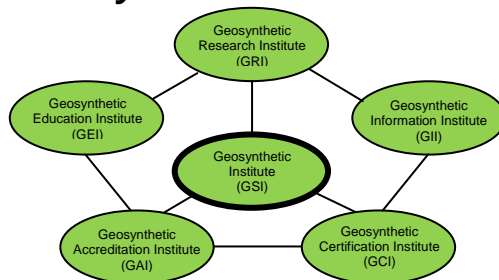


# The GSI Newsletter/Report

## Geosynthetic Institute



Vol. 28, No. 3

September, 2014

This quarterly newsletter, now in its 28<sup>th</sup> 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](http://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 [gkoerner@dca.net](mailto:gkoerner@dca.net) or [mvashley@verizon.net](mailto:mvashley@verizon.net).

## Activities of GSI's Directors and Officers

1. The inauguration of GSI-India was established on September 2, 2014 in Mumbai, India with Dr. George Koerner representing GSI and Dr. A. N. Desai representing the Bombay Textile Research Association (BTRA). As with GSI-Korea and GSI-Taiwan they will have available the complete set of information and knowledge of geosynthetics gained by us throughout our 28-year history. This includes accreditation and certification activities as well as research, education and information. We look forward toward a long and productive association; see more complete writeup on the associated "Global Geosynthetics Summit" in this Newsletter/Report.
2. The GSI-BoD reviewed fellowship proposals for academic year 2014-'15 and awarded three new proposals and one continuation. See the education section herein.
3. GSI Annual Meeting and GSI-BoD Meeting will be held in Berlin, Germany at the 10<sup>th</sup> IGS meeting on September 24, 2014. Contact George at [gkoerner@dca.net](mailto:gkoerner@dca.net) for details.
4. Webinars continue to be extremely active with ongoing efforts on behalf of GSI and ASCE. Contact Marilyn at [mvashley@verizon.net](mailto:mvashley@verizon.net) for a current listing.
5. The nine-person GSI Board of Directors is presently as follows:

### Term Ends 2014

- Mark Sieracke - Weaver Boos (Consultants and Testing Labs)  
e-mail: [msieracke@weaverboos.com](mailto:msieracke@weaverboos.com)

- Boyd Ramsey - GSE (Geomembranes and GCLs)  
email: [bramsey@gseworld.com](mailto:bramsey@gseworld.com)
- Wayne Hsieh - NPUST and GSI-Taiwan (International-2)  
e-mail: [cwh@mail.npust.edu.tw](mailto:cwh@mail.npust.edu.tw)

### Term Ends 2015

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

### Term Ends 2016

- A. N. Desai – BTRA & GSI-India (Agencies)  
e-mail: [atra@vsnl.com](mailto:atra@vsnl.com)
- Edgard Chow – Kuraray (Resin Producers)  
e-mail: [edgard.chow@kuraray.com](mailto:edgard.chow@kuraray.com)
- Kent von Maubeuge - NAUE GmbH & Co. KG (International-1)  
e-mail: [kvmaubeuge@naue.com](mailto:kvmaubeuge@naue.com)

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## Overview of GRI Projects (Research)

- 1. In-Situ Temperature Monitoring of Liner and Cover Geomembranes in Dry and Wet Landfills\*** - George Koerner is measuring the in-situ temperature behavior of liner and cover geomembranes and has installed 60± thermocouples for long term measurements in both wet and dry municipal solid waste landfills in Pennsylvania. The project has been extended into its 17<sup>th</sup>-year and has resulted in an extremely authoritative set of real-life data which is being used by many researchers in their geomembrane lifetime predictions. George will present a new paper in Berlin at the 10<sup>th</sup> IGS Conference.
- 2. Flow Behavior of Innovative Leachate Collection and Removal Systems (LCRS's)** – Several new geocomposite drainage systems are being compared to traditional geonet composites. The project is just now beginning and will be a multi-year effort. It is likely that a Standard Guide will be developed on this topic.
- 3. Flow Behavior of Fully Degraded Waste\*** - This is a field project on investigating the drainage of highly degraded MSW placed directly on leachate collection systems. The leachate collection materials consist of both natural soils and geosynthetic drains. The experimental setup has been dismantled and a second paper will be presented by George Koerner in Berlin at the 10<sup>th</sup> IGS Conference.
- 4. 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 two different geogrid's behavior over time. A 50-year time frame is envisioned. The long-term behavior will eventually be compared to UV laboratory exposed data as noted in Item #8 below.
- 5. Laboratory Exposed Lifetime of Geomembranes\*** - GSI is using three UV-fluorescent devices to estimate the projected exposed lifetime of many different types of geomembranes. Presently being incubated are HDPE, LLDPE, fPP, PVC (N.A.) and EPDM. Some of the products have exposure times of 70,000 light hours at 70°C and a replicate set of samples are being incubated at 60°C. Some will take at least 90,000 light hours (≈ 12.3 years). The third sequence at 80°C was started on 1/1/2010. They, of course, degrade much faster. Ongoing data is being reported to manufacturers and resin producers. GRI Report #42 is available on the 70°C data using a correlation coefficient to estimate field lifetime of the various geomembranes. In contrast, our GSI-8 Webinar gives preliminary data using the time-temperature superposition and Arrhenius modeling for improved field lifetime prediction.
- 6. 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 decade long study are change in thickness, presence of crazing and/or presence of cracking. Time will tell!
- 7. Laboratory Exposed Lifetime of PVC (European) Geomembranes** - Of late, we have been attempting to distinguish between PVC geomembranes manufactured in North America versus Europe. Of course, the difference is in the type of plasticizers and other additives used in the formulations. In this regard 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. (Note that the exposure and lifetime prediction of North American produced PVC GMs has been concluded).
- 8. Laboratory Exposed Lifetime of Geogrids** - The UV-fluorescent exposure of two different polypropylene biaxial geogrids which are used at the exposed faces of welded wire mesh MSE structures is ongoing. The various geogrids are now up to 40,000 light hours and data is being generated and sent to the respective manufacturers; Tensar and TenCate. Replicate samples are now being incubated at 60°C for eventual use in Arrhenius Modeling and lifetime prediction.
- 9. Laboratory Exposed Lifetime of TRM Fibers** - We are also using UV-fluorescent exposure of four different turf reinforcement mat fibers to assess their lifetime capabilities. They have been incubated at 60°C, 70°C and 80°C. A final report to the manufacturer (Propex) has just been submitted.
- 10. Laboratory Exposed Lifetime of Geotextiles** - We have completed a UV study on a heat-bonded nonwoven PP geotextile used for three dimensional cell structures which are exposed to the atmosphere. The results for the particular geotextile and its specific formulation at 20°C (68°F) average field temperature are 4.5 years for halflife of breaking strength and 4.1 years for halflife of breaking elongation. This study of other exposed geotextile lifetimes has been extended to include a lightweight needle-

punched nonwoven. Its lifetime, as expected, is much shorter. The third geotextile is a woven slit film and it is almost finished. A woven monofilament GT will conclude the series. Results will appear in about six months in a GSI Report.

11. **Laboratory Exposed Lifetime of Different Thickness Geotextiles** - The above six lifetime studies seem to engender new research efforts on a regular basis. We have been asked to evaluate the role of thickness (aka, mass per unit area) of needle punched nonwoven geotextiles. Presently, three are being evaluated which when added to the existing one will give data on 120, 200, 340 and 540 g/m<sup>2</sup> (3.5, 6.0, 10 and 16 oz/yd<sup>2</sup>) products.
12. **Retaining Wall Failure Evaluations\*** - We presently have 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, and now 244! *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. We have just recently presented the findings at two geotechnical conferences; one in Williamsburg and the other in Hershey. A paper was published by the Journal of Geotextiles and Geomembranes in October, 2013 and the publisher (Elsevier) reports that 700 requests have been made to date. Bob will present the information to the civil engineers of the National Academy of Engineering in October.
13. **pH Between Masonry Block Wall Units\*** - George Koerner has been measuring the pH between three types of masonry blocks for over six 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 are now down to eight and lower. George Koerner has a paper in this regard.
14. **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. The latest failure in this regard is in Easton, Pennsylvania. It is under investigation presently.
15. **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 reasonable for most geomembrane types, it is

very fast for HDPE which is semi-crystalline and cannot readily stress relax. 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 about five years to conclude. A paper will be presented at Geosynthetics '15 in Portland.

16. **Shrinkage of GCLs Under Wet/Dry Cycling** - George Koerner has been evaluating shrinkage of various GCLs in boxes on the overhead roof of GSI. The study is on behalf of CETCO and may be extended for other manufacturers.
17. **Temperature Behavior Under Different Geosynthetic Layers** - Since exposed lifetime of geosynthetics is influenced by sunlight the lifetime of layers directly beneath the uppermost one (heat only, but no sunlight) is of interest. George Koerner has set up such a scenario on behalf of Watershed Inc., a GSI member.
18. **Difficult Q & A's from the Techline** - As many of you know we service GMA's Techline on a daily basis. In so doing we categorize the questions on a five-point scale and have collected the most difficult ones of the 2500 Q & A's to date. These most difficult ones have formed GRI Report #43. We think it is most important in moving our technology forward and gives great insight as to potential future R & D for all of us.
19. **Generic Specifications** - A major continuing effort is ongoing with respect to the development and maintenance of GRI's generic geosynthetic specifications. The current status of these specifications is as follows:

Completed and Available on our Website

GM13 – HDPE Geomembranes  
GM17 – LLDPE Geomembranes  
GM18 – fPP and fPP-R Geomembranes  
GM21 – EPDM and EPDM-R Geomembranes  
GM22 – Exposed Temporary Covers  
GM25 – LLDPE-R Geomembranes  
GM19 – Geomembrane Seams  
GM28 – CSPE-R Geomembranes  
GT10 – Geotextile Tubes  
GT12 – Geotextile Cushions  
GT13 – Geotextile Separators  
GCL3 – Geosynthetic Clay Liners  
GS15 – Geocells

Working; Available Upon Request

GTXX – Turf Reinforcement Mats (tabled)  
GMXX – Coated Slit Film Geotextiles

Delayed; Available Upon Request

GGXX – Bidirectional Geogrids  
GGXX – Unidirectional Geogrids  
GNXX – Geonet Drainage Composites  
GCXX – Other Drainage Geocomposites  
GSXX – High Strength Reinforcement Geotextiles

The complete set of completed specifications are available to everyone (members and nonmembers) on the open section of our Home Page. Please download and use them accordingly. Also note that this is where the latest modification will always be available. There is a brief tutorial accompanying each specification. They will be updated shortly.

**20. 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 guide as to recommended testing of drainage geocomposites.
- A practice explaining the use of MARV for geotextiles

## 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](mailto: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'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 daily activities.

In addition to the information provided in our home page as just mentioned, Jamie Koerner (Special Projects Coordinator) is performing various surveys of pertinent topics in geosynthetics.

Most of these have been turned into GRI White Papers (for the concept please read the writeup on pg. 11-12 in this Newsletter/Report); the following being the most recent.

- #29 - Creep Tension Testing of Geosynthetics
- #30 - In-Situ Repairs of Geomembrane Bubbles, Whales and Hippos
- #31 (draft) - On the Need for a Better Test Method Than Wet or Dry Sieving to Obtain the Characteristic Opening Size for Geotextile Filter Design Purposes

## Progress within GEI (Education)

### Free CD

We sent a broadcast e-mail to everyone stating that many power point presentations were available and would be sent upon request. Many persons replied asking for all of them. Therefore, we put all 63 presentations on a CD which was sent to all GSI contact persons. That said, we have 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.

### 6<sup>th</sup> Edition of Designing With Geosynthetics

The 6<sup>th</sup> Edition of Designing With Geosynthetics continues to sell well in all three of its formats; hardback, softback and e-book... the latter is really cheap; i.e., \$3.50 for each volume! The two volume set can be purchased through GSI, Xlibris, Amazon and Barnes and Noble. A special link is available on the cover page of our website. All proceeds go to GSI.

Our most recent activity in this regard is to develop a power point presentation for the entire 914-page book. This is what it looks like and it does indeed contain 1230 nonencrypted ppt slides.



Call or e-mail if you want a copy. It is free to all, but we need your postal address.

## GRI Reports

To date, we have 43 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:

- #39 – Methods of Stabilizing Excessively Deformed MSE Walls
- #40 – On the Prevention of Failures of Geosynthetic Reinforced MSE Walls and Recommendations Going Forward
- #41 – Analysis and Critique of Twenty Large Solid Waste Landfill Failures
- #42 – Lifetime Prediction of Laboratory UV Exposed Geomembranes Based on a Correlation Factor (due January 2, 2012)
- #43 – An Analysis of the Most Difficult Q & A's of the First 2500 Submittals to the GMA Techline (just published)

## Courses

We have scheduled the following two courses here at GSI. GSI is approximately 4.5 miles from Philadelphia International Airport. They are as follows.

- #1 December 11, 2014  
QA/QC of Geosynthetics in Waste Containment Systems  
(Optional Exam Follows)
- #2 December 12, 2014  
Construction Inspection of MSE Walls, Berms and Slopes  
(Optional Exam Follows)

Each course carries with it 8 PDH's. All are held at GSI so laboratory demonstrations by George can illustrate and enliven the respective lectures.

Course Registration and Fee:

\$350/person for each one-day course (up to one month prior to course)

\$400/person thereafter

\$250/person – GSI Members

Contact: Marilyn Ashley ([mvashley@verizon.net](mailto:mvashley@verizon.net))

## Webinars

**(Second Wednesday of Every Month)**

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

**Registration at**

**[www.geosynthetic-institute.org/webinar.htm](http://www.geosynthetic-institute.org/webinar.htm)**

**1.5 Professional Development Hours; Cost \$250**

- W5 – October 8, 2014 “GSs in Hydraulic Applications”
- W6 – November 12, 2014 “GSs in Heap Leach Mining”
- W14 – December 10, 2014 “In0Situ Stabilization of Soil Slopes Using Geosynthetics”

- W13 – January 14, 2015 “Lifetime Prediction of Exposed and Nonexposed Geosynthetics”
- W9 – February 11, 2015 “Landfill Failures”
- W10 – March 11, 2015 “Landfill Bioreactors”
- W11 – April 8, 2015 “Lateral and Vertical Expansions”
- W12 – May 13, 2015 “Beneficial Uses of Closed Landfills”
- W1 – June 10, 2015 “MSE Wall Failures Data Base”
- W2 – July 8, 2015 “MSE Wall Back Drainage Design”
- W3 – August 12, 2015 “MSE Wall Remediation”
- W4 – September 9, 2015 “MSE Wall Inspection”

Note: These webinars are recorded and are available “on-demand” anytime and anyplace

## More Webinars

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

**Registration at [www.asce.org/webinars](http://www.asce.org/webinars)**

**1.5 Professional Development Hours; Cost \$400**

- ASCE 1 – October 3, 2014 “Geotextile Tubes”
- ASCE 2 – November 13, 2014 “Geosynthetic in Basal Reinforcement”
- ASCE 3 – December 9, 2014 “Geosynthetic Pond Liners”
- ASCE 4 – January 16, 2015 “Geotextile Filter Failures”
- ASCE 5 – February 25, 2015 “Geosynthetics in Roads”
- ASCE 6 – March 16, 2015 “Geosynthetics in MSE Walls and Slopes”

## GSI Fellowships

As in the past, GSI has been awarding graduate fellowships for students performing geosynthetics research. There were twelve new proposals this academic year. These proposals were reviewed by the GSI Board of Directors along with Bob and George Koerner.

The presently established criteria are as follows:

- Students must be working on a geosynthetics topic which furthers the technology in a proactive manner.
- Students must have completed their candidacy requirements leading to a doctoral degree. (Comment, we hope that some of them will “go academic” and teach and/or do research on geosynthetics in their immediate future)
- Students must be recommended by their advisor or department head.

The fellowships can be renewed for a total of three-years depending upon acceptable annual reports. Three renewals are being reviewed presently. Funding for each student is \$10,000 the first year and \$5000 for the second and third years.

The following table identifies the successful recipients, their university, advisor and topic for our year of activity. We congratulate the students and wish them success in their endeavors. If any readers wish to add congratulations or to find greater detail as to specific projects and students please contact us accordingly.

### GSI Fellowship Status for 2014-'15 Academic Year

#### Class 7(a) – 1<sup>st</sup> Year Funding at \$10,000 per student

No.	Name	University	Advisor	Topic
1-14	Asli Yalcin Dayioglu	University of Maryland	Ahmet Aydilek	Clogging Behavior of Recycled Concrete Aggregate in Geotextile Systems
2-14	Michelle (Mingyan) Deng	Missouri Univ. of Science and Technology	Ronaldo Luna	Reliability Based Optimization Design of Geosynthetics Reinforced Embankment Slopes
3-14	Yonggui Xie	Oregon State University	Ben Leshchinsky	MSE Wall Abutments: an Analytical Solution for Evaluating Service State Deformations with Geosynthetic Reinforcement

#### Class 5 (c) – 3<sup>rd</sup> Year Funding at \$5,000 per student

No.	Name	University	Advisor	Topic
3-11	Felix Jacobs	RWTH Aachen University	Martin Ziegler	Laboratory and Numerical investigation of Geogrid Reinforced Soil in Biaxial Compression Tests

Note that proposals for the new class for the A.Y. 2014-'15 are due on June 10, 2014. Please note Item #2 on "Activities of GSI's Directors and Officers" in this Newsletter/Report.

## Activities within GAI (Accreditation)

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

It should also be made clear that GAI-LAP does not profess to offer ISO certification, nor does it "certify" laboratory results. GAI-LAP provides accreditation to laboratories showing compliance with equipment and documentation for specific standard ASTM, ISO or GRI 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 240 GAI-LAP test methods available for accreditation. Please consult our home page for a current listing.

As of September, 2014, 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<sup>A</sup> - TRI/Environmental Inc. (135 tests)  
Jarrett Nalson -- (512) 263-2101  
[Sallen@tri-env.com](mailto:Sallen@tri-env.com)
- 3<sup>A</sup> - Golder Associates (45 tests)  
Henry Mock -- (770) 492-8280  
[dalexander@golder.com](mailto:dalexander@golder.com)
- 4<sup>C</sup> - Geosynthetic Institute (116 tests)  
George Koerner -- (610) 522-8440  
[gkoerner@dca.net](mailto:gkoerner@dca.net)
- 8<sup>B</sup> - Propex Operating Co., Ringgold (18 tests)  
Todd Nichols -- (800) 258-3121  
[todd.nichols@propexglobal.com](mailto:todd.nichols@propexglobal.com)
- 9<sup>B</sup> - Lumite (16 tests)  
Rebecca Kurek -- (770) 869-1700  
[rpage@lumiteco.com](mailto:rpage@lumiteco.com)
- 13<sup>A</sup> - TRI Env. Inc. (97 tests)  
Cora Queja -- (714) 520-9631  
[cqueja@tri-env.com](mailto:cqueja@tri-env.com)
- 14<sup>A</sup> - Geotechnics (49 tests)  
J. P. Kline -- (412) 823-7600  
[JPKline@geotechnics.net](mailto:JPKline@geotechnics.net)
- 20<sup>A</sup> - GeoTesting Express, MA (47 tests)  
Gary Torosian -- (978) 635-0424  
[gtt@geotesting.com](mailto:gtt@geotesting.com)
- 22<sup>B</sup> - CETCO Hoffman Estates (13 tests)  
Barbara Gebka -- (847) 851-1500  
[jim.olsta@cetco.com](mailto:jim.olsta@cetco.com)
- 24<sup>B</sup> - CETCO Lovell (10 tests)  
Roger Wilkerson -- (307) 548-6521  
[roger.wilkerson@cetco.com](mailto:roger.wilkerson@cetco.com)
- 25<sup>B</sup> - Ten Cate, Pendergrass (12 tests)  
Beth Wilbanks -- (706) 693-2226  
[b.wilbanks@tencate.com](mailto:b.wilbanks@tencate.com)
- 26<sup>B</sup> - Agru America Inc. (20 tests)  
Grant Palmer -- (843) 546-0600  
[gp@agruamerica.com](mailto:gp@agruamerica.com)
- 29<sup>E</sup> - FITI Testing and Research Institute (68 tests)  
Hong-Kwan Kim -- 82-2-3299-8071  
[hoganKim@fiti.re.kr](mailto:hoganKim@fiti.re.kr)
- 31<sup>D</sup> - NYS Dept. of Transportation (9 tests)  
Tom Burnett -- (518) 457-4704  
[tburnett@dot.state.ny.us](mailto:tburnett@dot.state.ny.us)
- 32<sup>A</sup> - Geo-Logic Inc. (6 tests)  
Ken Criley -- (530) 272-2448  
[criley@geologic.com](mailto:criley@geologic.com)
- 34<sup>B</sup> - GSE Environmental Richey Road (36 tests)  
Rich Schaefer -- (281) 230-6890  
[r.schaefer@gseworld.com](mailto:r.schaefer@gseworld.com)
- 37<sup>B</sup> - GSE Environmental Chile (19 tests)  
Mauricio Ossa -- 56-2 6010153  
[Mossa@gseworld.com](mailto:Mossa@gseworld.com)

- 38<sup>C</sup> - Sageos/CTT Group (103 tests)  
Eric Blond -- (450) 771-4608  
[eblond@GCTTG.com](mailto:eblond@GCTTG.com)
- 40<sup>B</sup> - GSE Environmental (14 tests)  
Bruce Pressley -- (843) 382-4603  
[bpressley@gseworld.com](mailto:bpressley@gseworld.com)
- 41<sup>A</sup> - SGI Testing Service, LLC (19 tests)  
Zehong Yuan -- (770) 931-8222  
[ZYuan@interactionspecialists.com](mailto:ZYuan@interactionspecialists.com)
- 42<sup>C</sup> - NPUST (GSI-Taiwan) (61 tests)  
Chiwan Wayne Hsieh -- 011-886-8-7740468  
[CWH@mail.npust.edu.tw](mailto:CWH@mail.npust.edu.tw)
- 43<sup>A</sup> - Ardaman & Associates (22 tests)  
George DeStafano -- (407) 855-3860  
[gdestafano@ardaman.com](mailto:gdestafano@ardaman.com)
- 44<sup>B</sup> - PGI and Fiber Web, Inc. (9 tests)  
Kim Thomas -- (615) 847-7155  
[Kim.Thomas@fiberweb.com](mailto:Kim.Thomas@fiberweb.com)
- 45<sup>B</sup> - Ten Cate Geosynthetics Malaysia SDN Bhd. (23 tests)  
Gan Wee Hunn -- (603) 519 28576  
[wh.gan@tencate.com](mailto:wh.gan@tencate.com)
- 46<sup>B</sup> - TAG Environmental Inc. (13 tests)  
Colin Murphy -- (705) 725-1938  
[colin\\_murphy@tagenv.com](mailto:colin_murphy@tagenv.com)
- 47<sup>B</sup> - GSE Syntec (10 tests)  
Andrew Barker -- (410) 327-1070  
[abarker@synteccorp.com](mailto:abarker@synteccorp.com)
- 49<sup>B</sup> - Engepol Geosintéticos (14 tests)  
Carolina Polomino -- (55) 51 3303-3916  
[carolina@engepol.com](mailto:carolina@engepol.com)
- 50<sup>B</sup> - ADS, Inc. Hamilton (7 tests)  
Terry McElfresh -- (513) 896-2065  
[terry.mcfresh@ads-pipe.com](mailto:terry.mcfresh@ads-pipe.com)
- 51<sup>B</sup> - Solmax International Inc. (22 tests)  
Simon Gilbert St. Pierre -- (450) 929-1234  
[simonGSP@solmax.com](mailto:simonGSP@solmax.com)
- 53<sup>B</sup> - Polytex Autofagasta (19 tests)  
Ximena Parra Pizarro -- 011 56 57 42 90 00  
[XPanna@polytex.cl](mailto:XPanna@polytex.cl)
- 55<sup>B</sup> - Atarfil Geomembranas (19 tests)  
Gabriel Martin Sevilla -- 34 958 439 200  
[gmartin@atarfil.com](mailto:gmartin@atarfil.com)
- 56<sup>B</sup> - Polytex Santiago (13 tests)  
Marta Tenorio F. Jeff -- 011 56-2-627-2054  
[MTenorio@polytex.cl](mailto:MTenorio@polytex.cl)
- 57<sup>B</sup> - Ten Cate Cornelia (13 tests)  
Melissa Medlin -- (706) 778-9794  
[m.medlin@tencate.com](mailto:m.medlin@tencate.com)
- 58<sup>B</sup> - Propex Operating Co. Hazelhurst (16 tests)  
Ron (Jeff) Bercher -- (229) 686-5511  
[Ronald.Bercher@propexglobal.com](mailto:Ronald.Bercher@propexglobal.com)
- 59<sup>B</sup> - Firestone (9 Tests)  
Janie Simpson -- (864) 439-5641  
[SimpsonJanie@firestonebp.com](mailto:SimpsonJanie@firestonebp.com)
- 60<sup>B</sup> - Polytex Lima (12 tests)  
Elias Jurufe -- 51 16169393  
[Ejarufe@polytex.cl](mailto:Ejarufe@polytex.cl)
- 61<sup>B</sup> - Raven Industries (17 tests)  
Clint Boerhave -- (605) 335-0288  
[Clint.Boerhave@ravenind.com](mailto:Clint.Boerhave@ravenind.com)
- 62<sup>B</sup> - Solmax International Asia (14 tests)  
Teoh Pei Ching -- (450) 929-1234  
[pcteoh@solmax.com](mailto:pcteoh@solmax.com)
- 63<sup>A</sup> - TRI Environmental, Inc.; DDRF (5 tests)  
Joel Sprague -- (864) 242-2220  
[JSprague@tri-env.com](mailto:JSprague@tri-env.com)
- 64<sup>B</sup> - Agru America (NV) (14 tests)  
Chris Adams -- (775) 835-8282  
[ca@agruamerica.com](mailto:ca@agruamerica.com)
- 65<sup>C</sup> - Bombay Textile Rsearch Assoc. (BTRA) (24 tests)  
Riyaz Shaikh  
(0) 022-25003551  
[btra@vsnl.com](mailto:btra@vsnl.com)
- 66<sup>B</sup> - Rowad International Geosynthetics Co. Ltd (14 tests)  
Asad Ullah Khan -- +966-3-812-1360  
[asad@rowadplastic.com](mailto:asad@rowadplastic.com)
- 67<sup>A</sup> - MicroBac Hauser Division (10 tests)  
Heather Smalley -- (720) 406-4806  
[heather.smalley@microbac.com](mailto:heather.smalley@microbac.com)
- 68<sup>B</sup> - Glen Raven Technical Fabrics LLC (4 tests)  
Richard Greeson -- (336) 229-5576  
[rgreeson@glenraven.com](mailto:rgreeson@glenraven.com)
- 69<sup>B</sup> - GSE Environmental (12 tests)  
Siriporn Chayaporenlerit -- 6638-636638  
[Siriporn@gseworld.com](mailto:Siriporn@gseworld.com)
- 70<sup>A</sup> - RSA Geo Lab LLC (48 tests)  
Raza Ahmed -- (908) 964-0786  
[geolab13@yahoo.com](mailto:geolab13@yahoo.com)
- 71<sup>B</sup> - Plasticos Agricolas y Geomembranas S.A.C. (15 tests)  
Jhoana Carolina Diaz Martinez -- 073-511814-511829  
[calidad@pga.peru.com](mailto:calidad@pga.peru.com)
- 72<sup>B</sup> - Tensar Corp. GA (5 tests)  
Mignon Kittler (770) 968-3255  
[mkittler@tensarcorp.com](mailto:mkittler@tensarcorp.com)
- 73<sup>B</sup> - Gai Loi JSE (9 tests)  
Paul Wong 84-650-362-5825  
[paul905677@gmail.com](mailto:paul905677@gmail.com)
- 74<sup>B</sup> - Agru America Inc.  
Mark Locklear (843) 221-4412  
[ml@agruamerica.com](mailto:ml@agruamerica.com)
- 75<sup>B</sup> - GeoMatrix S.A.S.  
Javier Diaz Cipagauta (571) 424-9999  
[jdiaz@geomatrix.com.co](mailto:jdiaz@geomatrix.com.co)
- 76<sup>B</sup> - Tehmco (Chile)  
Patricia Rojas Perez (562) 589-2800  
[projas@tehmco.cl](mailto:projas@tehmco.cl)
- 78<sup>B</sup> - PQA Mexico  
Cesar Augusto Arcila (669) 954-8202  
[calidadmexico@pga.com.co](mailto:calidadmexico@pga.com.co)

<sup>A</sup>Third Party Independent      <sup>C</sup>Institute  
<sup>B</sup>Manufacturers QC                      <sup>D</sup>Government

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

*George R. Koerner*

## Activities within GCI (Certification)

GSI presently has two 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 other (begun in 2011) is focused on MSE Wall, Berm and Slope field inspection. See our website at [www.geosynthetic-institute.org](http://www.geosynthetic-institute.org) under "certification" for a description and information on both of them. They are both 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 CQA activities with either geosynthetic liner or cover systems or MSE walls, berms, or slopes using geosynthetic reinforcement.

- 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.
- 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 eighth year has been recommended, and in some cases required, by solid waste owners, state regulators, and design consultants for proper QCA in field installation of both geosynthetic materials and compacted clay liners. The statistics to date are as follows.

Inspector Certification Test Results  
2006 – 2014

Year	Geosynthetic Materials		Compacted Clay Liners		Commentary No. of people failing both exams
	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%)	2
2007	82	11 (13%)	73	12 (16%)	7
2008	95	25 (26%)	89	20 (22%)	13
2009	36	7 (19%)	36	2 (5%)	2
2010	59	12 (20%)	54	7 (13%)	5
2011	54	6 (11%)	53	3 (6%)	1
2012	34	5 (15%)	28	3 (11%)	3
2013	32	4 (12%)	30	1 (3%)	1
2014	39	1 (3%)	36	2 (7%)	1
<b>TOTAL (to date)</b>	<b>572</b>	<b>75 (14%)</b>	<b>529</b>	<b>62(12%)</b>	<b>35</b>

The 5-year renewal period for those having taken the exam in 2009 is ongoing and about 60% have renewed accordingly. This is felt to be encouraging from our perspective.

Note that a GSI course on this topic will be offered on December 11, 2014 with the exam following directly.

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

The official launch of the 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. There are now eighteen persons certified by GCI for the inspection of MSE Walls, Berms and Slopes.

While a field inspector cannot require proper design or instruct a contractor how to build the 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. Please contact George Koerner at [gkoerner@dca.net](mailto:gkoerner@dca.net) or Jamie Koerner at [jrkoerner@verizon.net](mailto:jrkoerner@verizon.net) for questions or additional information.

Note that a GSI course on this topic will be offered on December 12, 2014 with the exam following directly.

**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). 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 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 direction of Dr. A. N. Desai has just been formed. 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. Desai has just been elected to GSI's Board of Directors. (See associated writeup on the "Global Geosynthetics Summit" in this Newsletter/ Report).

## Items of Interest

### 1. Flaming Rocks (aka Oil Shale)

A second shale revolution may be coming, squeezing out yet more oil.

The cliffs of Kimmeridge, on England's south coast, have on occasions been known to smoulder or even burst into flames in hot weather. That is because they are made of oil shale, a soft rock that has hydrocarbons trapped in its pores. The world's oil-shale beds may contain the equivalent of up to nine times as much oil as all of its conventional wells.

In this regard, a second shale revolution is in prospect, in which cleaner and more efficient ways are being found to squeeze the oil and gas out of the stone.

In this process, the shale is "cooked" cheaply, cleanly and productively in oxygen-free retorts to separate much of the oil and gas.

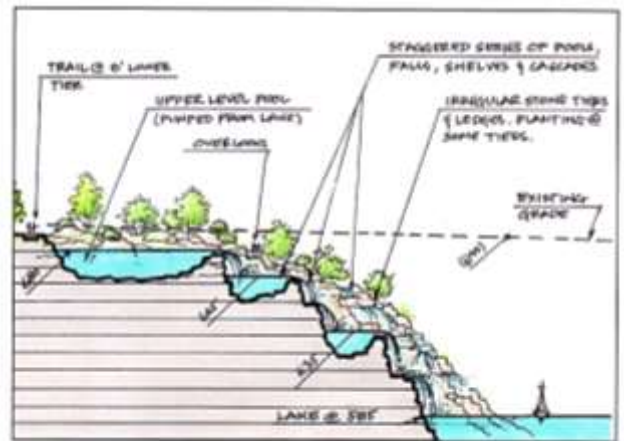
(ref. *The Economist*, June 28, 2014)

### 2. Reclamation Planning of Pits and Quarries

The extraction of sand and gravel and hard rock to produce aggregates for the construction industry is the largest segment of the mining industry in the United States. The United States Geological Survey (USGS) states aggregate production amounts to more than one-half the volume of all minerals produced. More than 2.6 billion tons of sand, gravel, and crushed rock were produced in 1998. Annual per capita consumption ranges from eight to 10 tons and can be more than 25 tons depending on national, regional, and state economic conditions. Aggregate is mined in every state, within or near every metropolitan area, and in most counties throughout the United States.

Aggregates are also a major target for replacement by all types of geosynthetics. In this

regard, we may be making progress because more-and-more quarries are closing. While a natural target for use as a landfill, some landscape architects are getting quite visual. We thought you might find the following graphic of interest.



Section illustrating modifications of quarry area and wall to create waterfalls.  
IMAGE COURTESY ANTHONY SALER

(ref. *Landscape Architecture Magazine*, July 2014)

### 3. Sine Favorable Initiatives in the News

- President Obama Signs \$12.3 Billion Water Resources Bill
- ASCE Launces New Advocacy Campaign to fix the Highway Trust
- ASCE Members Advocate for Transportation and Rally for Roads
- Executive Director Pat Natale Pens Post of USDOT Fast Lane Blog
- House Approves FY 2015 Transportation Appropriations Bill
- House Holds Hearing on New Water Rules Proposed by Corps and E
- DeFazio Introduces Oil Tax Bill
- Congressional Budget Office Issues Highway Budget Report
- Supreme Court Rules for Company in Closely Watched Super C
- ASCE Successfully Urges House Not to Cut Dam Rehabilitation Program
- STEM Innovation Network Legislation Introduced

(ref. *ASCE, Infrastructure in the News*)

# Global Geosynthetics Summit

by  
**Dr. George R. Koerner,**  
**Director of GSI**

## Overview

As some of you know the Geosynthetic Institute (GSI) and Bombay Textile Research Association (BTRA) have had a association for over five years. In September we advanced this relationship during the Global Geosynthetic Summit “Enhancing the Application of Geosynthetics in the Infrastructure Sector”.

The summit was held on September 5-6, 2014, at the Hotel Eastin, Ahmedabad, Gujarat, India. Sponsors for the event included; the Confederation of Indian Industry, Office of the Textile Commissioner and the Government of Gujarat. The summit theme was on Geosynthetics in Infrastructure Applications, with main topics including; roadways, shore and bank protection, landslide and rock fall applications, railways, landfills, canals, reservoirs and mining applications.



Fig. 1. Kanjal Patel, Chairman - CII Gujarat State Council opening the Global Geosynthetic summit



Fig. 2. Photo of the venue with some of the 300 delegates attending the summit

## Introductory Session

The welcome address and summit objectives were given by Dr. Chandan Chatterjee, Advisor - Project and Technology Industrial Extension Bureau (iNDEXtb), Government of Gujarat. This introduction was followed by George Koerner’s presentation on Global Market Scenario of Geosynthetics. Some elements follow.

The worldwide demand for geosynthetics is projected to increase about 9% annually to 6 billion sq. m. in 2014. North America accounts for 31% of global market sales whereas the Asia/Pacific Region accounts for 21% of global market sales. To contrast these worldwide numbers, Table 1 reveals the geosynthetic market in India.

The total production of geosynthetics in India is felt to be in the range of 1053 M sq. m with imports about 100 M sq. m. The total consumption, however, is about 453 M sq. m and an additional 700 M sq. m is being exported.

Table 1. The Current Market for Geosynthetics in India

Geosynthetic Type	Domestic Production (M sq. m)	Imports (M sq. m)	Domestic Consumption (M sq. m)	Exports (M sq. m)
Geotextiles	800	100	200	700
Geogrids	100		100	
Geomembranes	140	50	190	
Jute and Coir Geotextiles	10		10	
PVD	3		3	
TOTAL	1053	150	503	700

## Session 1: Roadway Applications

### *Introductory Remarks and Use of Geosynthetics in Flexible Pavements*

K. Rajagopal, Professor  
Department of Civil Engineering  
Indian Institute of Technology at Madras

### *“Geosynthetics for Road Applications”*

David Shercliff, Senior Sales Director  
Terram Geosynthetics

### *“Geosynthetics for Road Applications - User’s Perspective*

Sudhir Mathur, Chief General Manager-Technology  
National Highway Authority of India

### *“The Utilization of Geosynthetics for Construction and Rehabilitation of Bituminous Pavement”*

Satish Pandey, Scientist  
Flexible Pavement Division  
Central Road Research Institute”

**GRK Commentary:**

India is a rapidly developing country. It is at the stage where all forms of infrastructure need construction of new systems and/or rehabilitation and up-grading to the existing facilities. Roads and highway infrastructure is of utmost importance. Due to increase in traffic density, heavy axle loads (up to 120 kN) and harsh climate demands are very high on roadways. Geosynthetics can be effectively used for infrastructure projects involving roads resulting in significant savings, improved performance and good serviceability on both short-term and long-term basis.

Major advantages with the use of geosynthetics include,

- Reduction in pavement base and sub base thickness.
- Stabilization and reinforcement to avoid pumping of soil fines.
- Reduction or avoidance of reflective cracking.
- Increase the lifetime of the pavement.
- Reduction in soil erosion.
- Reduction of setback requirements for land.
- Reduction in use of natural materials.

Geosynthetics have exhibited good benefit/cost ratios in India. India has the second longest road network (4.7 M km) in the world after USA (6.4 M km) and followed by China (4.3 M km). However, the use of geosynthetics for road applications have unfortunately been limited.

### **Session 2: Shore and Bank Protection Applications**

*Welcome and Introductory Remarks*

R. Sunderavadivelu, Professor  
Ocean Engineering Department  
Indian Institute of Technology Madras

*“Geosynthetics for Shore and Bank Protection”*

Murari Ratnam, Director  
Central Soil & Materials Research Station  
Ministry of Water Resources  
Government of India

*“Advance Technology - Cost Effective Solutions for Riverbank Protection”*

Harish Kumar Varma, Senior Project Officer  
Natural Resources and Agriculture  
Asian Development Bank

A. K. Mitra  
Chairman - Technical Advisory Committee  
Water Resources Department  
Government of Assam

*“Ullal Sustainable Coastal Protection Project”*

Channappa Naik, Project Director  
Public Work Department  
Government of Karnataka

*“Experiences and Benefits from Various Geosynthetics Products in the Port Infrastructure Sector”*

Abhishek Basu, Head - Geo Technical  
Adani Ports and Special Economic Zone Ltd.

**GRK Commentary:**

Floods are a recurring phenomenon in India. Floods vary in magnitude but they affect most parts of the country almost every year. With the increase in population and development, there has been a tendency to occupy the floodplain, often resulting in serious consequences. Flood management and control rely heavily on geotextile tubes, containers and bags. Geosynthetics started playing a role in permanent riverbank protection after 2000. In India geotextile bags cost around \$2M USD per km where concrete blocks cost about \$5M USD per km. In addition the geosynthetic solution performs better than concrete as water protection, largely due to their permeability, flexibility and ease of underwater placement.

### **Session 3: Landslide and Rock Fall Application**

*Welcome and Introductory Remarks*

Major General U. S. Dadu  
Border Road Organization

*“Geosynthetics for Landslide and Rock Falls”*

Dr. V. Venkateswarlu, Director  
National Institute of Rock Mechanics  
Ministry of Mines  
Government of India

*“Geosynthetics for Dam Applications”*

Satish Naik, Chief Executive Officer  
Best Geotechnics Private Limited

*“Raw Materials for Geo-Synthetics”*

Dr. Sunil Mahajan, Head - PP Technical Group  
Product Application Research Centre  
Reliance Industries Limited

**GRK Commentary:**

The hazards generated due to rock falls and slides because of unstable slopes and weathering cause considerable harm to people and infrastructure in vulnerable areas if left unprotected. This kind of problem is faced in mines, highways and railroads in mountainous regions where excavations have been made. In order to mitigate these problems, protection measures can be made with geosynthetic solutions such as rockfall embankments, erosion and sediment control mats and rock fall curtains. All were discussed and critiqued during the session.

#### **Session 4: Railways Applications**

*Welcome and Introductory Remarks*  
Alok Kumar, Executive Director  
Civil Engineering - General  
Railway Board

##### *“Geosynthetics for Railway Application-Users Perspectives”*

Brijesh Kumar, Executive Director  
Geotechnical Engineering Division  
Research Design & Standards Organization

##### *“Jute Based Geotextiles for Infrastructure Applications”*

P. K. Choudhury, Project Coordinator  
National Jute Board

##### *“Geosynthetics for Railway Applications”*

Vikramjiet Roy, Managing Director  
Maccaferri Environmental Solutions Private Limited

##### *“Geosynthetics for Railway Applications”*

David Shercliff, Senior Sales Director  
Terram Geosynthetic

#### **GRK Commentary:**

The Indian Railways network is perhaps the most intricate in the world, currently encompassing three different gauges. It is a conglomeration of a number of private companies inherited by independent India sixty-six years ago. Today, the Indian Railways network is the fourth largest in the world with a total route network of about 64,600 kilometers spread across 7,146 stations. It operates more than 19,000 trains every day. Over 30 million passengers travel by trains on a daily basis in India and around 975 million tonnes of freight were transported via trains in 2012.

Maintenance of the sub-structure as well as the super-structure can be enhanced by the use of geosynthetics in the ballast, as well as within the various components of the cross-section as well as the foundation subsoil. Railway ballast and subsoil are critical as they are subjected to heavy cyclic stresses over long durations and traction loads. With good material getting scarcer and quarrying restrictions, geosynthetic solutions are plentiful. Geosynthetics play an important role in enhancing rail bed performance and catering to the new demands of higher loads and higher speeds.

#### **Session 5: Landfills, Lining & Mining Application**

*Introductory Remarks and Geosynthetics for Landfills*  
Dr. Manoj Datta, Professor - Civil Engineering  
Department  
Indian Institute of Technology - Delhi

##### *“Geosynthetics for Canal and Reservoir Lining”*

Vivek Kapadia, Superintending Engineer  
SardarSarovar Narmada Nigam Limited

##### *“Geosynthetics for Mining-Users”*

P. G. Samandhray, General Manager  
Gujarat Mineral Development Corporation Limited

#### **GRK Commentary:**

In India, the Ministry of Environment and Forest (MoEF) and Central Pollution Control Board (CPCB) developed regulations in 2000 which deal with the criteria for location, site specification, site investigation, planning and design, waste acceptance, landfill liners and covers, construction and operation as well as inspection, monitoring and record keeping. In addition, requirements for landfill liner and cover criteria, were specified.

Guidelines and check-lists have been provided by CPCB (August 18, 2000) for evaluation of MSW landfills. This requires construction of non-permeable lining system at the base and walls of the waste disposal area, consisting of a composite barrier being 1.5 mm thick HDPE or equivalent geomembrane, and a clay liner having permeability less than  $1 \times 10^{-7}$  cm/sec. The document also gives technical guidance on how to close an existing landfill. Going forward it is envisioned that each of India's 23 states will have 10 landfills with one being for hazardous wastes. Each hazardous landfill will have a footprint of 500-2,500 m<sup>2</sup>/year and the municipal solid waste facilities would each be 2,500 to 40,000 m<sup>2</sup>/year.

The use of geosynthetics for lining canals is more efficient and cost effective than conventional concrete lining or rip rap. Geosynthetics have a greater benefit/cost ratio and require considerably less operation and maintenance than conventional construction. There are two mega canal projects in India about to commence. A 453 km canal in GUJARAT and a 75 km canal in RAJASTHAN. Both are designed for flows in excess of 1,000 m<sup>3</sup>/sec with the main canal having a 90 m width and up to a 10.5 m depth.

#### **GRK Summary:**

An additional highlight of the summit was a tour of CTM Geosynthetic Co., a vendor for the Maccaferri Corporation. The company was founded by Mr. Amit Agarwal in 2012 and is a division of CTM Technical Textiles Ltd. The company makes woven polyester geogrids and polyethylene agricultural textiles. After a tour of the manufacturing facility and laboratory we experienced an authentic India dinner at Vishalla. What a fantastic evening!



Fig. 3. Photo inside CTM's manufacturing facility



Fig. 4. Team CTM outside Vassal

GSI and BTRA agreed to a memorandum of Understanding in September of 2014, and the MOU was signed by Prem Malik Chairman of BTRA and George Koerner Director of GSI. The GSI BTRA MOU is the fifth such agreement signed under GSI's global cooperation program. These MOU programs, initiated in 1999, promote communication between GSI and other geosynthetic institutes worldwide. They foster awareness and standardization of our research, information, education, accreditation and certification services. In addition they broaden the outreach of our generic specifications. More information about the MOU program can be found on our website.

In closing, we would like to thank Dr. Dessi and Raja Bhattacharjee of CII for a marvelous summit and a fantastic venue. We experienced 27 speakers during the two day event. I was impressed with the knowledge of geosynthetics and enjoyed vigorous discussion after each presentation. We personally would like to thank the Staff at CII for all their hard work. It is nice to have participated in such a successful event... GRK



Fig. 5. In the conference room at BTRA in Mumbai



Fig. 6. The handshake after signing the MOU with BTRA chairman Peur Malik

## Upcoming GSI Events

- GSI Webinars  
(2<sup>nd</sup> Wednesday of Every Month – see following website [www.geosynthetic-institute.org/webinar.htm](http://www.geosynthetic-institute.org/webinar.htm))
- ASCE Webinars  
(see following website [www.asce.org/webinars](http://www.asce.org/webinars))
- GSI Courses in Folsom, PA
- December 11, 2014  
QA/QC of Geosynthetics in Waste Containment Systems  
(Optional Exam Follows)  
Contact: [mvashley@verizon.net](mailto:mvashley@verizon.net)
- December 12, 2014  
Construction Inspection of MSE Walls, Berms and Slopes  
(Optional Exam Follows)  
Contact: [mvashley@verizon.net](mailto:mvashley@verizon.net)
- September 21-25, 2014  
10<sup>th</sup> Intl. Geosynthetics Conf.  
Berlin, Germany  
Contact: [www.geosyntheticssociety.org](http://www.geosyntheticssociety.org)
- May 15-18, 2015  
Geosynthetics '15  
Portland, OR

## 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 are ThermaGreen with Tim Walter/Blu Alexander/Ken vander Velden, Maccaferri with Massimo Ciarla and Pietro Rimoldi, and Jones and Wagener (Pty) Ltd. with Anton Bain, Ardaman & Assoc. with Nadim Fuleihan/Thomas S. Ingra/Jan Wildman, Tecnologia de Materiales (TDM) with José Ferreyros, American Wick Drain with Scott Morris and Craig Phelps and the Department of Water Affairs of South Africa with Kelvin Legge as contact persons. Thanks to all and welcome to GSI.**

**GSE Environmental**  
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**E. I. DuPont de Nemours & Co., Inc.**  
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**Propex**  
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**Chevron Phillips Co.**  
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**URS Corp.**  
*John Volk/Ron Hager*  
**Solmax Géosynthétiques**  
*Robert Denis/Guy Elie/Daniel Tan Su Ming*

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**CARPI, Inc.**  
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**Civil & Environmental Consultants, Inc.**  
*Tony Eith*  
**Agru America, Inc.**  
*Paul W. Barker/Markus Haager/Nathan Ivy*  
**Firestone Specialty Products**  
*Jeff PanKonie/William Johnson*  
**INHA (GSI-Korea)**  
*H.-Y. Jeon*  
**Waste Management Inc.**  
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**NPUST (GSI-Taiwan)**  
*Chiwan Wayne Hsieh [BoD]*  
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**Atarfil, S. L.**  
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Gabriel Martin*  
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Matt Leathermann*  
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**Maccaferri**  
*Massimo Ciarla/Moreno Scotto/Pietro Rimoldi*  
**Jones & Wagener (Pty) Ltd.**  
*Anton Bain*

**Ardaman & Assoc.**  
*Nadim Fuleihan/Thomas S. Ingra/Jan Wildman*  
**Tecnologia de Materials (TDM)**  
*José Ferreyros*  
**American Wick Drain**  
*Scott Morris/Craig Phelps*

**ASSOCIATE MEMBERS**

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**Nebraska Department of Environmental Quality**  
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**Maine Department of Environmental Protection**  
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**Pennsylvania Dept. of Environmental Protection**  
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**Florida Dept. of Environmental Protection**  
*Richard B. Tedder*

**U.S. Bureau of Reclamation**  
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*Margie Ring/Xuede (Dan) Qian*

**Environment Agency of U. K.**  
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**Florida Dept. of Transportation**  
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**National Design, Construction & Soil Mechanics Center**  
*Stephen D. Reinsch*

**Virginia Dept. of Environmental Quality**  
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**Massachusetts Dept. of Environmental Protection**  
*Paul Emond*

**Philadelphia Water Department**  
*Vahe Hovsepian*

**Dept. of Water Affairs of South Africa**  
*Kelvin Legge*

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