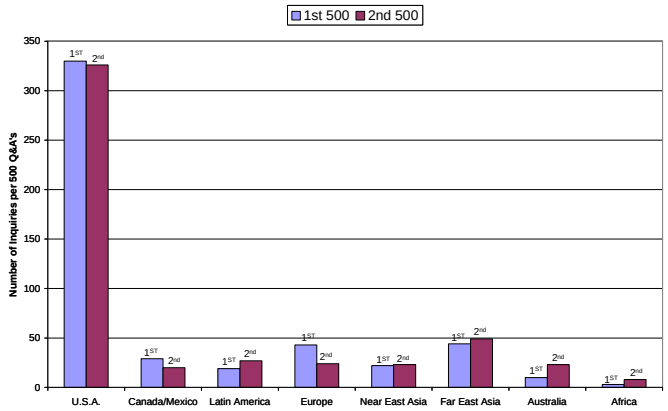


Figure 2 - Worldwide Location of Questioners
(Each bar represents 500 Q&A's)

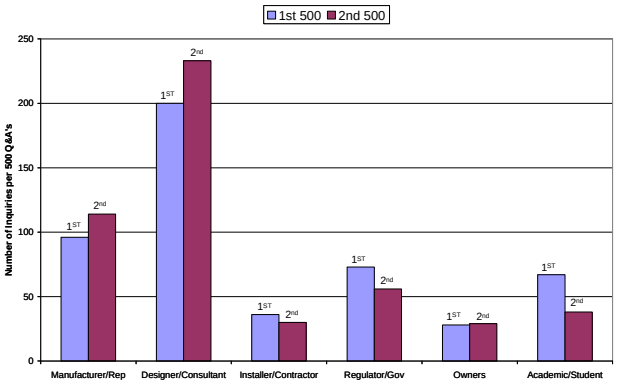


Figure 3 - Occupation of Questioners
(Each bar represents 500 Q&A's)

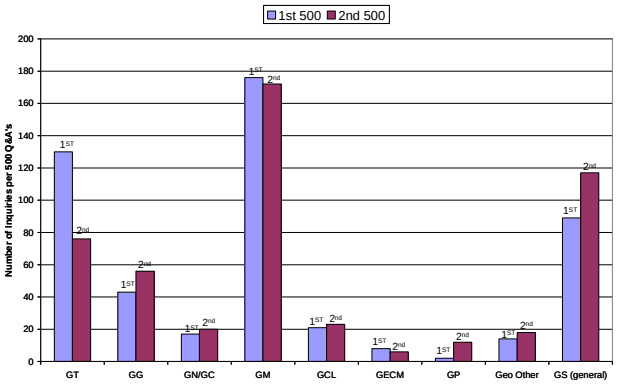


Figure 4 - Type of Geosynthetics Involved
(Each bar represents 500 Q&A's)

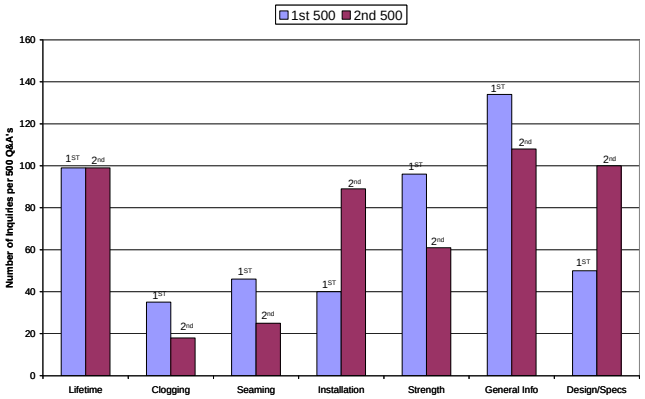


Figure 5 - General Category of Questions
(Each Bar represents 500 Q&A's)

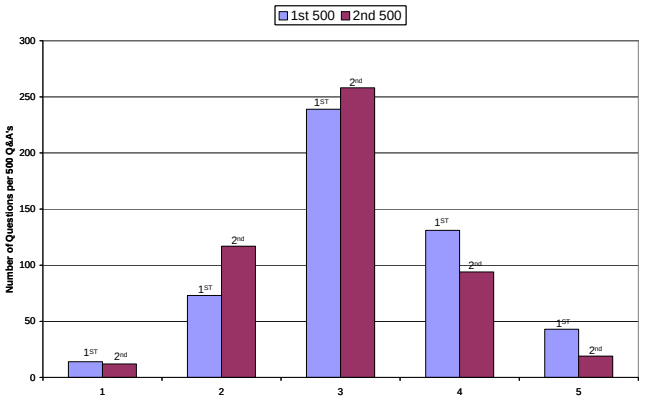


Figure 6 - Difficulty Level of Questions
(Each bar represents 500 Q&A's)

Question 1
What, if any, in-situ tests are available for GCL's. I am looking to avoid taking a sample and sending it to a lab. Any help is greatly appreciated. Thanks.

Answer
Dear XX, I never had that question before… Thanks… That said, I think that an adapted form of the Boutwell Permeameter test used in clay liners would be the likely candidate. It is generally used for CCLs but I really think it can be used for GCLs as well.

As it turns out, Gordon Boutwell and I went to graduate school together (don't ask how long ago) and you might want to contact him directly to see if he has ever done it on GCLs and, if not, get some pointers from him directly. His address is as follows:

Dr. Gordon P. Boutwell
Soil Testing Engineers, Inc.
316 Highlandia Drive
Baton Rouge, LA 70884
(222) 752-4790
Email: Boutwell@steofla.com

Thanks for asking.
[P.S. Our dear friend Gordon Boutwell passed away after this answer was provided.]

Question 2
Help! XX has a customer who is using a 22 ounce densely needled polypropylene nonwoven as a protective layer in a tunnel liner system. For the first time ever, we are being asked to provide flammability information on the nonwoven. The nonwoven is used to protect the membrane during installation and construction, and, of course to move water.

Do you know of a test method that would be appropriate in this application? We can perform both vertical and horizontal testing here, but have not found a method specific to geotextiles. Seems like an unnecessary requirement, but this particular customer is insisting on something… Thanks in advance for your help.

Answer
Dear XX, All GSs used in tunnel applications have to have their flammability characteristics available as well as the nature of the off-gas that are generated in the process of melting or burning. While the Geosynthetics Committee of ASTM does not have a specific D35 test method, ASTM does have several available test methods in the fabrics/protective clothing committee and possibly others. Right now I cannot get into the ASTM website for specific numbers but you might search under the appropriate topics.

I have copied this e-mail to Sam Allen who heads up Committee D35 and perhaps in the future an effort can be mobilized in this regard. For now, however, you will have to use what other ASTM or ISO Committees have on the books….Bob Koerner

Question 3
Hello, I have a technical question regarding the evaporation pan coefficient properties (k) for HDPE geomembranes.

I am designing an HDPE-lined evaporation pond, and have local evaporation data. I am unsure what pan coefficient (k) to multiply the evaporation data by. Typically for ponds on soil only, one scales down the evaporation data by a pan coefficient of 0.75 (nominal). However, on HDPE one would except the evaporation to actually increase, as the black material will heat up the water, particularly at shallow depths.

Any help in pointing me toward some information would be greatly appreciated! Thanks.

Answer
Hi XX, You ask a good question and, in truth, I don't know the answer and really don't even know where to look. That said, if you have angst over the black color of the HDPE geomembrane, use a white (or green or tan) one instead. The cost difference is very small and I am sure that the evaporation coefficient will be lower. How much so???
Best wishes, Bob Koerner

Question 4
I am looking for test studies that have been done on the use of geocells cellular confinement systems under concrete block pavements. Where or who could help me with this subject matter?

Answer
Dear XX, You ask a really neat question, which is how I often begin my response to questions that I don't know the answer to!!! I do understand your concern since concrete block pavements are invariably placed on smooth and uniform subgrades. If any post-installation settlement occurs one hopes that it will be uniform settlement. The discontinuous support created by the walls of HPDE geocells vis-à-vis their soil infill is troublesome to me as well as apparently it is to you.

I specifically mention HDPE walls of the geocells since you should know that there are some geocells made from more flexible LLDPE and, even better in this case, from geotextiles. The latter might be the best case scenario.

I know of no test studies or technical papers on your topic and don't recall ever seeing any manufacturers literature on the subject. I share your concern in this regard…. Bob Koerner

Question 5
My name is XX and I am studying bentonite properties. I am wondering, if a GCL can be applied for radioactive waste confinement? What I have read so far is a little bit confusing. Bentomats are not recommended for toxic and radioactive materials. Does it make a

difference regarding the thickness of bentonite layer in the GCL or chemical polymers which reduce flow? Bentonite used to be applied for the confinement of low and high level radioactive waste, but pH level is important. Then it can be used in cement and as a backfill for high radioactive levels. Does it relay to the GCL or to the different volumes of bentonite? Is there any precedents of application of bentonite for radioactive waste confinement recently? I would greatly appreciate if you would direct me to some sources and articles. Sincerely.

Answer
Dear XX, This is the first time I have had this question so thanks in this regard. That said, the bentonite clay particles, per se, should be quite resistant to any form of radioactivity since bentonite is a basic geologic material. However, in the format of GCL (a bentonite and water mixture) you have physical voids which may or may not retain the moisture content at 100% saturation. As a result, I would be hesitant in using a GCL as a radioactive material barrier.

To my knowledge there are no papers on the subject of GCL's vis-à-vis radioactive waste containment. You might contact the GCL manufacturers in this regard….. Bob Koerner

Question 6
What would be the most appropriate geo-liner to prevent vapors from elemental mercury within soil and concrete migrating to ambient air? The barrier must be durable and impermeable to mercury vapors over a significant time frame. We are also proposing to cap the liner with a 0.5-1m layer of silty clay material.

Answer
XX, the commercial liner with the lowest gas vapor transmission values is high density polyethylene. It also has the longest projected lifetime. That said, I doubt if anyone ever evaluated mercury vapors, but it is possible using the ASTM E96 standard. You could certainly commission a testing lab to do such work.

I have copied my colleague, Dr. Grace Hsuan, and she might have some thoughts on the matter…Bob Koerner.

Question 7
Canadian landfills apparently have not been allowed to use geocomposite drainage materials in lieu of two feet of gravel because they have to prove it will not clog for a period of up to 100 years. Have you studied this regarding the various geocomposites on the market or been to Canada to present your findings? Thanks for your help.

Answer
Thanks for your question. Back in 1985, the State of Pennsylvania felt uneasy about geonets as a leak detection layer in double lined landfills so we did a full scale experiment on a landfill cell measuring about 400m by 50m. It was double lined with a geonet between the primary and secondary geomembranes. Both geomembranes were 1.5 mm smooth HDPE. We injected a water truck load of water in the high end of the geonet and waited until it flowed to the outlet sump, measuring the time for all of the water to appear. We then repeated the experiment with successive layers of waste in the landfill cell. Each iteration took longer but all of the input water did appear. Of course, the waste load applying normal stress caused intrusion of the geomembranes into the void space of the geonet thus increasing the transmission times. It was a pretty neat set of tests. At any rate, it convinced the local regulators, and Pennsylvania has used geonets ever since.

Now… will that convince your Canadian regulators and does it address the 100-year clogging issue??? I doubt it but I do remember that Ottawa once had in its regs that the geomembrane had to last in "perpetuity". Things might change. They might even look into gravel clogging. I have seen several cases of gravel particles completely bonded together and called "biorock". It had zero transmissivity. I don't know if the above helps, but its Friday and it's after 5:00 PM and my wife is waiting on the back porch with a glass of white wine and I'll sign off accordingly… Bob Koerner

Question 8
Firstly, I apologize if I am contacting the wrong person. I believe you are one of the authors of the 1997 document "Final Covers for Solid Waste Landfills and Abandoned Dumps"?

If so, I am wondering if you might entertain a question regarding the water balance hand calculation methodology that the document contains.

I have been struggling to determine an accurate, and defensible, method of calculating a site water balance (generally for the purpose of determining infiltration rates) that uses real climate data instead of just "picking numbers out of a hat" for variables such as evapotranspiration and infiltration. I am studying land development, and either comparing pre-development to post-development infiltration of precipitation (to maintain recharge to groundwater); or, the impact of subsurface sewage disposal systems (which rely on infiltration of precipitation for dilution). Your methodology appears to be built on very solid concepts, and I have used it in a few reports. However, I noted what appears to be a "quirk" in the calculations:

Even in winter months when the ground is frozen, there can be high volumes of infiltration/percolation calculated.

Overall, I've found that when using the spreadsheet design from the 1997 document, calculated annual

EVT seems reasonably accurate, but Runoff is sometimes fairly low, and Infiltration is often higher than expected based on the soil types (especially for fine grained soils).

I recognize that this document is more than 10 years old, so it is possible that revisions have been made. I was just wondering if you have any thoughts, explanation, or comments that might help.

Answer
Thanks for the question and for reading the book. I think it is one of the better books on the subject, but the ASCE Book Store apparently did not. When we inquired about a 2nd Edition, ASCE said no and then they even discontinued the publication of this 1st Edition!!! That said, the water balance method is really Dave Daniel's procedure and while many have subsequently used it (particularly in place of EPA's HELP Model) I do not have an answer to your question.

I have copied Dave and perhaps he can respond to you in this regard. Sorry… Bob Koerner

Question 9
A landfill cap design calls for a 2-foot thick vegetative layer and soil cover, consisting of topsoil and non-calcareous quarry screenings, overlying drainage composite and 40-mil VLDPE. There is a concern that the cap geosynthetics may be susceptible to damage and penetration by burrowing animals into the underlying waste. Are there any documented instances of this taking place at landfill caps in North America? Does a cap design using PE geosynthetics need to consider this possibility and, if so, would you suggest any design guidance offering preventive measures?

Answer
You ask a common question which I will try to answer in several ways.

1. The only known situation of an animal clawing its way through a geomembrane that I know of was on a final cover where the animal was trapped beneath the geomembrane as it entered into its anchor trench. So as to escape the animal scratched the underside until it produced a hole of about 150 mm in diameter. The edges of the hole were serrated and very sharp on its underside; clearly a survival situation.
2. I am told that there is an old report by a German organization which concluded that the hardness of the animal's teeth versus the geomembrane type is critical. Sorry, but I don't have the report.
3. One way of preventing burrowing animals from getting to the geomembrane is to provide a "biobarrier" in the protection soil above it. This would consist of a layer of stones/rocks of sufficient size to prevent/discourage the animal from digging through it. Stone size and layer thickness are obviously important considerations.
4. There is no reason that the animals would consume the polymers since there is no nutrition in them. I once asked a biochemist to speak on the topic at one of our conferences and he essentially said "forget about it".

Question 10
My name is XX and I'm working with geosynthetic materials for almost eight years. A company, here in Brazil calls me and asked if I know how long they should stay with a piece of the sample for future tests. This company makes geogrids and nonwoven geotextiles.

Do you know where I can find this information?

Answer
You ask a question for which there is no standard answer. Let me give some examples. In the landfill business, owners in the USA are required to keep archived samples of all geosynthetics for 30-years. This is probably the upper limit. Typical materials warranties are for 20-years. I know of many CQA inspection firms who keep samples for seven-years (incidentally that is how long one must keep income tax information in America). At the lower limit, some private owners only keep samples for one year, which is the typical warranty time for installation.

So pick your number; 30, 20, 7 or 1… That's not a good answer but the best I can give….Bob Koerner

Question 11
I want to make a very low shrinkage industrial PET fibre (less than 2.5%). What is the main factor that influences the shrinkage? Is there any standard operating procedure (SOP) available?

Answer
Thanks for your question but it's beyond my polymer expertise. That said, my colleague, Dr. Grace is, and I have forwarded your question to her. RMK

Question 12
I'm trying to evaluate the feasibility of recycling an HDPE geomembrane exposed pond liner, which meets the GRI GM-13 standard for 60 mil thickness. I understand that the material requirements for new pond liners require virgin material, so it can't be reused for that application. I've called a couple of plastic processors who have never heard of plastic pond liner recycling, although the material itself is fully recyclable.

Therefore I was hoping to get your input on the potential for recycling this material given the noted application, and potential markets (if any) for reuse of the processed HDPE. One thing of note is that the pond liner being evaluated for recycling is subject to glycol, which is non-toxic, although its discharge is

limited at wastewater plants due to high biodegradable organic compound concentrations. The liner could be washed in place before its removal.

Thank you for your attention.

Answer
Thank you for your interesting question. Let me answer in two parts:

1. GRI GM13 requires virgin resin which can include up to 10% rework material of the same formulation. It does not allow any post-consumer resin (PCR) which is unfortunately your situation. The reason for no PCR is that the quality of the material cannot be assured. This concern is over impurities as well as the depletion of antioxidants during manufacturing and the unknown service life that was encountered.
2. For a noncritical and nonpermanent application, however, there might be a position for PCR. This is particularly the case since you know its history. If the glycol is thoroughly washed off, and additional AOs are added in the new formulation, I think your reuse can be considered. Lastly, you will have to work carefully with a manufacturer if you decide to go ahead.

Good luck, and if you do proceed let me know the outcome… Bob Koerner

Upcoming Events

- July 20-24, 2009
  U. S. Army Corps of Engineers
  Infrastructure Conference
  Cleveland, OH
  Contact: www.usaceiscconf.org/2009
- September 2-5, 2009
  GeoAfrica 2009
  Cape Town SA
  Contact: www.geosyntheticssociety.org
- November 2-4, 2009
  ASCE Geotechnical Conference
  Hershey, PA
  Contact: cbeenenga@gfnet.com
- November 10-11, 2009
  Geosynthetics in the Middle East
  Dubai, UAE
  Contact: www.geosyntheticssociety.org
- December 7-8, 2009
  GSI Courses on Design and QA/QC
  Folsom, PA
  Contact: mvashley@verizon.net
- January 27-29, 2010
  ASTM Committee D35
  San Antonio, TX
  Contact: csierk@astm.org
- January 28, 2009
  GSI Annual Meeting
  San Antonio, TX
  Contact: mvashley@verizon.net
- January 29, 2009
  GSI BoD Meeting
  San Antonio, TX
  Contact: mvashley@verizon.net
- March 22-23, 2010
  GSI Courses on Design and QA/QC
  Folsom, PA
  Contact: mvashley@verizon.net
- September 15-16, 2010
  GCL Conference
  Wurzburg, Germany
  Contact: robert.koerner@coe.drexel.edu

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 The Mannik Smith Group with John Browning and Frank Biehl as contact persons; Plasticos Agricolas y Geomembranes, S.A.C. of Peru with Marino Gomez Montoya as the contact person; Afitex-Texel with Pascal Sainier as contact person; and EVAL Americas (Kararay) with Robert Armstrong as contact person. The newest associate member organization is the Philadelphia Water Department with Vahe Hovsepian as the contact person. Thanks to all and welcome to GSI.

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In The Next Issue

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- Progress within GEI (Education)
- Activities within GAI (Accreditation)
- Activities within GCI (Certification)
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- The GSI Centers-of-Excellence
- Items of Interest
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