The discipline of geosynthetics began many years before it had a name. The terms “geotextile” and “geosynthetics” were not coined until Dr. JP Giroud used those terms in a seminal paper and presentation at an engineering conference in Paris in 1977. The significance of that conference led to it being known, after the fact, as the First International Conference on Geosynthetics (1 ICG).

This year, as Land and Water Magazine celebrates its 40th anniversary, the 1983-founded International Geosynthetics Society (IGS) will hold its 10th International Conference on Geosynthetics, 21-25 September 2014 in Berlin, Germany.

But even before the term geotextile was proposed, the materials were being used in the field. The Dutch incorporated geotextiles into the extraordinary Delta Works flood protection scheme in the early 1960s. This design, which helped usher the international geosynthetics manufacturer Tencate into the geosynthetics market, was a response to a deadly North Sea flood in the Netherlands in 1953.

The utilization of geotextiles in the Delta Works engineering response has been part of the system’s exceptional long-term durability. The American Society of Civil Engineers (ASCE) even honored the Delta Works as one of the Seven Wonders of the Modern World.

Further to the early use of geotextiles, Prof. Georg Heerten published an article in 1984 in the very first issue of the renowned journal Geotextiles & Geomembranes. His topic: “Geotextiles in coastal engineering—25 years experience.”

Prof. Heerten formerly held a key leadership position with the manufacturer NAUE in Germany (which advanced geosynthetic clay liner materials through manufacturing innovations with needle-punched nonwoven geotextiles). Today, Professor Heerten is Chairman of the German Geotechnical Society (DGGT), which is co-locating its 2014 biennial “Baugrundtagung” (geotechnical conference) with the 10th ICG in Berlin.

Suffice it to say, geotextiles have enjoyed a long history, not only as “geotextiles” but under various names (e.g., “construction fabrics”) extending back well before they were given a formal name.

Even Dr. Giroud was utilizing geosynthetics in designs years before he had more engineering-specific names for them. Eight years before the watershed moments at the Paris conference, where the geosynthetics field would finally transition towards a more unifying, forward-looking identity in terminology, Dr. Giroud was working with geotextiles and geomembranes as a practicing engineer. His early 1970s work included a number of field firsts, such as the first use of a double-liner system, the first use of a geotextile cushion with a geomembrane, and the first use of a geotextile for filtration and internal integrity of a dam embankment.

That dam—the 17 m high Valcros
Dam in France—set the stage for a number of important dam and embankment designs that utilized geotextile filtration for long-term performance.

Valcros Dam was constructed in 1970. It continues to perform well today.

EXPANDING FUNCTIONS

It is impossible to succinctly describe the last 40 years in geotextiles, but their multi-functional utility cannot be overlooked. Indeed, geosynthetics have extended into common use in every major sector of civil engineering; but in nearly all cases that inclusion of a geosynthetic, that exploration and establishment of design, has been assisted by geotextiles.

Geosynthetics are function-specific materials. Geomembranes, for example, provide containment. Geogrids provide reinforcement. Geotextiles provide nearly everything: filtration, drainage, separation, protection, reinforcement, etc.

Contaminated or weak soils are separated from clean soils by geotextiles. Wastewater soils, dredged spoils, and other are dewatered and isolated for easy disposal through geotextile tubes. Soil containers constructed of geotextiles are filled with local soils, sewn together, and installed along waterways for erosion control and scour protection. Landfills utilize geotextile cushioning between geomembranes and geocomposite drainage layers. (Installers are particularly versed in addressing this importance to geotextiles. Visit Colorado Lining International’s website, for example, to find information on the many ways geotextiles beneficially impact waste management and other containment installations.) Geotextiles are used to wrap or line drainage trench zones, for everything from buried pipes of all sizes to avenue-wide installation. Roadways utilize geotextile separation to extend roadway service lives and decrease maintenance needs.

The list of applications that use geotextiles is extensive. The list is so long the geotextile is often not noted in project descriptions, but you can readily see geotextiles in project photos.

As example, re-open the January/February 2014 issue of Land and Water Magazine. On page 16, you’ll find Matthew Kocian’s article “GeoHistory in the Making.” In it, Kocian describes a 40+ year geotextile performance study from a low-volume road in Delaware. (Kocian works for Polymer Group, Inc., which produces one of the longest-utilized brands in the field’s geotextiles: Typar.) On page 20, Kristy Morris, Eileen Alduenda, and Nancy L.C. Steele write on an impressive neighborhood retrofit design in “Monitoring Your BMPs.” Look at the photo on page 23: geotextile in the infiltration trench.

In short, geotextiles play a strong role in helping other materials—geosynthetics, aggregates, concrete, etc.—perform better. This helps those materials expand their application reach.

A CHALLENGE OF PERCEPTION

One of the true challenges of the geo-
Geotextiles are being utilized in, and of key energy access roads in Alaska. Pho-
has guarded against frost boil degradation challenging settings. Mirafi ® H2Ri, for example,
substantial and benefi cial impact in chal-
Higher strength geotextiles are having a
inter-related in engineering and construction.
Geotextiles are being utilized in, and at times enabling, some of the most interest-
field may be less through a purely historical
So in some respects, the science behind manufactu-
But these materials, no matter how deeply or how long they are buried, should not be "out of sight, out of mind" materials. Geotextiles have long performed exceptionally in engineering and construction.
Geotextiles are being utilized in, and at times enabling, some of the most interest-
So the best way to view their impact on the field may be less through a purely historical perspective; the most revealing look may be found in how they are influencing engineering today and going forward.

TRENDS

A Wider View of Geocomposites

For many years, the term "geocompos-
In wastewater, geotextile tubes are be-
Also of note in waterside constructions, geotextile tubes are playing a fan-
"soft," these bags are far from weak. They are extremely durable in both exposed and buried installations.
A long record of exemplary installations can be found in Australia, the United Kingdom, Germany, and the United States.
As noted earlier, Georg Heerten wrote about 25 years of projects with this product sector back in 1984.
But the feel of geotextile containers is newer today. Artificial surf reefs, extensive shoreline protection installations (walls, breakwaters, etc.), and scour protection strategies are growing. Geotextile containers are even being used in offshore wind farm constructions.
There, the geotextile containers are providing scour and erosion protection around the offshore turbine footings. They are even helping improve the construction of offshore monopiles by creating a stable base which the pile may be driven through.
Also of note in waterside constructions, geotextile tubes are playing a fan-
In wastewater, geotextile tubes are be-
In wastewater, geotextile tubes are being used to separate solids and sludge. For wastewater treatment plants (WWTPs),

Geosynthetics are function-
specific materials. Geomem-
branes, for example, provide containment. Geogrids provide reinforcement. Geotextiles provide nearly everything: filtration, drainage, separation, protection, reinforcement, etc.

On the Waterfront, Out to Sea

Geotextiles are really extending influ-
ance in shoreline and immediate offshore installations. Geotextile sand containers are being used to create soft armor defense against wave-induced erosion. Though "soft," these bags are far from weak. They are extremely durable in both exposed and buried installations.

The Federal Highway Administration’s (FHWA) Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS) utilizes geotextiles to greatly shorten construction windows and equipment needs while signifi cantly lowering construction costs for small bridges. Photo by FHWA.
Colorado Lining International, Inc. offers assistance in liner selection, fabrication and installation budgeting to engineers, regulators and contractors.

We offer an array of lining capabilities:

- **Floating Covers**
  - Evaporation, Algae & Insulated
- **New PATENT-PENDING Floating Covers**
  - For Frac Tanks, Clarifiers & Defined Sump
  - Featuring exclusive GeoBubble™ material
- **Spray Coatings**
- **Custom Fabrication**
- **Storm Water Ponds**
- **Rainwater Harvesting**
- **Design-Build Projects**

By taking a site specific approach to geomembrane and pond liner selection you can rest assured the material will fit the application and will be fabricated and installed by trained and certified crews.

**Fabrication Facilities in Colorado & Texas**

Colorado Lining is an IAGI AIC contractor and is dedicated to training and certifying our technicians through the CWT Program.
this may mean more energy-efficient operations. Dried sludge from biosolids can generate 6,000 Btus. If separated out, WWTP biosolids involve many other energy-producing elements: grit, 4,000 Btus; screenings, 9,000 Btus; and grease, 16,000 Btus (which is more than gasoline). Considering that WWTP and related water-moving and treatment operations consume ~4% of US energy, and factoring in that up to 60% of a water utility’s costs may be related to energy needs (depending on municipal size, state regulations, extensiveness of treatment, etc.), geotextiles may be part of a much more energy-efficient future.

While the construction of the products may be called a geotextile container or bag or tube, the end results are often the same: durability, strength, excellent filtration characteristics, erosion control, the ability to utilize local fill, increased sustainability, lower costs, etc.

**Better Liners**

Geosynthetic clay liners (GCLs)—another composite product that benefits immensely from geotextiles—are seeing revitalization through both bentonite modification that enhances the internal sealing performance of the geosynthetic and greater geotextile cover/carry layer performance. Much of the credit here is due to manufacturers working more closely with clients to determine more precise challenges to GCLs (e.g., specific slope angles, soil conditions, freeze-thaw cycles, roots); and the result is a rapidly expanding portfolio of GCL product options, all of which are achieving some pretty impressive performance results.

Needlepunch (nonwoven geotextile) technology in manufacturing and performance characteristic-enhancing coatings are big drivers in helping the GCL market unveil new innovations. And it is moving GCLs out of a basic capping system solution into an extremely broad range of long-term containment installations.

Companies playing an important role here include CETCO, GSE, Terrafix, Geo fabrics Australasia and NAUE.

**Greater Strength**

Geotextiles are being produced in significantly higher strengths, and the engineering principles that govern the basic functions to geotextiles enable faster construction, including in applications that traditionally were not geotextile applications.

The US Federal Highway Administration (FHWA), for example, has crystallized many years of research in the field utilization of geosynthetic-reinforced soil (GRS) in bridge construction. Targeted to smaller, single span bridges, such as those frequently needed by county engineers, the GRS-IBS (Integrated Bridge System) approach has been found to reduce construction costs by 25 – 30% (versus standard pile capped abutment on deep foundations). Up to 60% savings are actually achievable. One of the primary reasons for savings is the significantly shorter construction window—“days, not months,” the FHWA notes. Also, this type of construction decreases the need for highly specialized construction equipment. And since deep foundations are not needed for piles, the land disturbance is greatly decreased. The construction footprint of the GRS-IBS approach is, thus, a great way to lower the carbon footprint of construction and overall impact construction has on the environment.

(A basic search for “GRS-IBS” online yields an enormous amount of practical information from FHWA, county engineers, video demonstrations, etc.)

In other strength-related trends that are building upon geotextiles’ past and shaping their future use, a number of companies are marketing high-strength materials that reassert the engineering behind these materials.

Tensar markets a high-strength geotextile called Basetex®, which is being used in tensioned membrane designs, such as for load-transfer platforms with piled embankments.

Tencate’s Mirafi® H2RSi series exemplifies not only the traditional expansion in functions that geotextiles have been part of but the future in which geotextiles can in many respects perform these functions solely: confinement, reinforcement, drainage, filtration, and separation. Utilizing a special yarn to provide enhanced wicking through the plane of the geotextile and exhibiting a tensile modulus that surpasses many other “traditional” stabilization
products, the material is being used in rail construction, roads, embankments on soft soils, MSE structures, voids bridging, and much more.

Polymer Group, Inc.’s geotextile-based geocellular confinement product DefenCell® has been used not only by the military for protection against ballistics but in the civilian market (often as Typar® Geocell) for flood defense, load support, slope protection, secondary containment berms, and erosion and sediment control.

HUESKER’s Comtrac®, a high-quality, water-permeable woven for soil reinforcement was one of the world’s first geosynthetic reinforcement products. Since it was first used in 1974, the product has proven itself on thousands of projects in a wide variety of applications, such as earthwork reinforcement or sludge lagoon capping. The geotextile features high tensile strength in conjunction with low strain, low creep, high resistance to microorganisms as well as chemical and physical action, and integral separating function. Because of its high-strength, low-creep properties, Comtrac® can permanently accommodate high tensile forces even at low elongations.

THE TAKE AWAY

It is impossible to concisely tell the historical and current story of geotextiles. But they continue to be materials that demonstrate extraordinary utility and innovation. Fiber optics are being embedded in them to offer real-time monitoring of installations (e.g., levees in flood zones). Their increasing strengths are blurring the old lines in soil stabilization products. In short, they are doing what they have always done: making engineering and construction stronger and more economical; and providing better environmental performance. L&W

by Chris Kelsey

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