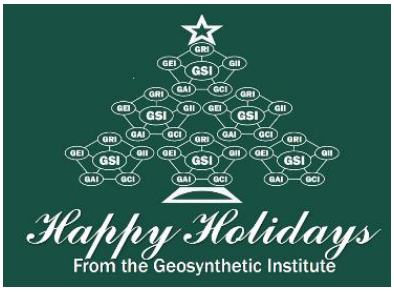
The GSI Newsletter/Report



Vol. 37, No. 4 **December, 2023**

This quarterly newsletter, now in its 36th year, presents the activities of GSI and its related institutes to all who are interested. It is available on the institute's home page at www.geosynthetic-institute.org. It also serves as a quarterly report to its member organizations. Details are available by contacting George R. Koerner or Jamie Koerner at phone (610) 522-8440; or e-mail at gsigeokoerner@gmail.com or Jamie@geosynthetic-institute.org

Activities of GSI's Officers and Board of Advisors (BOA)

2023-2025 Board of Advisors

The following are the names of the current BOA members and their contact information. We thank them for their time and advice on matters concerning the Geosynthetic Institute. Elections were held end of October for term 2024-2026 BOA positions. Please welcome Henry Mock - WSP as our newest consultant representative and Anthony Johnson - Agru America Inc. as the new barrier group representative. Jacek Kawalec - Tensar has graciously volunteered to serve an additional 3 year term as GSI's international representative.

Term Ends 2024

- Burrill (Bo) McCoy - Waste Management Inc.
  (Owners and Operators)
  e-mail: bmccoy2@wm.com
- Rene Laprade - Solmax Geosynthetics
  (Geotextiles and Geogrids)
  e-mail: r.laprade@solmax.com
- Sam Allen – TRI Environmental Inc.
  (Test Laboratories)
  e-mail: Sallen@tri-env.com

Term Ends 2025

- Henning Ehrenberg – NAUE GmbH & Co. KG
  (International-1)
  email: hehrenberg@naue.com
- Miranda Rine – C.P. Chemical
  (Resin and Additives Group)
  email: Miranda.rine@cpchem.com
- David Carson – U.S. EPA
  (Agencies)
  email: carson.david@epa.gov

Term Ends 2026

- Henry Mock – WSP
  (Consultants)
  email: henry.mock@wsp.com
- Anthony Johnson – Agru America Inc.
  (Barrier Group)
  email: ajohnson2@AgruAmerica.com
- Jacek Kawalec – Tensar
  (International - 2)
  e-mail: Jacek.Kawalec@vp.pl

GSI continues to have virtual quarterly meetings with the Board of Advisors via Zoom. The 4Q BOA meeting was held on December 22, 2023. In addition to information on the progress of the 5 institutes within GSI (Research, Accreditation, Information, Education and Certification), a financial overview of the institute was presented. Income exceeded expenses for the third year in a row. In addition, all seven year end metrics were met.

IN THIS ISSUE

Overview of GRI Projects (Research)

The following projects are all funded by GSI membership dues unless specifically noted. Most are long-term projects for which we are well positioned to accomplish. In an attempt not to repeat information in the quarterly newsletters, we will merely list the ongoing projects and new research details. Please contact George or Grace if you have advice or concerns.

George Koerner (gsigeokoerner@gmail.com)
Grace Hsuan (hsuanyg@drexel.edu)

1. **Durability of Geosynthetics** (15 materials)

   Durability of Exposed Geosynthetics (GM, GT, GG, HPTRM, Turf, WD & GCCM) GSI is using two outdoor exposure racks and four UV fluorescent devices to estimate the projected exposed lifetime of a litany of different geosynthetics. We currently have 15 geosynthetic materials under investigation. The goal of the study is to quantitatively illustrate the durability of these materials and to correlate outdoor exposure to accelerated weathering.

2. **GRI GS-27 "Determining the Rate of Capillary "Wicking" Within Geosynthetics"**

   This test method was developed by the Geosynthetic Research Institute (GRI), with the cooperation of the member organizations. The method is applicable to many geosynthetics and is used to determine the rate of capillary wicking. The method covers the measurement of liquid transport on a specimen of known cross section as it is exposed to Distilled Deionized Deaired (DDD) water at a known environmental conditions. It has a relevance to a broad range of geosynthetics and its applicability is seen mainly in the transportation arena. It is envisioned that this method will be brought forward to the ASTM D35 task Group in Louisville Kentucky in January of 2024 for consideration as a standard.

3. **GeoMat Specification**

   GSI is undertaking a new effort in regards to a GeoMat Specification. This specification will cover open 3-D mats and composite structures. Such mats are constructed of continuous polymeric fibers that are fused where they intersect. They can be used in a multitude of applications from drainage to reinforcement. This specification is being developed by the Geosynthetic Research Institute (GRI), with the cooperation of the member organizations for general use by the public. The specification will sets forth a set of minimum, physical, mechanical, hydraulic, chemical and endurance properties that must be met. **If you are interested in the effort, please reach out to us.** We are currently receiving materials at GSI for in-house testing to corroborate category thresholds.

4. **GSI's Bituminous Geomembrane Specification**

   The Bituminous Geomembrane specification is now GRI – GM38 Standard Specification for "Test Methods, Test Properties and Testing Frequency for Bituminous Geomembranes (BGM)" This specification covers bituminous geomembranes (BGM) which are factory produced materials in the form of rolls used to mitigate fluid loss. This specification sets forth a set of minima, physical, mechanical, chemical and endurance properties that must be met, or exceeded by the geomembrane being manufactured. The specification was originally adopted in August 12, 2023. It went through a significant revision in the end of the year (December 7, 2023), with a name change from Bituminous Geosynthetic Barrier (BGB) to Bituminous Geomembranes (BGM), the original GRI standard GS32 changed to GM38, ASTM D1079 reference was added, definition of "batch" was added and finally a clarification of section 4.3 on non-leaching of constituents. We also changed the characterization of finished roll goods from typical, moderate and severe to grades 1 through 3.

5. **Chlorine Aging**

   Chlorine aging of geomembranes has been an endeavor that has taken much effort at GSI over the past six months. The relatively new EIA = PVC+KEE specification "GRI-GM34" covers physical, mechanical, chemical and endurance properties of EIA geomembranes. The majority of the required properties are evaluated by test methods established by the ASTM D35 Geosynthetics Committee. In cases where no ASTM standards are available, GRI test methods or practices are developed accordingly to fill the gaps. One such case is a practice for chlorinated water resistance. The purpose of this immersion challenge is to artificially *accelerate* the aging of EIA geomembrane. This important characteristic is covered under GRI GM-24 "Standard Practice for "Incubation and Subsequent Evaluation of Double 180° (Star) Folded Geomembranes" This practice covers a procedure for the accelerated aging of geomembranes when fabricated into a double 180° (star) fold. The specification states the resistance to oxidative

degradation by chlorine solutions over a relatively short time frame and at a relatively high concentration. Increasing the free chlorine concentration in the incubation solution should result in faster degradation of the tensile properties and may lead to cracking of the material. *In contrast, chlorine* resistance is an indication of more stable formulations. The incubation is held at 50°C + 1°C and 10 ppm chlorine concentration. The solution is verified weekly with a conductivity probe to maintain its concentration over time. Geomembranes are tensile tested and observed for cracking for 90 days of exposure.

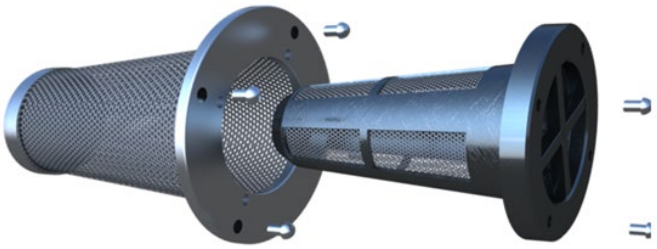
6. Geosynthetic Straps GRI GS-35

GSI has been working on a tensile test method for geosynthetic straps for years. We finally promulgated it as GRI GS-35 "Test method for the determination of the tensile strength properties of geosynthetic straps by subjecting them to tensile loading. This test method is intended for quality control and conformance testing of geosynthetic straps. However, the results can also be used for design.

In determining the tensile strength of various geosynthetic straps, there are numerous difficulties in clamping and testing representative samples due to their thickness, width, coating, stiffness and varying forms of construction. This method performs tensile tests on representative specimens, to determine its strength. From the test data, a force-elongation curve for each test with a description of the type of failure that occurred should be presented. On each of these curves, the ultimate strength and corresponding strain should be indicated. In addition, modulus at a specific strain levels may be requested (i.e., 1, 2, 5 and 7%). The strength of some of these straps is amazing and therefor lends to designing super structures.

7. JET Filter Investigation

Earth retaining structures, such as seawalls, bulkheads, bridge abutments and retaining walls, require proper drainage. Inevitably, hydrostatic water pressure builds up behind such walls over time. Without proper drainage, the wall will subsequently become distressed and possibly experience failure. Maintainable weep hole filters will extend the life of any new or existing structure. JET Filters have proven to be a maintainable weep hole system for both new construction and retrofits of old infrastructure. They consist of a cage and a removable geotextile cartridge for easy operations and maintenance. GSI has written a new test method to evaluate these products over time. The long-term flow test is a bit tricky because it deals with partially saturated flow rather than our conventional Darcian flow. As seen in the pictures below, the process is scalable to the lab and will be presented to ASTM for consideration in the ASTM D1987 test method task group.



8. Lab QUVA Methane and Stress Exposure Simulation

We have experimented a lot with GRI Method GM-35 Standard Test Method for "Measuring the durability of geomembranes that are exposed to Ultra-Violet Radiation, Condensation, Methane and 3-D Stress". This is a complex and time-consuming test to maintain. In truth, all our efforts have proven insignificant. To date, we have not found that it accelerates the aging of geomembranes to any great extent.

9. Mechanical Connection Testing of Geosynthetics to Concrete

Standard Test Method for "Measuring the connection strength of geosynthetic to concrete or mortar" has seen much interest. The objective of this test method is to determine the strength (capacity) of the connection between the geosynthetics and concrete or mortar in the laboratory. Mechanical connection tests are performed in tension to verify that the design load can be adequately transferred from the geosynthetic to the cured pozzolanic material.

The method has two procedures. Both procedures (one where the geomembrane is pulled with the concrete anchored and the other where the concrete is pulled and the geomembrane is fixed) determine the load-deformation behavior of the geosynthetic connection system to provide the engineer with data to judge the adequacy of adhesion of the two-component system. These tests are performed in the laboratory on a continuous rate of extension machine. Therefore, the connection is isolated to a single repeating unit of the embedment liner. Thus, this test is an index test and does not consider group affect influences.

10. Arrhenius Modeling

CARPI Inc. is sponsoring Arrhenius Modeling of four PVC geomembranes formulations at GSI. The Arrhenius method assumes that the mechanism of degradation at elevated temperature is similar to that of degradation under ambient conditions. This ten years plus effort is a huge undertaking for the institute. It keeps our endurance test lab solvent and operable and has provided justification for a large maintenance contract form Q-Panel for several years. We currently have three QUVA fluorescent devices running around the clock at 75, 65 and 55 degrees Celsius servicing this project. We are very grateful for CARPI Inc.'s continued support and interest in the long term durability of their products made at different manufacturing facilities around the world.

11. Durability of PET Geogrids in MSE Walls

GSI Wall pH study and durability of PET GGs is in its 20th year. We continue to measure the pH between three types of dry cast masonry retaining wall blocks. Concern here is over PET geogrids which are known to be sensitive to very high alkalinity environments. Indeed, the PH values started high, but over time they are now down below eight. It is nice to know that Mother Nature likes to buffer things from a pH perspective and we are always trying to reach equilibrium. A paper on this topic will be presented at GeoAmericas 2024.

12. **Comparing geomembrane stabilized with Graphene rather than carbon black**

According to the United States criteria in OSHA HCS for classifying hazardous substances, Carbon Black is not classified for any toxicological or eco-toxicological endpoint. However, as a combustible dust or a reaction by product it is designated by OSHA as a hazardous chemical, particularly when it is airborne. For this reason, some forward-thinking individuals in the geosynthetic industries are looking for alternatives to carbon black to protect the polymer from UV degradation, act as a black pigment, and improve the conductivity. We are currently testing five samples with graphene content from 1 to 5%. We will counterpoint all GRI GM13 properties and report on our findings in the coming year.

13. Destructive vs Trial Welds

A standard quality control (QC) and quality assurance (QA) plan during installation of an unreinforced polyethylene geomembrane often requires destructive testing of the production welded seams at regular intervals. This testing is different from "trial weld testing." Prior to welding of the seams, within the project footprint, a "trial weld" is fabricated on site as a proficiency test. The procedure utilizes project specific geomembrane material, environmental conditions, welding technician and equipment intended to perform the seaming of geomembrane installed as part of the containment system. There are cases where on-site trial welds become difficult to pass, even when experienced crews, quality equipment and materials are present. The difficulty can lead to a scenario where trial welds fail and destructive seam tests pass when sent to a 3rd party lab for testing, (this is a nightmare for geomembrane installers). Variables are numerous and often difficult to identify between these two different testing scenarios. However, we have just written a paper entitled "When Field Seam Test Results Fail, Yet Laboratory Test Results Pass: A Practical Approach to Understanding Why." The paper will be presented at GeoAmericas in Toronto. The paper shows results from a ton of shear and peel tests that gave rationale for the discrepancy with both fusion and extrusion seaming rheology.

14. **Controlling the smooth edge thickness of textured polyolefin geomembranes**

Over the past several years, we have seen a reduction in thickness of the weld edge (smooth edge) of textured geomembranes. This is presenting a challenge for installers when trying to achieve passing trial seams in the field prior to production welding. Seam tests are passing, but just barely (10% above GM19a or less). As a result, we have written GRI GM-37 "Determining the Weld Edge Thickness of Geomembrane" and added notes to GM13 and

GM17 to give a means of evaluating the smooth edge thickness and to try and remedy the situation.

15. Exhuming GS's from Ultra-Lightweight Foam Glass Aggregate MSE Wall

Lightweight fill, including geofoam and expanded shale, are becoming increasingly popular in the United States in terms of construction. Ultra-Lightweight Foam Glass Aggregate (UL-FGA) is a relatively new member of this group in the USA. With its rise starting in Europe in the late 20th century, UL-FGA quickly became a sustainable alternative to traditional lightweight aggregate fills; not only is it made from 100% post-consumer recycled glass, but it also increases the lifetime of other materials within the construction project. We presented a paper at the 12th ICG entitled "Geosynthetic damage due to installation stresses in ultra-light weight foamed glass aggregate versus conventional aggregate" with Loux, Filshill and Schuller.

We are currently extending this work with the exhumation of geosynthetic from the MSE Wall or I-95. This is an amazing site of opportunity. After the tragic bridge collapse and complete closure of I-95 just north of Philadelphia, PA on June 11, 2023, Penn DOT organized an emergency repair to reopen six lanes through this essential transportation corridor. The solution was to build a temporary MSE wall of UL-FGA reinforced with geosynthetics. The structure functioned spectacularly and was constructed in only eleven days. At the end of the year, Buckley Construction Company dismantled the MSE wall and we had the privilege to exhume the geosynthetic contained within. We are currently testing the exhumed materials at GSI and will generate survivability partial factors of safety for each. Results will be available in the next quarter.

16. Strain Hardening Modulus - MQC

The Institute has had a major effort of relating the stress cracking performance of HDPE geomembranes to strain hardening modulus (SHM). The SHM is based on ASTM D6693 testing. This test method is used to develop a test method from which the susceptibility of unaged HDPE geomembrane sheet material to stress cracking under a constant tensile load condition and an accelerated environmental condition can be predicted using strain hardening modulus value. This comparison of characteristics of similar materials by standardizing the method for deriving the onset, modulus, and break point on the stress-strain curve from an HDPE Tensile Test. Strain hardening data can be appropriate for assessing the stress crack susceptibility of HDPE geomembranes. However, it should be very clearly stated that this method shows a good correlation between strain hardening modulus and stress crack performance within a specific formulation (resin type plus master batch). In addition, this method shows very poor correlation between strain hardening modulus and stress crack performance across different formulations. As such, this method is a useful manufacturing quality control (MQC) tool but is not appropriate for setting specification criteria by engineers to compare different geomembranes. To this end, if formulations are compared, they should be of the same supplier, grade, and density. We are looking forward to collaborating with ASTM and ISO on this subject.

17. Exhumed Geosynthetic from MSW Landfill

GSI has completed testing of exhumed geosynthetic from a 31-year-old MSW landfill. The landfill cell had an excellent service record, (less than 2 GPAD leakage rate into the secondary) and was only being exhumed due to a reconfiguration of the landfill footprint and lateral expansion of the cell. GSI has tested Primary and Secondary Geomembranes, Fusion and Extrusion Seams, Geotextiles, Geonet, GCL against all of the requisite GRI specification and base line information. The information is under review by the stakeholders but from preliminary data the geosynthetics are working great and enduring the environmental condition at the bottom of the MSW landfill very well (exceeding expectations). Much more information regarding this effort will be presented in the coming months.

18. Beyond GM-13 and GM-17 Specifications

GM-13 and GM-17 have achieved acceptance and adaption in many markets and countries throughout the world. The documents have been modified over time with 16 and 14 modifications/revisions, respectively. However, the barrier market has significantly expanded in scope, range and expected performance over the past decade. A "one size fits all" approach, while appropriate in the past, is no longer adequate to address the industry's needs. For this reason, GSI has contracted a group of talented engineers and scientists with a wealth of knowledge on formulating and manufacturing PE geomembranes to prepare new

specifications for geomembrane barriers based on application requirements including, but not limited to durability, lifespan, barrier properties and other factors. This process would include investigation of existing databases from multiple sources with review and discussion of the proposed levels and values. This undertaking will be somewhat lengthy and, of course, a proposed output will need review by a larger group. We anxiously await their final report so that we can move forward with three new specifications for HDPE. The three specifications are: Super (High temperature and chemical resilient), Colored HDPE and Conductive HPDE.

19. **Surfactant Replacement for NCTL Stress Cracking Test**

    As many of you know, the Geosynthetic Institute is in search of an alternative surfactant for stress cracking tests for HDPE geomembranes. It has been brought to the attention of the ASTM D5397 task group that the surfactant used in this experiment (Igepal CO-630) is a regulated substance in some countries (i.e., EU REACH directive). For this reason, many labs throughout the world are requesting a substitute-alternative surfactant for determining the stress crack resistance of HDPE via this method.

    GSI is working with the ISO task group on this subject. The German committee of NAUE, SKZ, SOLMAX and HKA are currently in round robin testing with three different GRI geomembranes using BASF's Dehyton PL. These three geomembranes are the same materials that GSI used for the ASTM round robins. Hopefully they will find a REACH (EU) compliant surfactant that has the similar SP-NCTL signature as Igepal CO-630 across HDPE geomembrane formulations commonly used in our industry. We will keep you posted.

Progress within GII (Information)

The bylaws are available to anyone upon request.

As you can see by the listing below, we are still disseminating a lot of new information at the institute.

- GRI Methods, Specifications, Guides & Practices
- Quarterly Newsletters
- White papers
- GSI Website
- Bimonthly GMA Techline
- Bimonthly GSI News Column in Geosynthetics Magazine
- Conference Papers
- GRI Reports

Kathryn Wright, an undergraduate civil engineering student at Lafayette, is working at the Geosynthetic Institute over her winter break. She will be running tests relating to the exhumation of geosynthetics from the I-95 MSE Wall project.

On November 28, Villanova graduate students from Dr. Kristin Sample-Lord's class visited the Geosynthetic Institute to get an in depth presentation on what the Geosynthetic Institute's role is within the industry and an in-person look at research taking place at the institute. Everyone enjoyed the break from their graduate course for one evening!

Villanova University graduate students touring the Geosynthetics Institute

IGS Geosynthetic Handbook

A new effort for GSI is the IGS GS handbook. This handbook will be a dynamic document that will continue to evolve over time, updating as new information and technologies develop. George R. Koerner will be the first editor of the handbook. This practical text is intended to serve as a general reference document in the field of geosynthetics. Polymeric construction materials used in civil applications are now commonly accepted as solutions to geotechnical and environmental engineering challenges. This handbook offers a comprehensive overview of geosynthetics and their various applications. The chapter breakdown and authors of the handbook are as follows:

I **Introduction to Geosynthetics**
(George Koerner)
(geomembranes, geotextiles (filters, cushions, reinforcements), geosynthetic drains (including PVDs), geogrids, geofoam, erosion control, pipe)

II **Geosynthetics in Roads and Pavements**
(Eli Cuelho)
(summary of design and design resources (example global specifications; installation best practices/lessons learned; relevant MQC/MQA

testing practices; contracting considerations; sustainability considerations)

a) Separation and Subgrade Stabilization
b) Base Reinforcement
c) Asphalt reinforcement/Overlays
d) Roadway drainage / subgrade dewatering / wicking / road base drainage

III **Geosynthetics in Subsurface Drainage/Water Storage** (Barry Christopher)

(summary of design and design resources (example global specifications; installation best practices/lessons learned; relevant MQC/MQA testing practices; contracting considerations; sustainability considerations)

a) Land mass dewatering/consolidation
b) Structure drainage
c) Subsurface water reservoirs/water holding facilities
d) Structural Root boxes

IV **Geosynthetics in Erosion and Sediment Control** (Joel and Jay Sprague)

(summary of design and design resources (example global specifications; installation best practices/lessons learned; relevant MQC/MQA testing practices; contracting considerations; sustainability considerations)

a) Hard Armor Systems
b) Slope and Channel Protection
c) Silt Fence
d) River Bank Protection
e) Coastal Shoreline Protection

V **Geosynthetics in Reinforced Soil Systems** (Chris Lawson)

(summary of design and design resources (example global specifications; installation best practices/lessons learned; relevant MQC/MQA testing practices; contracting considerations; sustainability considerations)

a) Overview
b) Embankments over soft foundations
c) Reinforced steeped slopes
d) Mechanically stabilized earth walls and berms

VI **Geosynthetics in Seepage Control Systems** (Kent von Maubeuge)

(summary of design and design resources (example global specifications; installation best practices/lessons learned; relevant MQC/MQA testing practices; contracting considerations; sustainability considerations)

a) Ponds
b) Reservoirs
c) Canals

VII **Geosynthetics in Environmental Protection** (Kerry Rowe)

(summary of design and design resources (example global specifications; installation best practices/lessons learned; relevant MQC/MQA testing practices; contracting considerations; sustainability considerations)

a) Landfills
b) Remediation Sites
c) Industrial Effluent Impoundment
d) Mining

VIII **Geosynthetics Support Systems** (George Koerner)

MQC/MQA
CQC/CQA
Prefabricated Systems
On-Site Fabrication
Standardization
Specification / Regulations
IGS
GSI
Accreditation Programs

IX References / Links

We feel fortunate to have such an esteemed team participating in this effort. We look forward to collaborating with these colleagues and anticipate updates on the handbook which is targeted for release in 2024.

Geosynthetic Institute's upcoming Activities:

- 2024 January 24-26th ASTM D35 Louisville, KY USA
- 2024 April 19-26th ICGEE Busan, South Korea
- 2024 April 28- May 1 GeoAmericas Toronto Canada with GSI Annual Meeting

Members Only Section on Website

Accessible with a members-only password. Your contact person/persons (names listed beneath member company) must obtain a password from Jamie Koerner to access the members-only section of the Geosynthetic Institute website. Jamie can be reached by e-mail at Jamie@geosynthetic-institute.org. When you get into this members-only section, the following information is then available.

- **GRI Test Methods (all)**
- **GRI Reports**
- **GRI Technical Papers (419 Citations)**
- **Notes of GSI Meetings**
- **Links to the GSs World**
- **Keyword Search for Generic Papers**
- **Example Problems**
- **Frequently Asked Questions (FAQs)**

GRI Reports

To date, we have 48 GRI Reports available to members and associate members. These reports vary in length from 30 to 200 pages. They are in the password protected section of our home page at www.geosynthetic-institute.org/member/reports.html.

White papers are available for free to everyone, however GRI reports are only free to members (located in the member's only section of the website). Non-members can purchase the reports from the online GSI bookstore.

Progress within GEI (Education)

GSI Fellowships - 2024

Please note that proposals for individual student fellowship awards for the 2024-'25 Academic Year are due on **Monday, August 19, 2024.**

Webinars - Prerecorded

There are many prerecorded webinars available to purchase on our website. These GSI webinars (1 ½ hours in duration) cover a large variety of topics related to geosynthetics. The webinars that are available can be found listed below and also on our website at:

www.geosynthetic-institute.org/webinar.htm

GSI 1 "A Data Base and Analysis of 320 Failed MSE Walls With Geosynthetic Reinforcement"
GSI 2 "MSE Wall Back Drainage Design"
GSI 3 "MSE Wall Remediation and Monitoring"
GSI 4 "MSE Wall Inspection"
GSI 5 "Geosynthetics in Hydraulic Applications"
GSI 6 "Geosynthetic Applications Used in Heap Leach Mining"
GSI 7 "Geosynthetics in Agriculture and Aquaculture"
GSI 8 "Geosynthetics Applications in the Private Sector"
GSI 9 "Behavior and Analysis of Twenty Solid Waste (Landfill) Failures"
GSI 10 "Wet (Bioreactor) Landfills for Rapid Degradation of MSW Organics"
GSI 11 "Lateral and Vertical Expansions Over Old and Existing Landfills"
GSI 12 "Landfill Covers: Past, Present, Emerging"
GSI 13 "Beneficial Uses of Abandoned and/or Closed Landfills"
GSI 14 "Lifetime Predictions of Covered and Exposed Geosynthetics"
GSI 15 "In-Situ Stabilization of Soil Slopes Using Nailed (or Anchored) Geosynthetics"
GSI 16 "Sand Drains-to-Wick Drains-to-Sand Columns (Including a Major Failure Case History)"
GSI 17 "Geosynthetics in Erosion Control"
GSI 18 "Pond Liner Design and Performance"
GSI 19 "Wave (or Wrinkle) Management [For Proper Deployment of GM"
GSI 20 "Geosynthetic Drainage Materials: Applications, Design, Installation and Performance"
GSI 21 "A Brief Overview of Geosynthetics and Their Major Applications"
GSI 22 "Geosynthetic Reinforced MSE Walls; Overview, Failures and Items for Improvement"
GSI 23 "Geosynthetic Filters: Concerns and Issues"
GSI 24 "Disposal of Coal Combustion Residuals"
GSI 25 "Soil Consolidation by Wick Drains, aka PVDs"
GSI 26 "Applications and Design of Geotextile Tubes"
GSI 27 "Stability Design of Landfill Cover Soils"
GSI 28 "Geomembrane Puncture"
GSI 29 "QA/QC of Geosynthetics"
GSI 30 "Lifetime Durability of Geosynthetics"
GSI 31 "Laboratory Testing of Geosynthetics"
GSI 32 "Sustainability with Geosynthetics"
GSI 33 "Ultraviolet Resistance of Geosynthetics"
GSI 34 "Geosynthetics in Roadways"
GSI 35 "Geosynthetics used in Canal Linings"
GSI 36 "Geosynthetics as Hydraulic Barriers"

Each webinar provides 1.5 Professional Development Hours available upon completion of a short quiz

GSI Members Cost - $200
(unlimited number of attendees for GSI Members)
Nonmembers Cost - $250

Courses

The following pre-recorded courses are available through our online bookstore to both members and non-members.

1. Quality Assurance/Quality Control of Geosynthetic in Waste Containment Facilities
   (Recordings are available)

2. Construction Inspection of Mechanically Stabilized Earth (MSE) Walls, Berms and Slopes
   (Recordings are available)

The third and newest of GSI courses is an On-Line "Designing with Geosynthetics (DwG)" course. Please go to www.geosynthetic-institute.org/courses.htm and scroll down to Course #3. Here you will see the requisite details. The course itself is completely synchronized with the 6th Edition of the DwG textbook. It consists of 1540 slides with ~ 18 hours of voice over; about one minute for each slide.

Contact Jamie Koerner at jamie@geosynthetic-institute.org if you want additional information.

Activities within GAI (Accreditation)

This program is growing steadily with much interest internationally and with the proficiency test program (PTP)

- Began in 1995 w/ISO 17025 as model.
- GSI operates under 17011.
- 123 labs, 24 different countries, 265 possible tests

The following laboratories are accredited by the GAI-LAP for the number of test methods listed in parenthesis.

1A - TRI/Environmental Inc. (155 tests)
Jarrett Nelson -- (512) 263-2101
jnelson@tri-env.com

3A - WSP (43 tests)
Henry Mock -- (770) 492-1893
Henry.Mock@wsp.com

4C - Geosynthetic Institute (108 tests)
George Koerner -- (610) 522-8440
gsigeokoerner@gmail.com

8B - Solmax Geosynthetics (Propex) - Ringgold (18 tests)
Todd Nichols -- 438-553-3757
tnichols@solmax.com

9B - Lumite (17 tests)
Rebecca Kurek -- (770) 869-1787
rkurek@lumiteco.com

13[A] - Precision Geosynthetic Labs (TRI Env.) (76 tests)
Chad Blackwell -- (714) 520-9631
cblackwell@tri-env.com

14[A] - Geotechnics (55 tests)
J. P. Kline -- (412) 823-7600
JPkline@geotechnics.net

20[A] - GeoTesting Express, MA (63 tests)
David Norton - (978) 635-0424
dnorton@geotesting.com

22[B] - CETCO Hoffman Estates (11 tests)
Minerals Technologies Inc.
Dennis Wind – (847) 851-1904
Dennis.wind@mineralstech.com

24[B] - CETCO Lovell (12 tests)
Minerals Technologies Inc.
Ryan Nicholls -- (307) 548-6521
Ryan.Nicholls@mineralstech.com

25[B] - Solmax (TenCate), Pendergrass (13 tests)
Randy Johnson-- (706) 693-2226
rjohnson@solmax.com

26[B] - Agru America Inc. (27 tests)
Serena Evans-- (843) 546-0600
Sevans@AgruAmerica.com

29[e] - FITI Testing and Research Institute (80 tests)
Hang Won-Cho -- 82-2-3299-8071
hwcho@fitiglobal.com

31[D] - NYS Dept. of Transportation (8 tests)
Jim Simonds -- (518) 485-5707
Jim.Simonds@dot.ny.gov

34[B] - Solmax (GSE) - Houston, TX USA (21 tests)
Sai Prasad Namburi
sprasad@solmax.com

38[C] - CTT Group SAGEOS (125 tests)
Oliver Vermeersch -- (450) 771-4608
overmeersch@gcttg.com

40[B] - Solmax (GSE) - Kingstree, SC USA (14 tests)
Bruce Pressley -- (843) 382-4603
bpressley@solmax.com

41[A] - SGI Testing Service, LLC (19 tests)
Zehong Yuan -- (770) 931-8222
ZYuan@sgilab.com

44[B] - Berry Global Inc. (9 tests)
Julie Solarz -- (615) 847-7299
juliesolarz@berryglobal.com

45[B] - Solmax (TenCate) Malaysia SDN Bhd. (29 tests)
Boon Kean Tan -- (603) 519 28576
bktan@solmax.com

46[B] - TAG Environmental Inc. (13 tests)
Manpreet Saini-- (705) 725-1938
manpreet.Saini@tagenv.com

49[B] - Engepol Geossinteticos (16 tests)
Patricia Natali -- (55) 51 3303-3901
patricia@engepol.com

50[B] - ADS, Inc. Hamilton (8 tests)
Justin Elder -- (513) 896-2065
justin.elder@ads-pipe.com

51[B] - SOLMAX - Canada (20 tests)
Claude Cormier -- (450) 929-1234
ccormier@solmax.com

53[B] - Polytex Autofagasta (19 tests)
Mario Contreras Cardenas -- 011 55-288-3308
mcontreras@polytex.cl

55[B] - Atarfil Geomembranes (21 tests)
Gabriel Martin Sevilla -- 34 958 439 200
gmartin@atarfil.com

56[B] - Polytex Santiago (15 tests)
Sebastian Iturrita Monroe-- 011 56-2-677-1000
Siturrita@polytex.cl

57[B] - Solmax (TenCate) - Cornelia (26 tests)
Taylor Kolesnick-- (706) 778-9794
kolesnick@solmax.com

58[B] - Propex Furnishing Solutions - Hazlehurst (10 tests)
Lee Branch -- (912) 375-6180
Lee.Branch@propexglobal.com

59[B] - Holcim Solutions & Products (9 Tests)
Janie Simpson -- (864) 439-5641
Janie.Simpson@holcim.com

60[B] - TDM Geosintéticos S.A. (20 tests)
Henry De La Cruz -- 051-1-6300330
Hdelacruz@tdmgeosinteticos.com.pe

61[B] - Viaflex (24 tests)
Clint Boerhave -- (605) 335-0288
Clint.Boerhave@viaflexcom

62[B] - SOLMAX - Selangor - Malaysia (18 tests)
Pei Ching Teoh -- (450) 929-1234
pcteoh@solmax.com

63[A] - TRI-SC Labs (15 tests)
Jay Sprague -- (864) 346-3107
Jesprague@tri-env.com

64[B] - Agru America (NV) (14 tests)
Ryan Steele -- (775) 835-8282
RSteele@AgruAmerica.com

65[C] - Bombay Textile Research Assoc. (BTRA) (25 tests)
PK Panda (0) 022-25003651
geotech@btraindia.com

66[B] - Rowad International Geosynthetics Co. Ltd (15 tests)
Mohammad Ishad Hussain-- +966-3-812-1360
irshad@rowadplastic.com

69[B] - Solmax - Rayong - Thailand (18 tests)
Siriporn Chayaporenlert – 66-386-36758
siripornc@solmax.com

70[A] - RSA Geo Lab LLC (49 tests)
Rasheed Ahmed – (908) 964-0786
geolab13@yahoo.com

71[B] - Plasticos Agricolas y Geomembranas S.A.C. (25 tests)
Manuel Constantino Olivares Espinoza –
073-511814-511829
calidad@pqapag.com

72[B] - Tensar Corp. GA (5 tests)
Lynn Cassidy-Potts (770) 968-3255
lcassidy@tensarcorp.com

73[B] - Gai Loi JSE (10 tests)
Paul Wong 84-650-362-5825
paul905677@gmail.com

74[B] - Agru America Inc. (9 tests)
Mark Lockliear - (843) 221-4121
mlockliear@agruamerica.com

75[B] - GeoMatrix S.A.S. (45 tests)
Javier Diaz Cipagauta (571) 424-9999
jdiaz@geomatrix.com.co

76[B] - Tehmco (Chile) (18 tests)
Rodrigo Campoy 56-22-580-2852
rcampoym41@gmail.com

78[B] - PAG Mexico (16 tests)
Cesar Agusto Arcila (669) 954-8202
directorcalidad@payg.mex

79[A] - TRI Geosynthetic Testing and Services (32 tests)
Mansukh Patel 86-512-6283-1396
Mpatel@tri-env.com

80[B] - Texel Technical Materials (Alkegen) (10 tests)
Eric Trudel (418) 387-4801
Etrudel@alkegen.com

81[B] - Solmax (GSE) - Rechlin - Germany (18 tests)
Evelyn Kroeger 49-40-767420
ekroeger@solmax.com

83[B] - Solmax Geosynthetics S.A.E. (13 tests)
Ahmed Abdel Tawab - 202-2-828-8888
atawab@solmax.com

84[B] - Owens Corning (18 tests)
Ashutosh Dixit - 1-778-945-2888
Ashutosh.dixit@owenscorning.com

85[B] - PAG Tacna (26 tests)
Manuel Olivares Constantino Espinoza –
073-511814-511829
calidad@pqapag.com

86[B] - BOSTD China (29 tests)
Zheng Hong - 86-532-8780-6917
zhenghong@bostd.com

87[B] - Willacoochee Industrial (19 tests)
Miranda Adams - 912-534-5757
miranda@winfabusa.com

88[B] - Geosynthetic Testing Services Pvt. Ltd. (16 tests)
Ravi Kant - 02717-250019
rkant@gts-pl.com

89[B] - Megaplast India Pvt. Ltd. (13 tests)
Tatwadarsi Tripathy - 91-937404-4620
geo.sqc@megaplast.in

90[B] - Techfab (India) Industries Ltd. - Daman (10 tests)
Anant Kanoi - 91-22-2287-6224
anant@techfabindia.com

91[B] - Techfab (India) Industries Ltd. - Rakholi (3 tests)
Rajendra Chavan - 91-982-593-9922
geogrid.qualitylab@techfabindia.com

92[B] - Techfab (India) Industries Ltd. - Khadoli (2 tests)
Navir Kumar - 91-22-229-76224
woven.qualitylab@techfabindia.com

93[B] - Garware Technical Flbres (19 tests)
Rajendra K. Ghadge - 0-932-601-8083
rghadge@garwarefibres.com

95[B] - Mexichem Colombia (Pavco) (8 tests)
Jenny Colmenares Chavez - 57-1-782-5100 (ext. 1534)
jienny.colmenares@wavin.com

96[B] - Tensar China (7 tests)
Zhu Shaolian - 603-6148-3276
zsl@tensar.com.cn

97[A] - TUV SUD PSB Singapore (17 tests)
CHA Ming Yang - 65-6885-1514
ming-yang.CHA@tuv-sud.psb.sg

99[B] - Atarfil Middle East (16 tests)
Mohammad Hneine - 971-564-33-1271
mhneine@atarfil.com

100[B] - Atarfil Geomembranes USA (12 tests)
Alejandro Carreras - 757-263-4057
acarreras@atarfil.com

101[B] - Solmax (GSE) - Spearfish, SD USA (7 tests)
Chuck Taylor - 605-642-8531
ctaylor@solmax.com

102[B] - SKAPS Industries (12 tests)
Sadhvi Arora - 706-336-7000
sadhvi.Arora@skaps.com

103[B] - STRATA Geosystems Pvt. Ltd. (24 tests)
C. V. Kanade - 91-22-4063-5100
cv.kanade@strataindia.com

104[A] - Advanced Terra Testing (32 tests)
Kerry Repola - 303-232-8308
krepola@terratesting.com

105[B] - Pavco Wavin - Peru (8 tests)
Nestor Sifuentes Boggio - 51 990 277 136
nestor.sifuentes@wavin.com

107[A] - TRI Australasia PTY LTD (38 tests)
Warren Hornsey - +617-5535 7227
Whornsey@tri-env.com.au

108[B] - Solmax Geosynthetic Co. Ltd. Suzhou (13 tests)
Pei Ching Teoh - 86512-66667-6100
pcteoh@solmax.com

109[B] - Hock Technology Co. Ltd. (17 tests)
Song Binghong - 186-7873-9722
Binghong.Song@sdhock.com

110[C] - Geofabrics Australia Pty. Ltd. - GRID (53 tests)
Ryan Hackney - 61-42-781-0392
r.hackney@geofabrics.com.au

111[B] - Huesker Inc. - Shelby (9 tests)
Callie Kesterson - 704-406-8308
ckesterson@huesker.com

112[C] - Instituto Mauá Tecnologia Brazil (14 tests)
Henrique Nelson Satkunas
Henrique.satkunas@maua.br

113[B] - Azul Pack Filmes - Embalagens (7 tests)
Camila Nicoletti Brito
Camila.brito@azulpack.com.br

114[B] - Lonax Industria Brasileira DeLonas Ltda. (13 tests)
Felipe Diniz
qualidade@lonax.com.br

115[B] Doha Waterproof Factory (21 tests)
Ahmed Al-Masre
infor@dohawaterproof.com

116[B] Soleno Textile Techniques Inc. (6 tests)
Kathie Fleury
kfleury@soleno.com

117[B] Reinforced Earth India Pvt Ltd. (4 tests)
Robert Lozano
Rlozano@reinforcedearth.com

118[B] Layfield Canada (9 tests)
Richard Langford
Richard.Langford@layfieldgroup.com

119[B] Mexichem Brasil (10 tests)
Nathalia Miyahara
Nathalia.Miyahara@wavin.com

120[B] Gold-Joint Testing Technology. (26 tests)
ACE Geosynthetics
Amy Tang
amy.tang@geoace.com

121[B] Techfab (India) Karajgam (18 tests)
Prabhu Tripathy
p.Tripathy@techfabindia.com

122[B] TDM Geosinteticos Brasil (6 tests)
Wladimir Caressato
Wcaressato@TDMbrasil.com.br

123[B] Tecelagem Roma Ltda (6 tests)
Marcos Fernando Leme
qualidade@roma.ind.br

124[B] Geo Source (7 tests)
Pravin Dilip Bhokare
qc@geosource.in

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

We have 5 new laboratories that joined the GAI-LAP program this year. If anyone desires more information on the GAI-LAP program, its test methods, the associated laboratories, etc., please go to our website www.geosynthetic-institute.org/gai/lab.htm or contact George Koerner.

Activities within GCI (Certification)

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

Applications to sit for the GCI-ICP exams need to be submitted to the Geosynthetic Institute for approval prior to taking the exams. Applications and payment information for the exams can be found at: https://geosynthetic-institute.org/applications.htm

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

TRI Environmental Inc. teaches two courses, "Construction QA/QC for Geosynthetic Installation" and "Construction QA/QC for Compacted Clay Liners and GCL Installation" in preparation for taking the Inspector Certification exams. More information can be found on TRI Environmental website.

The Geosynthetic Institute has a pre-recorded "QA/QC of geosynthetics in waste containment facilities" course that can be purchased by anyone wanting to take the course online (accommodates your schedule) in preparation for the GCI-ICP certification exams. More information can be found at: www.geosynthetic-institute.org/courses.htm

Inspector Certification Test Results 2006-2023

Year	Geosynthetic Materials		Compacted Clay Liners	
	No. of people taking exam	No. of people failing exam	No. of people taking exam	No. of people failing exam
2006	141	5 (3%)	128	12 (9%)
2007	82	11 (13%)	73	12 (16%)
2008	95	25 (26%)	89	20 (22%)
2009	36	7 (19%)	36	2 (5%)
2010	59	12 (20%)	54	7 (13%)
2011	54	6 (11%)	53	3 (6%)
2012	34	5 (15%)	28	3 (11%)
2013	32	4 (12%)	30	1 (3%)
2014	45	1 (3%)	42	3 (7%)
2015	56	6 (11%)	51	6 (12%)
2016	36	3 (10%)	35	5 (18%)
2017	78	5 (6%)	66	3 (4%)
2018	53	5 (10%)	51	1 (3%)
2019	114	20 (18%)	119	15(13%)
2020	100	14 (14%)	92	10 (11%)
2021	70	14 (20%)	61	8 (13%)
2022	89	15 (17%)	80	13 (16%)
2023	81	18 (22%)	76	13 (17%)
Total	**1255**	**176 (14%)**	**1173**	**137 (12%)**

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

While a field inspector cannot require proper design or direct a contractor how to build a wall, flaws can be identified for possible design modification or mitigation action. Furthermore, and at minimum, construction practices can be observed and corrected if inadequate or improper. The official launch of this inspection program was on December 1, 2011 with a course and the examination afterward. A somewhat revised course on November 29, 2012 was presented. Presently, the corresponding course for this certification program has been transferred into a series of six presentations that have been recorded and can be viewed at your leisure.

Program #3 - Geosynthetic Designer Certification

Please see www.geosynthetic-institute.org/gdcpintro.pdf for the requisite details. Included are introduction requirements, application, reference material, sample questions, proctor manual and proctor application. You must have six-months of geosynthetic designer experience to take the exam.

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. GSI has affiliated institutes in two countries (Korea and India), and potentially others in the future. These affiliated institutes are full members of GSI and are empowered to translate and use all available information so as to create similar institutes and activities in their respective countries.

GSI-Korea was formed on February 9, 1998 as a collaborative effort between FITI Testing and Research Institute (a quasi-government organization) and INHA University (through its Geosynthetics Research Laboratory). **INHA University** is located in Incheon and the geosynthetics laboratory is led by Professor Han-Yong Jeon.

Dr. Jeon is happy to announce and chair the **2nd International Conference on Geosynthetics and Environmental Engineering (ICGEE2024)** to be held on April 19–20, 2024, in Busan, South Korea. The ICGEE2024 combines Academia with Industry to adapt scientific achievements into practical applications in the field of Geosynthetics and Environmental Engineering. The 2nd ICGEE will continue to promote relevant engineering research and applications in a vast range of topics, including Geosynthetic applications and sustainability, Civil and Structural Engineering, Environmental Engineering and Science. The event will give researchers and engineers from around the world the opportunity to present and discuss recent developments in the field. The call for papers is open. Please choose one of the following links to submit your contributions:

https://www.icgee.com/openconf/openconf.php
Email: cfp@icgee.com

Important Dates for 2nd ICGEE Conference:
Submission Deadline: February 20, 2024
Notification Date: March 10, 2024
Registration Deadline: April 15, 2024

GSI-India under the direction of Dr. T.V. Sreekumar was formed in 2015. The hosting organization is the Bombay Textile Research Association (BTRA) which is a premier textile research institute providing testing, research, training and consultancy services. BTRA is located in

Mumbai, India and is accredited as per ISO 17025. The Geosynthetic test lab is also GAI-LAP accredited. Testing at BTRA is performed as per the latest EDANA, ASTM, INDA, AATCC, ISO, EN and AASHTO international standards. BTRA is known for its excellence in textile R & D and is currently branching out into all forms of geosynthetics with a fantastic R & D laboratory.

GSI Member Organizations

We Sincerely Thank all 63 (47 full and 16 associate) Members Organizations of the GSI family for their continued guidance and support. Without members, GSI could not exist. The current GSI member organizations and their contact members are listed below.

Solmax
Mark Harris/Jacques Cote/Simon Gilbert St-Pierre/ Jimmy Youngblood/Guillaume Beaumier
U.S. Environmental Protection Agency
David A. Carson (BOA)
Federal Highway Administration
Silas Nichols/Daniel Alzamora
Golder Associates Inc.
Frank Adams/Paul Whitty/Linda Grover
Tensar International Corporation
Mark H. Wayne/Joseph Cavanaugh/Jacek Kawalec [BOA]
TenCate Geosynthetics
John Henderson/John Lostumbo/Rene Laprade [BOA]
Minerals Technology/CETCO
Reza Gorakhki/Stacy Byrd/Michael Donovan/Hilary Walker
Huesker, Inc.
Flavio Montez/Andreas Elsing
NAUE GmbH & Co. KG
Alexander Naue/Henning Ehrenberg [BOA]
Propex Operating Company LLC
Drew Loizeaux/Noah Nichols
Berry Global Inc.
Keith Misukanis/Monica Baker
TRI Environmental Inc.
Sam R. Allen [BOA]/C. Joel Sprague
U. S. Army Corps of Engineers
Kevin Pavlik/Richard DePasquale
Chevron Phillips Chemical Co.
Ashish Sukhadia/Lawrence Szmutko/Miranda Rine [BOA]
CARPI, Inc.
Alberto M. Scuero/Massimo Bugliosi/John A. Wilkes
Civil & Environmental Consultants, Inc.
Tony Eith
AGRU America, Inc.
Tom Nichols/Markus Haager
INHA (GSI-Korea)
H.-Y. Jeon
Waste Management Inc.
Greg Cekander/Burrill (Bo) McCoy [BOA]
GeoComp/GeoTesting Express
W. Allen Marr/Gary Torosian/Joe Tomei
ATARFIL
Emilio Carreras Torres/Jorge Fernandez Lopez/ Gabriel Martin/Alejandro Carreras Torre
Republic Services Inc.
Joe Benco/ Mike Beaudoin/Dave Vladic
InterGEO Services Co.
Şükrü Akçay/Archie Filshill
Viaflex
Clint Boerhave/Stacy Coffin/Greg Anderson
CTI and Associates, Inc.
Te-Yang Soong [BOA] / Kevin Foye
Advanced Earth Sciences, Inc.
Kris Khilnani/Suji Somasundaram
Carlisle Syntec, Inc.
Paul Markel/Vivian Zhang
EPI, The Liner Co.
Daniel S. Rohe/Paul Livingston
Weaver Consultants Group, Inc.
Mark Sieracke
Aquatan (Pty) Ltd.
Piet Meyer/ Sanet van der Merwe
Jones Edmunds, Inc.
George Reinhart/Tobin McKnight
Afitex-Texel
Pascal Saunier/Stephan Fourmont
BTRA (GSI-India)
T. V.Sreekumar/ R.A. Shaikh
Watershed Geosynthetics LLC
Michael Ayers/Steve Mayes/ Bryan Scholl
Maccaferri
Moreno Scotto/Sachin Mandavkar/Knight Piesold
Jones & Wagener (Pty) Ltd.
Jabulile Msiza/Angelique Grieve
Ardaman & Assoc.
Mohamad Al-hawaree/Thomas S. Ingra
American Wick Drain
Scott Morris /Seth Marlow/Jeff Quill
INOVA Geosynthetics/AERO Aggregates
Archie Filshill/Theresa Loux
Owens Corning Science & Technology LLC
Katie Hill/Jason Woodall
SKAPS Industries
Nilay Patel/Anurag Shah
Duke Energy
Asha Sree/Ken Karably
Chesapeake Containment Systems (CCS)
Ryan Kamp
Layfield Group
Deepaksh Gulati/Mark Simpson/Brian Fraser [BOA]
Engepol Geossineticos Ltda
Patricia Ferreira/Andréia Machado/Ildo Oliveira
Concrete Canvas
Lee Church/Melanie Fuhrman/Nathan Ivy
Jet Filter System
Doug Stoutin/Greg Heilman
Cooley Inc.
Lance Reed/Ray Peebles
Doha
Ishad Abdulsalam/Ahmad Al-Masre
Dow Inc.
Dell Doyle/ Rhythm Chokshi
Azul Pack Filmes & Embalagens Ltda
Leonardo Dhein-Azul Pack/Camila Valle/Daniel Moreno Meucci
IKO-Axter SAS (Colanche)
Bertrand Breul/Preston Kendall/Natalie Daly

Associate Members

Delaware Solid Waste Authority
Robin Roddy/Lindsey Baer
Nebraska Department of Environmental Quality
Michael Behrens

New York Department of Environmental Conservation
Sheri Mazurek
Maine Department of Environmental Protection
Victoria Eleftheriou
New York Department of Transportation
Steve Heiser
California Water Resource Control Board
Scott Couch/ Brianna St. Pierre/Joshua Munn
New Jersey Department of Environmental Protection
Tom Farrell
Pennsylvania Department of Environmental Protection
Jason Dunham
Florida Department of Environmental Protection
Joe Dertien
U.S. Bureau of Reclamation
Brian Baumgarten/Peter Irey
Michigan Dept. of Environmental Quality
Margie Ring/Tiffany Johnson
Environment Agency of U. K.
Darren Legge
Florida Department of Transportation
David Horhota
National Resource Concservation (NDCSME)
Laura Wilson
Virginia Department of Environmental Quality
Jenny Poland
Massachusetts Department of Environmental Protection
Tom Adamczyk
Pennsylvania Department of Transportation
Beverly Miller/Kruz Schrann