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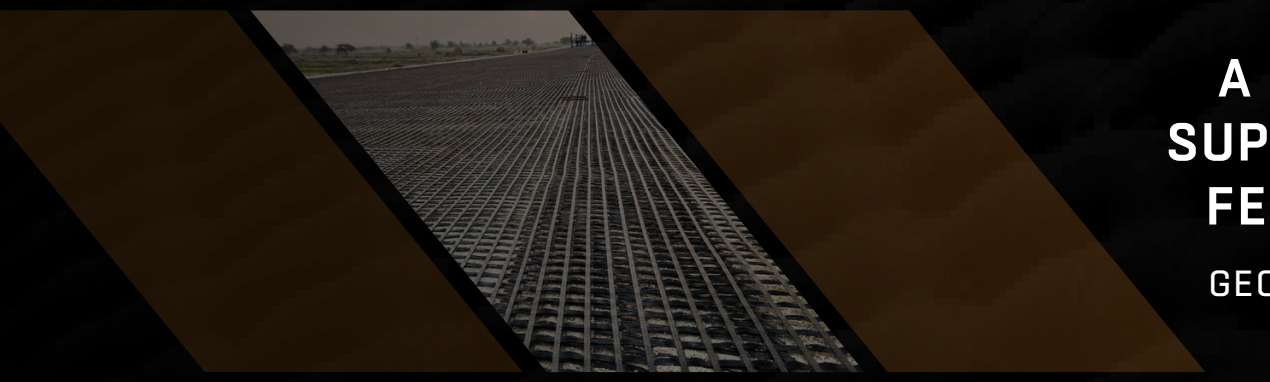
SPECIAL ISSUE

TRENDS AND INNOVATIONS 2025



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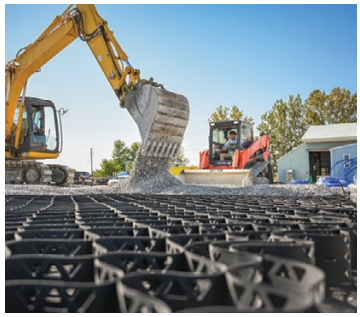

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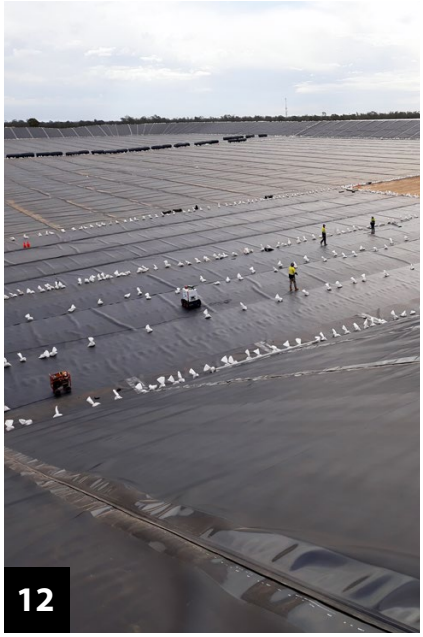
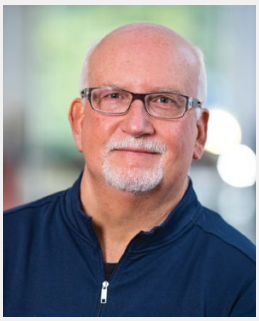


A closer look at trends in the geosynthetics industry



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For this special 2025 Geosynthetics Digital Supplement, we delve into specific trends in three significant geosynthetics categories: Geomembranes, geogrids and geotextiles.

Pamela Mills-Senn takes a look at geogrids with representatives from Maccaferri, Titan Environmental Containment, and TechFab USA. One of the major concerns that arose from these conversations is that as extreme weather becomes increasingly common, the demand for geogrid applications to prevent or address environmental damage is rising. Climate change is sparking infrastructure and construction projects, making these products even more essential so they will continue to be integral in managing soil stabilization in regions vulnerable to environmental stressors. Companies are also exploring cutting edge research and development and looking into the fusion of nanotechnology, smart geosynthetics and artificial intelligence to enhance the functionality and performance of its products. An area of potential concern pertaining to geogrids is microplastics/microplastic emissions and that using geosynthetics significantly reduces microplastic emissions by streamlining construction processes and minimizing the needs for natural resources like gravel, sand and clay.

For Kelly Hartog's feature on the geomembrane market, she talks with representatives from ATARFIL, Viaflex and XR Geomembranes to discuss how their businesses are focusing on the evolution of the industry. The discussions include a trend in site-specific geomembrane development and manufacturing where pre-known site conditions allow for better-fitting formulations as well as developing products that allow for more friendly use of resources that limit damage to the environment. Increased sustainability also continues to be a focus area among owners, engineers and utilities with more attention focused on broader acceptance of alternative materials in the geomembrane space.

And Shelly Miron speaks with AGRU America, HUESKER and TYPAR Geosynthetics about current and ongoing trends in the geotextiles industry and recent innovations at their companies. Continued growth, multiple company mergers and product innovation are reflected in the global geotextile market, and these discussions included prioritizing sustainability in products specs, particularly in regards to PFAS (per- and polyfluoroalkyl substances) protection and the trend toward ensuring products protect the environment. Other insights include a focus on more sustainable options for the use of geotextiles, better ways to use recycled materials, the moving of sites toward Zero Waste to Landfill, and the aim to remove plastic waste from manufacturing and construction projects.

We hope you enjoy this special digital supplement and find this geosynthetics information valuable!

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Trends in geogrids: crisis and opportunity

As extreme weather becomes increasingly common, the demand for geogrid applications to prevent or address environmental damage is rising. Climate change is also sparking infrastructure and construction projects, making these products even more essential.

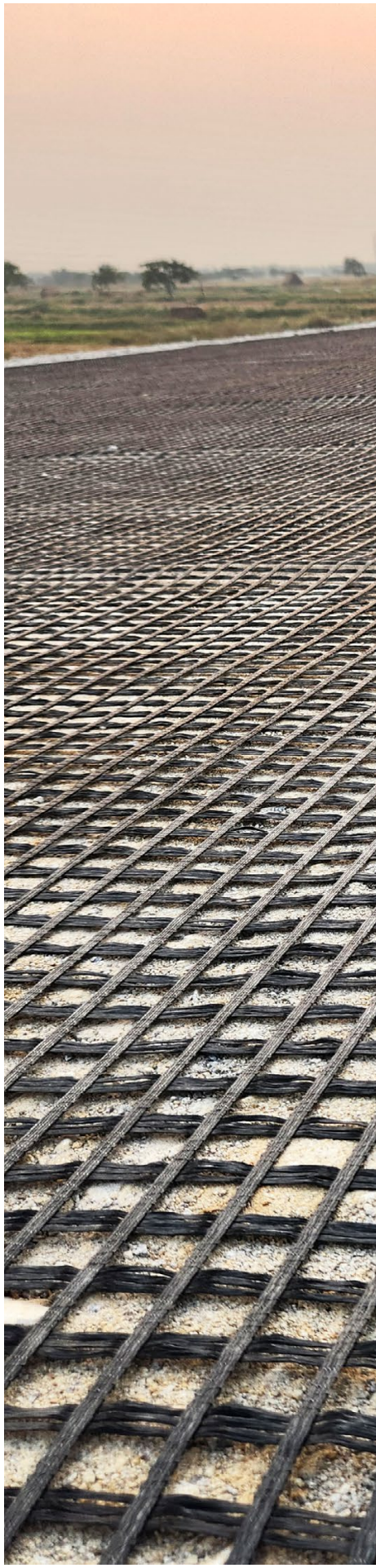
By Pamela Mills-Senn

The demand for geogrids is accelerating, driven in no small way by environmental changes—changes that have intensified the need for these types of solutions, says Sean Bradley, business development manager, Southeast, for Maccaferri.

"Geogrids are increasingly being used to address geotechnical challenges such as poor soil conditions, flooding and erosion control," he explains. "As climate changes and extreme weather events become more frequent, geogrids will continue to be integral in managing soil stabilization in regions vulnerable to [these] and other environmental stressors."

At the same time, geogrid manufacturers, like those in other industries, are facing the challenge of becoming more eco-friendly, both in their processes and in what they offer. This has caused many to explore sustainable geosynthetics and practices as well as to investigate smart technology, artificial intelligence and other strategies that would allow them to operate more efficiently and improve the performance and durability of their products. Their efforts could ultimately serve to reduce the carbon footprint often accompanying construction and infrastructure projects. Still, even in their current iterations, geogrids confer important earth-friendly benefits—for example, by reducing the need for traditional materials such as concrete and steel, says Bradley, the extraction and transportation of which create their own negative environmental impacts.

The overarching intentions are to devise robust, longer-lasting geogrids that can weather the harshest conditions without compromising their performance, offer innovative solutions for existing and new applications and further expand demand and use. The following are what some geogrid manufacturers are doing to ensure they meet these objectives both now and in the future.



Pamela Mills-Senn is a freelance writer based in Seal Beach, Calif.

FIGURE 1 TechFab offers a diverse range of geogrid reinforcement formats. Shown here is the company's biaxial 80 knitted 80 kN/m TechGrid deployed for pavement applications. Photo courtesy of TechFab/TechFab USA.

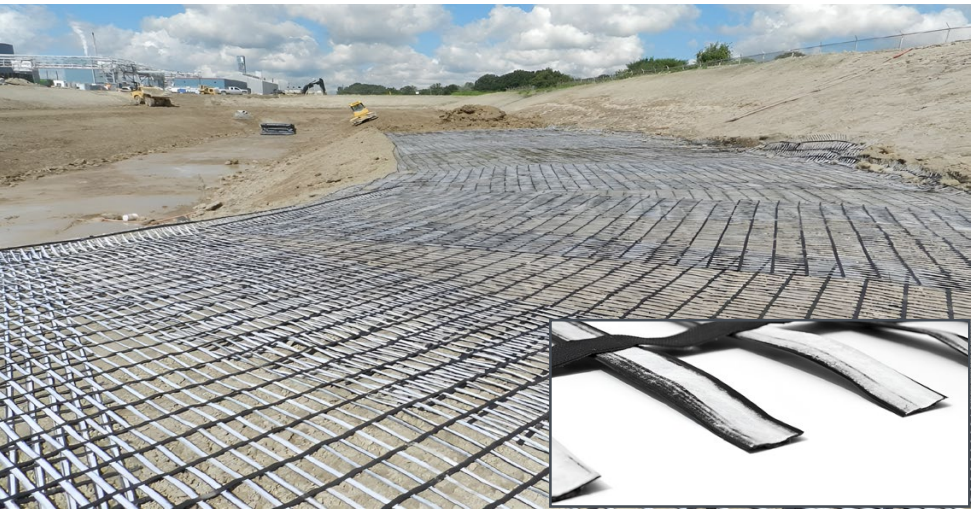


FIGURE 2 Manufactured from high tenacity, multifilament polyester yarns aligned and coextruded with LLDPE to form polymeric strips, Maccaferri's ParaDrain is designed to facilitate drainage. It's deployed for the reinforcement of cohesive soils with low permeability and high moisture content, as shown here where the grid is being used to help stabilize an embankment.

FIGURE 3 Inset is a close-up view of ParaDrain's structure. By enabling moisture to more rapidly leave the soil, the geogrid allows for increased speed of construction, resulting in greater production efficiencies. Photos courtesy of Maccaferri.

FIGURE 4 Designed for reinforcement applications in combination with concrete wall facing panels, the ParaWeb geogrid from Maccaferri is being used here as a geogrid reinforcement layer for a concrete panel facing a MSE (Mechanically Stabilized Earth) wall.

FIGURE 5 The ParaWeb strips, shown inset here, are planar structures consisting of a core of high tenacity polyester yarn tendons encased in a LLDPE sheath. The geogrid is specially coated to enhance resistance to environmental challenges such as UV rays, moisture and chemicals. Photos courtesy of Maccaferri.

Need propels innovation

Headquartered in Hagerstown, Md., Maccaferri has been providing civil engineering, geotechnical and environmental solutions for 145 years, creating sustainable products designed to support infrastructures across various sectors. Among the global company's offerings are those focused on retaining walls, slope protection, hydraulic engineering and geosynthetics.

There are several key trends influencing the geogrid market and driving product development, says Bradley, including the interest in green infrastructure and in products with extreme-weather resistance. Technological advancements in manufacturing figure in as well.

"As environmental factors continue to shape sustainability needs and resilience to more severe weather, this will require innovation in the geogrid manufacturing process to improve performance and cost effectiveness," he says. "This should also lead to a continued variety of products being used for more specialized applications."

Two of the company's geogrids are ParaWeb® and ParaDrain®. ParaWeb's strips are "planar structures" that consist of a core comprised of "high-tenacity polyester yarns encased on a polyethylene (LLDPE) sheath." The product—intended for reinforcement applications in conjunction with concrete wall facing panels—combines high tensile strength and durability, providing long-term resistance to UV rays, moisture and chemicals, even under harsh weather conditions and soil environments.

"ParaDrain is manufactured from high-tenacity, multifilament polyester yarns aligned and coextruded with LLDPE to form polymeric strips," Bradley says. "The longitudinal strips have a channel shape and are covered by a geotextile to provide draining capacity in this direction. The strips are laid flat in the machine direction with a secondary strip laid and welded across the full width in the cross direction."

Designed for applications requiring the reinforcement of cohesive soils characterized by low permeability and high moisture content, ParaDrain's key feature is its "excellent drainage performance," he says, explaining that its earth reinforcement properties are comparable to the typical uniaxial geogrids. "[But] with the [additional] benefit of a drainage channel that can assist with compaction and drainage when working with very poor cohesive soil," Bradley adds.

Maccaferri also offers sustainable soil reinforcement and stabilization solutions to the mechanically stabilized earth (MSE) wall market. Referred to as the Terramesh® family, these can be designed for use with geogrids as the reinforcement element. Maccaferri also has acquired NESA Srl, an Italian company that designs, makes and installs instruments for environmental and industrial monitoring as well as for early warning systems. The objective behind this purchase, says Bradley, is to integrate smart systems into their own products for monitoring and performance studies.

"The geogrid market is experiencing innovation driven by the growing need for more durable, sustainable and efficient solutions," says Bradley, who predicts the entry of increasingly sophisticated and versatile products into the market.

"As infrastructure needs evolve and sustainability becomes a central focus, these innovations are paving the way for more cost-effective, long-lasting and environmentally responsible geogrid applications in the future," he says.

The geogrid market is experiencing innovation driven by the growing need for more durable, sustainable and efficient solutions.

FIGURE 6 Here, the Swamp Grid™ from Titan is being deployed at the Transcona railyard in Winnipeg, Man., Canada. The Canadian National Railway wanted an additional six-track extension at the yard; a challenge since the site was swampy, with wet and soft clay soils. The biaxial Swamp Grid, consisting of Pyramid Grid™ bonded to a six-ounce continuous filament, needle-punched nonwoven geotextile provided the solution. Photo courtesy of Titan Environmental Containment Ltd.

Billion-dollar demand

"The global demand for geogrids is increasing by leaps and bounds due to increasing infrastructure development," says Sam Bhat, CTO Geosynthetics for Titan Environmental Containment Ltd. "Clients are looking for technically superior, sustainable, cost-effective and user-friendly geosynthetic solutions compared to traditional methods."

With locations across Canada and in the U.S., Titan is a global organization that over the last 18 years has been offering a wide range of geosynthetic solutions as well as comprehensive technical services and design support to address civil and geo-environmental engineering needs. The company specializes in the supply and installation of geogrids, geotextiles, geomembrane liners and more to industries including civil infrastructure, mining, agriculture, waste/wastewater management, oil and gas.

Bhat provides search-engine-sourced figures placing the approximate value of the global geogrids market as $1.3 billion (USD) in 2023, with expectations this will increase to nearly $2 billion by 2032. Market growth is steady, he says, propelled by global warming, degrading permafrost, and induced ground freeze and thaw cycles, among additional factors.

"The cumulative impact of these complexities has led to increased maintenance expenses, has curtailed road lifespan and has elevated safety concerns for inhabitants," he says, adding that economic activities have also become a concern. "Hence,

the geogrids and other related products need to be innovated and designed to resist the freeze-thaw cycles and be able to perform in extreme temperatures."

To this end, Titan has been developing a new geogrid composite specifically designed to withstand freeze-thaw cycles and extreme weather while reducing frost-heave damage. The comprehensive product offers reinforcement, separation, drainage, filtration and wicking, preventing pooling and reducing "the accumulation of pore pressure," Bhat says.

"This is a novel composite material created as a result of bonding an open aperture, high stiffness polymeric geogrid to a nonwoven geotextile possessing wicking properties in addition to the reinforcement and hydraulic properties of the composite material," he explains. "Wicking properties refers to the water movement through the material horizontally and vertically at zero hydraulic gradient."

Another product is the Swamp Grid™, an engineered, high stiffness geogrid composite deployed for various purposes, including oil-platform access roads, temporary military roads, forestry and logging roads, coastal roads and parking lots, railway sub-ballasts, soft-saturated subgrades and foundation support. The geogrid component is made from polypropylene that has been heat bonded to the geotextile component, which is comprised of a continuous filament PET needle-punched nonwoven.

"[It is] designed as an all-in-one solution for soil reinforcement, with added soil filtration, separation and subbase drainage performance," Bhat says. "It provides up to 40 percent savings in granular thickness, thus greatly reducing the CO_2 footprint.

"There are still knowledge gaps in the industry. Hence the correct education is the key to the future for geogrids and for gaining maximum benefit from their usage," he continues, adding that Titan is "aggressively considering sustainable geosynthetic solutions, is using AI models in our research projects, as well as exploring smart geogrids."

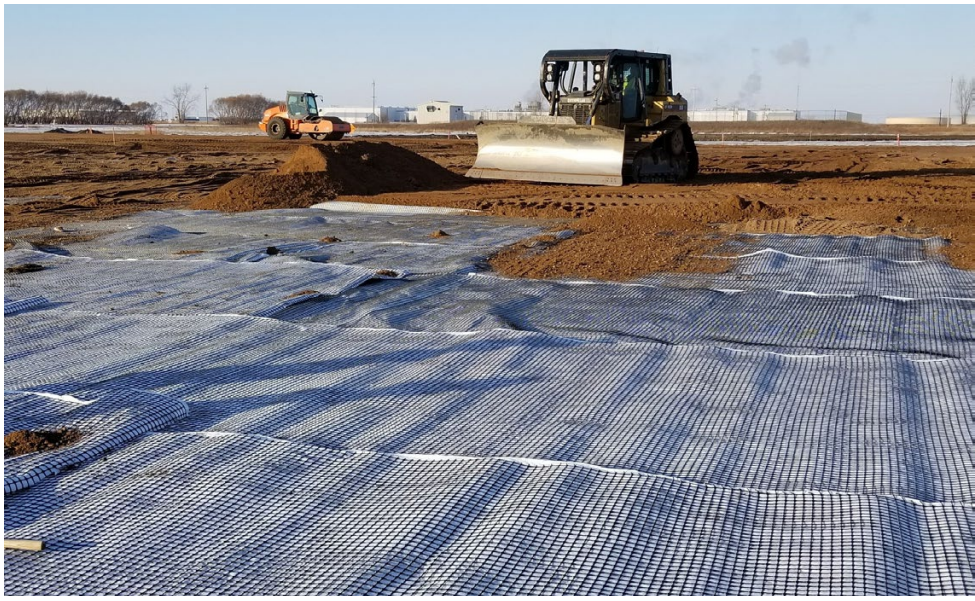


FIGURE 7 Featured is a jobsite under development at the Roquette pea processing plant in Portage la Prairie, Man., Canada. The site was subjected to a high volume of vehicle traffic with very heavy axle loads. The Titan Swamp Grid was utilized to provide the necessary reinforcement by incorporating one layer of the geogrid at the interface of the granular sub-base course and the sub-grade, enabling the site to withstand the heavy traffic footprint. Photo courtesy of Titan Environmental Containment Ltd.

Forecast? Continuing growth

Robert Lozano, general manager R&D and Product Application for TechFab USA Inc., also feels optimistic about the geogrids market, predicting continued growth over the next five-to-10 years, thanks to increased infrastructure demands, including from the commercial and residential sectors.

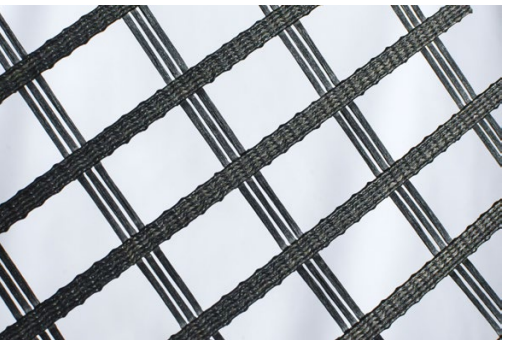
"Additionally, applications that are not visible to the public are growing," he says. "Applications such as landfills, water management structures and protection of federal and state assets will become progressively critical for the growth of the geogrid market."

TechFab USA is located in Holmdel, N.J.; TechFab India Industries Ltd. is

FIGURE 8 Railway track beds running from Edmonton to Edson, Alta., Canada, needed to be twinned, a project taking place during the winter and over poor soil conditions. Titan deployed its Swamp Grid 30 geogrid as a means to stabilize the railway track bed, utilizing a three-lift design, with each lift including one layer of the geogrid along with gravel. Photo courtesy of Titan Environmental Containment Ltd.

FIGURE 9 (TOP) This photo details the structure of TechFab's uniaxial knitted TechGrid. Constructed from polyester yarn with a PVC coating, the reinforcement grid is used for applications requiring high tensile strength.

FIGURE 10 (BOTTOM) Various grades of the TechGrid solution from TechFab are shown here being used in a reinforced soil wall system with block facing. TechGrid's characteristics make it suitable for applications like retaining walls, roadways, embankments and slope stabilization. Photos courtesy of TechFab/TechFab USA.



headquartered in Mumbai. Founded in 2003, the geosynthetics manufacturer offers solutions for infrastructure and environmental projects such as highways and railways, retaining walls, ports, landfills and more. The company provides international markets with a diverse product portfolio that includes geogrids, geotextiles, drainage composites and prefabricated vertical drains as well as customized solutions.

Although offering multiple geogrid products, TechFab's current focus for the U.S. market is on TechGrid. Described by Lozano as a "high-performance, polyester-knitted geogrid" and one of the company's "flagship products," TechGrid is intended for reinforcement applications that are especially challenging.

He says the product demonstrates "superior connection performance with segmental concrete blocks," allowing users to deploy a cost-effective solution that doesn't sacrifice stability or functionality. The product's qualities of high tensile strength and durability, along with "minimal creep deformation," make it "ideal" for applications such as retaining walls, roadways, embankments and slope stabilization, Lozano says.

Interest in geogrids is on the upswing for several key reasons, especially from the construction and infrastructure sectors, he says.

"Rising investments in transportation projects such as highways, bridges and railways drive demand for geogrids. These solutions are essential for retaining structures, soil reinforcement and enhancing load-bearing capacity," he explains, adding that the need for materials capable of withstanding harsh environmental conditions is another contributing factor.

An area of potential concern pertaining to geogrids Lozano mentions is that of microplastics/microplastic emissions, an

issue increasingly popping up on people's radars. Since geogrids and geosynthetics are primarily comprised of plastics, they can be looked at as contributing to this problem. However, this is not necessarily the case, he says.

"Using geosynthetics significantly reduces microplastic emissions by streamlining construction processes and minimizing the needs for natural resources like gravel, sand and clay," Lozano explains. "Traditional construction methods involve extensive extraction and transportation of these materials, leading to environmental degradation and higher carbon emissions."

"By replacing conventional materials, geosynthetics cut down on energy-intensive extraction and processing stages, reducing both environmental impact and the risk of microplastics pollution," he continues. "Their durability also decreases the need for frequent repairs, further lowering the demand for new raw materials over time."

They are "fully committed" to sustainability and as such, actively support the International Geosynthetics Society (IGS) and the efforts underway to standardize and advance environmental responsibility, Lozano says.

"The company aims to align with the UN's global sustainability goals and promote eco-friendly construction practices through innovations in materials and design," he says.

"TechFab is also exploring cutting-edge research and development. We are looking into the fusion of nanotechnology, smart geosynthetics and artificial intelligence to enhance the functionality and performance of our products," Lozano continues, adding that currently, he's especially excited about the innovations in the utilization of new fibers and in textile technologies, both of which are expanding the applications of geosynthetics for use in marginal soils. G

Lifting the veil on the geomembrane market

By Kelly Hartog

In 2024, the geomembrane market size was estimated at almost $2,477.9 million, with the market expected to nearly double by 2034 to around $4,124.6 million.

There has been an ongoing worldwide push in the industry for more environmentally conscious products by consumers, along with greater government regulation requirements for these man-made outdoor containment barriers.

Geosynthetics spoke with representatives from three major companies, who addressed how their businesses are focusing on increased sustainability and the evolution of the industry.

On trend

Jorge Fernández López is the sales and marketing director at ATARFIL in Granada, Spain. Established in 1995, ATARFIL specializes in safe containment solutions mainly for waste, water and mining applications, and focuses on the design and manufacture of polyolefin (PE) geomembranes. The company has manufacturing facilities in Spain and Dubai as well as R&D facilities that collaborate with a variety of institutions to develop site-specific geomembranes. ATARFIL also has sales offices in the U.S., Australia, Turkey and Mexico.

Sustainability, López says, is part and parcel of the company's goals.

"Safe containment is a [form] of sustainability, and it's related to a more efficient use of resources, water storage and floating covers as a way to maximize the use of water and avoid leaks and evaporation," he says. He adds that ATARFIL also aims to develop more suitable products that avoid contaminating soil and groundwater "and allow a more friendly use of resources limiting the damage to the environment."

Beyond his own company, López notes a trend in site-specific geomembrane development and manufacturing, where pre-known site conditions allow for better-fitting formulations.

He adds this new outlook "facilitates the use of PE geomembranes in new applications, where once the initial requirements

Kelly Hartog is a freelance writer in Los Angeles, Calif.

FIGURE 1 Replacement of a caustic bladder at the Yarwun alumina refinery in Queensland, Australia. Photo courtesy of ATARFIL.

FIGURE 2 Chambers Reservoir in Parker, Colo. Photo courtesy of Viaflex.

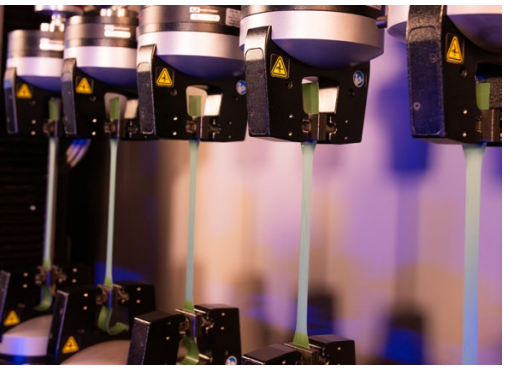


FIGURE 3 Viaflex Quality Lab in Sioux Falls, S.D. Photos courtesy of Viaflex.

are identified, resin and additives selection can help in developing more suitable geomembranes and therefore more sustainable solutions."

"We're certainly seeing more attention being focused on sustainability, and we are finding a broader acceptance of alternative materials in the geomembrane space where it's dominated by HDPE (high-density polyethylene) and linear low-density polyethylene," says Stacy Coffin, executive director of geosynthetics and installation services at Viaflex in Sioux Falls, S.D.

Initially established in 1956 as a fabricator of plastic film in the high-altitude research-balloon market, Viaflex has now been working in geosynthetics for almost 40 years, with an emphasis on reinforced, more flexible films in manufacturing through lamination, fabrication and installation.

"We're seeing higher performance plastics with less total thickness, so, fewer materials used as well as the use and the acceptance of recyclability," he says, noting that while Viaflex isn't currently directly involved in the point, "we are seeing that come up more and more."

"Sustainability has continued to be a focus area among owners, engineers and utilities," says Tina Oliver, strategic market manager for geomembranes and military installations at Seaman Corporation's XR® Geomembranes in Wooster, Ohio. Established in 1949, Seaman Corporation is a multigenerational family business, and XR Geomembranes is a 50-year-old manufacturing and fabrication facility, with additional plants in Bristol, Tenn.

The company's XR Technology is "a sustainable material based on the limited raw materials required and typical service life of end installation," Oliver says.

Beyond sustainability, all three companies have seen expansion into new markets and additional trends, with Coffin noting an expansion in the market propelled by the mining industry.

Viaflex director of installation Pat Elliott adds there also is buzz around PFAS (per- and poly-fluoroalkyl substances) containment.

"Containment of PFAS and controlling microplastics is a growing trend," he says. "So you'll see different containments in that sector as well."

Viaflex director of engineering Derek Coover adds, "From an innovation side, we've developed liners that can be used as a cap or a liner to keep the PFAS contaminants contained within that contaminated soil to keep them from drifting out or down into the water table."

He expands on this, sharing, "You don't want a leachate in the landfill that likely contains high levels of forever chemicals migrating down into the water table."

It's why, he notes, that outside of standard geomembranes, Viaflex is

introducing "what we call barrier geomembranes, where there's another component—EDOH or ethyl alcohol. If you're comparing it to straight polyethylene, it's about two to three orders of magnitude better or less permeable for the PFAS materials to permeate through."

Oliver concurs. "Permeability is a significant consideration and is expected to continue to be a focus area, particularly in consideration of PFAS contamination and remediation."

She also notes that there are legacy requirements, "and then there are contaminants of concern. And it's the whole discussion around PFAS and what's the next thing in PFAS and remediation of contaminated soils, so permeability/impermeability is probably one of the most significant yardsticks by which we would measure XR's protective properties."

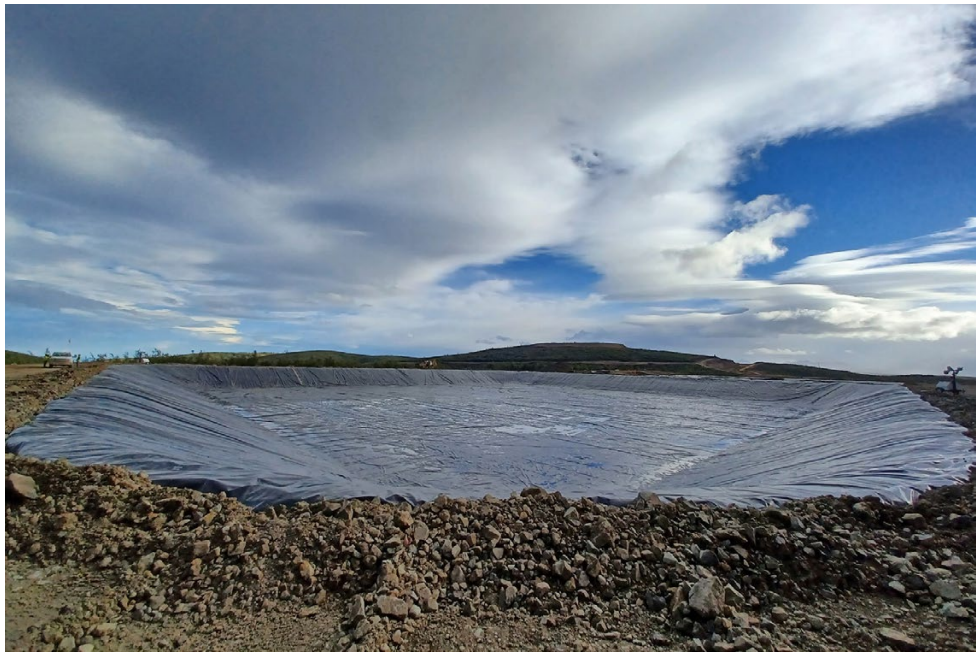


FIGURE 4 Seaman Corporation's 9146 XR-5 ULT geomembrane used at Kinross Manh Choh Gold Mine in Tok, Alaska. Photo courtesy of EnviroCon, Inc.

Increased product demand

López believes there will be continued demand for products in what he views as the industry's initial applications: water, waste and mining, "with a focus on more specialized products to help develop new market niches."

Oliver adds power, oil and gas to that list, noting, "There is the geopolitical complexity of changing administrations and [whether] there will be more drilling or less drilling or different drilling, so that's something to be sensitive to," she says.

She adds, "For the most part, due to the form, fit and function of geomembranes, we're going to have plenty of installation scenarios, whether we increase drilling on the north slope or we have more environmental considerations about what's happening up there."

Elliott, however, notes that while the geosynthetic market "serves lots of markets, including oil and gas production

FIGURE 5 Seaman Corporation's 8130 XR-5 geomembrane dike liner at a secondary containment facility in Charleston, S.C. Photo courtesy of International Cover Systems.

FIGURE 6 Wastewater treatment ponds in Ione, Calif. Photo courtesy of Viaflex.

FIGURE 7 Seaman Corporation's 9146 XR-PW geomembrane potable water storage renovation at Thunderbird Reservoir in Phoenix, Ariz. Photo courtesy of Field Lining Systems Inc.

and mining, those markets fluctuate." He says that's why Viaflex focuses more on increased demand for water management, "because water is always going to be critical, so that's where we see the long-term growth."

That growth extends to water containment and storage. "Pump water storage, clean energy, all those sorts of things," says Elliott. "We're seeing some large reservoirs out on the horizon. We haven't built many of them yet, but there's a lot of them in the planning."

"Those are increasing because as these municipalities grow, they have to have the water available to serve their people," says Elliott.

Coover adds, "By focusing on the portable water storage or drinking water storage, not only do you want to keep the PFAS out and [from] migrating into that drinkable water, but you also don't want that to be coming from the membrane itself. So we work to make sure that our raw materials are going into those membranes that are there to help mitigate PFAS but they're also not the source of the PFAS getting into drinking water."

Oliver says she also sees a lot of opportunity "in the generic umbrella that's water management, because when we talk about conservation of resources, that's a big thing for us. We have been in the sustainability business for a long time. We back it up to reduce, reuse, recycle."

Innovate and automate

All three companies agree there is major potential for automation in the industry. López goes one step further, calling it a "necessity. The way geosynthetics are installed is still too dependent on labor and exposed to human errors, as this is a very competitive industry where installers need to be at the job site for too long

every day, exposed to harsh conditions," he explains.

He adds that there is concern in the industry about the importance of the installation process, the welding process, and how welds will perform along the lifespan of the installation. "In most cases," he says, "the lining installer is decided based on the lowest cost bid, which is also related to the crews needed at the site and the square-foot/day rate per crew."

That, he says, can affect the quality of the installation and potentially compromise both mid- and long-term performance. He says using more advanced technology in the installation process would be tremendously beneficial if they can increase the square-foot/day ratio without sacrificing installation quality.

"It's about increasing the deployment speed while avoiding scratches in the liner, reducing the time spent in placing the panels before welding," López says, "and improving the quality of the welds, along with other considerations such as dynamic temperature-pressure-speed balance based on site conditions, limiting the thickness reduction and reducing the welding temperature."

At Viaflex, Elliott says on the installation side, welders already have increased technology and are doing online data collection and monitoring. "There are talks of automated machines for deployment," he shares. "It is in the infant stages,

By focusing on the portable water storage or drinking water storage, not only do you want to keep the PFAS out and [from] migrating into that drinkable water, but you also don't want that to be coming from the membrane itself.

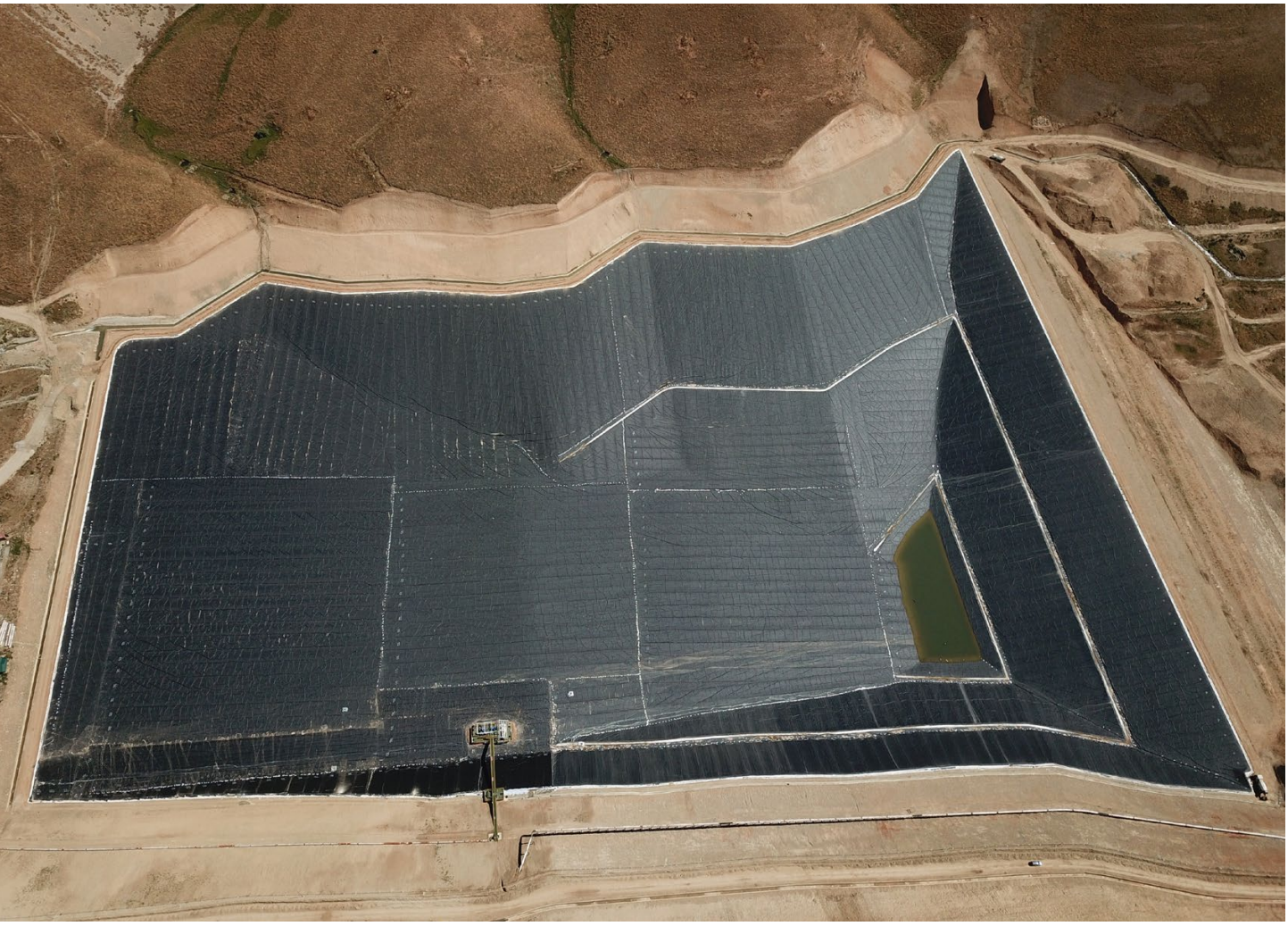


FIGURE 8 A tailings dam project at Chaarat Mine, Kyrgyzstan. Photo courtesy of ATARFIL.

AI will help manufacturers be more efficient in the production plant, reducing resource consumption during the manufacturing process, reducing rejection and improving the quality of the products.

but the welders are advancing, and currently, it's more about data collection and understanding what's going on during the seaming process."

Viaflex and ATARFIL also see a role to be played in the future by artificial intelligence (AI).

López calls AI "more than a fashion. It's a huge avenue for understanding the impact of our industry and every single product. It's a way to create metrics and to identify the areas where a [greater] effort is needed."

That, he says, can be achieved via metrics only, and "internally, AI will help manufacturers be more efficient in the production plant, reducing resource consumption during the manufacturing process, reducing rejection and improving the quality of the products."

Coover says that while there's no current direct use of AI at Viaflex, "We are doing online monitoring to help ensure the quality of the products that we're producing—data collection that's going into the seams that we're making—the fabrication aspect of it, so that we can ensure the quality now that can set the groundwork for where AI could come into play in the future."

A flexible future

Looking to the broader future of the industry, Oliver says, "I think there's every reason to believe that we will see an increased requirement for even more flexible materials, and there's something to the discussion around smart technology."

However, she adds, "I don't think we've reached the delta yet whereby people will say the increased cost investment will offset the historical failure mode. So [XR] looks at a lot in terms of leak detection. I think it's a great technology. I think we're going to see more and more of that as an industry."

Coffin agrees.

"We're already seeing greater adoption rates of more high-performance films in lighter weights. The flexibles seem to be taking hold," he says. "HDPE has dominated the industry over the years, and we believe that will continue, but there is a need for more flexible, higher-performing films with some chemical- and gas-resistance attributes. We continue to see opportunities in those areas."

According to López, the PE geomembrane market will eventually be divided into two sectors: "low-end geomembranes for low-risk applications (with an on-site CQA–Certified Quality Auditor) and high-end geomembranes for applications involving chemicals, UV exposure and high temperatures."

Elliott says he believes more stringent regulations will push the industry to adopt greater technologies in the industry.

"The United States and North America is slightly behind the curve regulations-wise, with Europe and some of the more advanced markets having tighter regulations," he says. "As regulations in the U.S. increase over the next 10 to 15 years, I think you're going to see more dollars put behind that, and more of a priority to advancing the technologies of membranes. The regulations have got to change to force people to use them." G

FIGURE 9 A municipal solid waste landfill cell extension project in Cordoba, Spain. Photo courtesy of ATARFIL.

FIGURE 10 Phase 1 of the Orlando Utilities Commission's coal ash landfill closure as part of a project to create a renewable energy facility in Orlando, Fla. Photo courtesy of ATARFIL.

FIGURE 11 Geomembrane liners for heap leach pads cover the Don David goldmine in Oaxaca, Mexico. Photo courtesy of ATARFIL.

Looking ahead: Execs discuss trends in the geotextiles industry

By Shelly Miron

Continued growth, multiple company mergers and some product innovation were all reflected in the global geotextile market last year. A Grandview Research report published before the election valued the world's 2022 market at $7.1 billion and predicted annual growth of 6.6% between 2023 and 2030. Key drivers cited were:

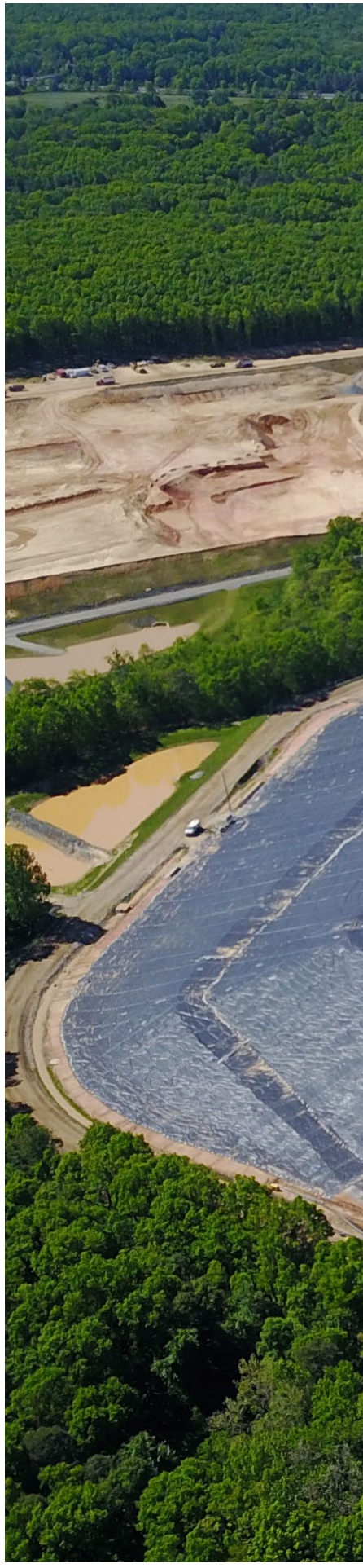
- Boosted urbanization and industrialization of developing countries
- The relative cost-effectiveness and lifespans of geotextiles
- Growing environmental concerns surrounding soil erosion
- Favorable regulations in European economies
- Increased government spending in China
- Wider use of such products in U.S. construction applications

In December 2024, Geosynthetic Materials Association (GMA) members traveled to Washington, D.C., for their semi-annual meetings with congressional leaders. The group met with 21 congressional offices, discussing matters relating to Build America, Buy America Act (BABAA) requirements, infrastructure funding and continued push for additional uses of geosynthetics in projects to help prolong the use of roads and civil construction projects.

One of the participants, TYPAR Geosynthetics' director of sales, infrastructure, Keith Misukanis, like many in the industry, is waiting to see what the new administration will do. Misukanis predicts the BABAA, established in 2022, will continue to have a profound effect on the industry, as it prohibits federal financing for infrastructure projects unless the construction materials have been produced in the U.S. But he says there are gray areas surrounding the rules.

Come together: Mergers, acquisitions are on a roll

One pattern Misukanis has seen over the last 10 years is a boost in company consolidations, particularly among U.S. firms. "Larger distributors have been grabbing up more independents," he notes. "I think they're seeing chances for better purchasing, better access to materials and more streamlined distribution."



EDITOR'S NOTE

In January 2025, The U.S. Department of Transportation's Federal Highway Administration (FHWA) announced a new final rule to end FHWA's longstanding waiver that allows manufactured products used in federal-aid highway projects not to comply with FHWA's Buy America requirements. The new federal rule changes outdated policy and boosts American manufacturing. The rule is a result of the FHWA's review of its Manufactured Products General Waiver, required by President Biden's Bipartisan Infrastructure Law Build America, Buy America (BABAA).

Freelance writer Shelly Miron is a former news reporter based near the Twin Cities in Minnesota.

FIGURE 1 AGRU's latest IDSs have effectively replaced earlier, more expensive soil/aggregate drainage systems by offering better shear strength and drainage performance along with lower costs, material requirements, and installation times. Photo courtesy of AGRU.

The EPA set very high regulations on requirements for PFAS, so we're going to see a lot of requirements for their handling. Everybody's going to be working on good solutions, and there will be huge amounts of investments due to federal government regulation.

Recent acquisitions he cites are Hanes Geo Components buying Terrafix® Geosynthetics and Nilex Inc. (among others); Ferguson buying GeoSolutions; and Core & Main Inc. acquiring Earthsavers Erosion Control LLC, L&M Bag & Supply Co. Inc. and ACF West Inc. "Of geosynthetic manufacturers, there's been consolidation, with Solmax bringing in TenCate and Propex and [Berry Global Group Inc.] joining with Glatfelter to become Magnera," he adds.

In the pipeline: Improved protection from PFAS

Misukanis defines the overall industry as risk averse and slow moving when it comes to new innovation. "If you're building a road and decide to take a new product and it fails, that's a problem," he explains. "It leads to the conservative nature of infrastructure building."

That said, he's aware of innovation aimed at preventing the migration of PFAS (per- and polyfluoroalkyl substances) from geosynthetic composite lining systems to landfills. "The EPA set very high regulations on requirements for PFAS, so we're going to see a lot of requirements for their handling," he says. "Everybody's going to be working on good solutions, and there will be huge amounts of investments due to federal government regulation."

FIGURE 2 AGRU structured liners are utilized across various applications, including mining, energy, and municipal solid-waste landfill containment and closures. Photo courtesy of AGRU.

Other new innovations

Asked about innovation at AGRU America, Bill Urchik, applications engineer for geosynthetics, points to its integrated drainage system (IDS) that effectively has replaced earlier, more expensive soil/aggregate drainage layers by combining a structured geomembrane with a geotextile overlay to create one closure and containment solution. It offers shear strength performance, long-term drainage performance, a reduction in required geosynthetic material and reduced installation time and cost.

"It provides increased interfacial strength, a big concern for engineers who don't want their landfills to slide, since that costs a lot of money to repair," Urchik says. "It's really gained promise here in the last 10 years."

Anthony Johnson, AGRU's VP-technical services, notes that industry engineers increasingly prioritize sustainability in product specs, particularly in regards to PFAS protection. "Whether this be in the civil, environmental or energy sectors, there's been a trend toward ensuring products protect their environment and do not contribute to the proliferation of undesirable microplastics or PFAS."

Recently launched at HUESKER Inc. is the active geocomposite Tektoseal Active PFAS. Built of two layers of geotextile using HUESKER's blend of an ion exchange resin and activated carbon, it can be customized to address

project-specific contaminant concentrations while shielding pollutants from PFASs, according to Flavio Montez, CEO of HUESKER Inc.

Greener by the day

Misukanis says the industry at large is highly focused on more sustainable options for the use of geotextiles—many centering around the land-use planning approach low-impact development (LID), or methodologies around managing stormwater runoff to protect water quality. Companies are also looking for better ways to use recycled materials, he says, and moving sites toward Zero Waste to Landfill (describing projects in which 99% of commercial waste is diverted from landfills).

A leader in nonwovens, TYPAR is one of several companies aiming to remove plastic waste from manufacturing and construction projects. "One of the beautiful things about geosynthetics is that they make the resources we have more effective, so more use will reduce the carbon footprint of construction," he says. "Our R&D department is working on that."

Montez calls sustainable management at the family-owned HUESKER "second nature to us," noting that it aims to be CO_2 neutral by 2045. Measures to that effect include optimizing sustainable energy resources and recycling, avoiding waste, reducing CO_2 emissions and taking measures toward a circular economy. "For decades, we've been making sure we diversify not only our supply chains and product portfolio, but also our geographical positioning, in a future-proof way. We ensure all employees adhere to our strict code of conduct and ask all business partners to do so as well. We also keep an eye on our social environment and focus on supporting local initiatives at our numerous locations around the world."

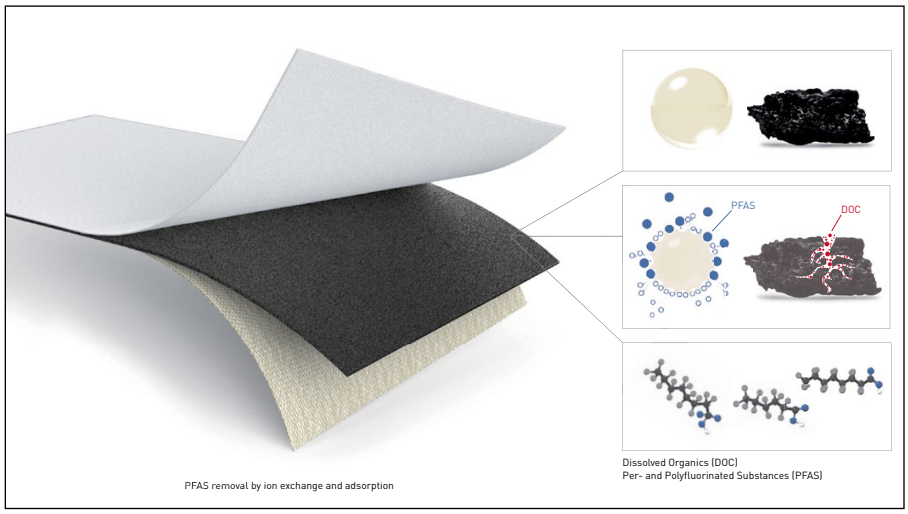


FIGURE 3 Launched recently, HUESKER's Tektoseal Active PFAS pollutant barrier can be installed evenly and erosion-proof on and in soils and even underwater. Photo courtesy of HUESKER.

Geotextiles…are being extensively used in erosion control, soil stabilization and drainage systems to enhance the durability and sustainability of infrastructure projects.

One recently launched HUESKER product focusing on environmental consciousness is an ecoLine geogrid made from recycled materials that match technical properties of the original filament. Designed for long-term applications, a version known as the Fortrac eco geogrid reinforces retaining walls built to last 100 years.

Conversely, HUESKER bioLine geotextiles made from naturally renewable, biodegradable raw materials (for example, the SoilTain DW bio) are effective for temporary applications.

Yuse Lajiminmuhip, head of marketing at AGRU, points out that discussing improvements in sustainability can help the public understand the role of geotextile products. "For example, we can talk about how geosynthetics can help reduce the overall amount of aggregate material required for a project, and therefore reduce the number of trucks on the road needed to haul that aggregate to the job site," he says.

Demand for more sustainable geotextiles is driven by eco-conscious customers and increasingly green building standards, according to a report by Data Bridge Market Research.

"Geotextiles…are being extensively used in erosion control, soil stabilization and drainage systems to enhance the durability and sustainability of infrastructure projects," the report states. "And the increasing focus on recycling and reuse supports the geotextile market by driving demand for products made from recycled fibers."

FIGURE 4 Dewatering tubes made from SoilTain offer flexible filling quantity, high absorption capacity per hour, high dry residue, processing without intermediate storage and low use of resources. Photo courtesy of HUESKER.

Cost quandary: Clients want lower price tags

Misukanis says geotextile manufacturers can expect demands for lower pricing as the year continues. "There's always pressure for reduced building costs and efficient materials, with people looking for their construction dollars to go further," he explains.

Another trend in the industry is the increasing necessity to optimize geotextiles to build on the less-than-optimal land that remains available for building, Misukanis adds. "Housing in the 1950s would all be sitting on flat land that's nice and easy to work with," he explains. "Now, construction can happen on more challenging space that requires stabilizing the ground more."

The Data Bridge report states that the "substantial initial investment for geotextile materials and installation can be a significant barrier, especially in regions with limited budgets. This high upfront cost may deter projects, particularly in developing areas where financial constraints are more pronounced." However, it adds that innovations including high-strength, multifunctional fabrics and advanced manufacturing processes are boosting versatility, performance and cost-efficiency across the industry.

As Verified Market Reports stated last year, "The initial cost of geotextiles may be higher than traditional materials, [but]

the long-term cost savings from reduced maintenance and extended project lifespan make geotextiles a cost-effective solution."

Labor lament: Workers wanted

A 2024 report from Deloitte and the Manufacturing Institute estimates that manufacturers as a whole could need 3.8 million new workers by 2033, and approximately 1.9 million of those jobs may go unfilled if current labor gaps remain. However, a 2024 study on nonwoven geotextiles from Verified Market Reports states that "AI-driven analytics facilitate better material design and quality control, while automation streamlines manufacturing processes, reducing costs and improving product consistency. These technological advancements are expected to accelerate market growth and innovation, offering the ultimate potential for more sustainable and high-performance geotextile solutions."

Not surprisingly, geotextiles manufacturers struggle with the same worker shortages as other manufacturers, according to Misukanis. That's leading some to explore advanced automation to counter that problem.

HUESKER, for example, employs a robot to transfer finished yarn reels, effectively taking 2.5 tons per day off the shoulders of employees.

Growing demand for niche products

While TYPAR specializes in what Misukanis calls "basic building materials"

FIGURE 5 (TOP) HUESKER CEO Flavio Montez points to growing demand for geocomposite materials engineered for drainage systems, canal linings, sediment capping and other construction applications, especially those that address PFAS-contaminated sites.

FIGURE 6 (BOTTOM) HUESKER recently launched its ecoLine geogrid made from recycled materials that match technical properties of the original filament. A version known as the Fortrac eco geogrid reinforces retaining walls built to last 100 years. Photos courtesy of HUESKER.

FIGURE 7 TYPAR's geocell ground stabilization systems ship in compacted panel form and expand into honeycomb formations to the desired shape and dimension on-site. Photo courtesy TYPAR Geosynthetics.

Another trending market is the rehabilitation of asphalt pavements.

and not highly specialized products, he says the industry is ripe for innovation in niche areas, such as products that could better stabilize railroad beds, or bridge systems or liners that can better protect landfills from leakage. "If we go toward more battery- and electric-powered cars, we're going to have heavier vehicles on the roads, which calls for a change in materials," he adds.

Montez also points to enhanced demand for geocomposite materials used in drainage systems, canal linings, sediment capping and other construction applications, especially as they relate to PFAS-contaminated sites. As such, HUESKER's key products include a polymeric membrane double-bonded with nonwovens to produce the high peel and sheer strengths needed for canal linings, especially in irrigation districts. Another product matches nonwovens with active media to effectively cap contaminated sediments in streams and rivers, and another combines active media with a hydrophobic polymeric material to absorb oil spills.

And a fourth optimizes a uniquely absorbent natural fiber media to address silt fences in brown field sites near sensitive water areas. "Another trending market is the rehabilitation of asphalt pavements," Montez adds. "Although this is a very traditional application of geosynthetics, we anticipate a growth in demand due to better understanding of the benefits, which includes the increased life of the pavement, reduced maintenance and reduction in carbon emissions and cost. HUESKER produces a full range of interlayer grids in Shelby, N.C. made of polyester or glass filaments, with a unique asphalt coating that provides a superior bond within the asphalt layers."

At AGRU, according to Johnson, clients in the environmental sector are demanding improved performances from geotextiles, including components of composite geosynthetics such as geosynthetic clay liners and geonet/geocomposites. "From geotextiles that exhibit greater resilience to UV degradation to geotextiles that provide increased interface friction performance as part of designed systems, AGRU has been working diligently with customers to advance the technology available and meet the demanding and constantly evolving design requirements of owners and engineers."

Smart geotextiles are sharing key info

Misukanis and Urchik say they have yet to work closely with high-level "smart" geotextiles that employ electrical fibers, electronic devices and/or sensors, but online sources point to developments such as graphene-coated conductive pavements that monitor fatigue damage;

geotextile products that monitor soil conditions in real time; and geotextile-fortified dikes that can monitor water levels, wave loads and storm surges in real time.

An example of HUESKER's use of smart technology is its geosynthetic building materials that enable both short- and long-term structural monitoring and verification of design models.

As for artificial intelligence, Johnson notes that AGRU is still studying its industry potential. "Like most other entities, AGRU is optimistic regarding recent advances in AI and looking to integrate AI technology as a driver of innovation and quality, he says. "(We're) currently researching ways to integrate AI tools as a means to further advance the quality of our products, assist engineers with project design and better streamline our support processes."

Some final encouraging news for geotextile manufacturers: Data Bridge predicts demand for geotextile products will remain healthy into the indefinite future in accordance with the global surge in residential, commercial and industrial construction activities. "In major urban development projects such as the Dubai Creek Tower, geotextiles are crucial for foundation stabilization and soil management," the report states. "This rising demand reflects the essential role of geotextiles in ensuring structural integrity and soil stability."

In summary, Montez says he's optimistic about the future when it comes to geosynthetics and HUESKER's ability to meet continued industry challenges.

"Applications are becoming more and more common in civil engineering projects," he notes. "Associations like GMA along with manufacturers and universities play an important role on the dissemination of technical and practical knowledge. We expect the investments in infrastructure to continue growing here in the U.S., with preference for materials made in America."

FIGURE 8 TYPAR Geocell CS systems are permeable to water, air and nutrients for better stability and vegetative performance. Photo courtesy TYPAR Geosynthetics.

Johnson also speaks positively about the industry's future. "Studies are being performed worldwide to quantify the environmental impact of geotextiles. Those of us in the industry for some time recognize that geotextiles are a critical component for long-lasting infrastructure, which can serve several different functional applications, including filtration, separation, and protection of adjacent materials and/or subgrade. "Through innovation and education AGRU is looking to ways to both increase the efficacy of geotextiles to perform in these applications, as well show the public and those not familiar with these materials they are a sustainable and critical component of our infrastructure."

FIGURE 9 TYPAR GeoCell GS cells transfer downward forces laterally, reducing loads on underlying soils to provide stabilization over poor soil conditions, protect soil and roots from compaction, and provide site access for light, heavy, and industrial vehicles. Photo courtesy TYPAR Geosynthetics.

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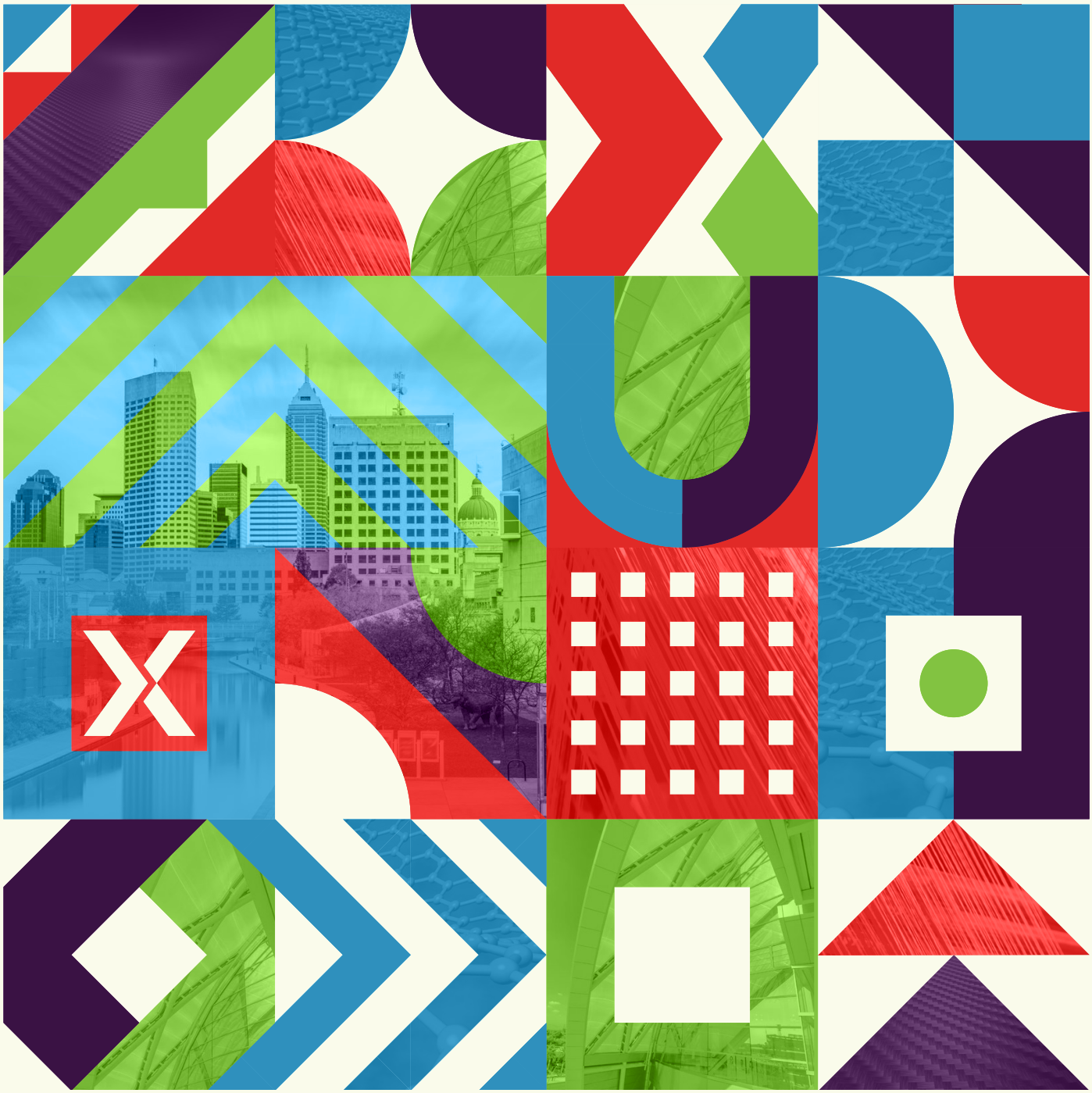

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