BENTOLINER
GEOSYNTHETIC CLAY LINERS
Laying the Groundwork

Historically, containment systems have used liners consisting of either compacted clay or synthetic polymers as barriers to contaminate. Traditional containment systems consist of a geomembrane and a compacted clay liner (CCL) composite liner system. Research conducted by the United States Environmental Protection Agency (USEPA) demonstrates the performance of composite liner systems as shown in Figure 1 on page 3. Geosynthetic clay liners can be used as an alternative to the space consuming CCLs in composite liner systems.

What is a GCL?

A geosynthetic clay liner (GCL) is a manufactured hydraulic barrier used in containment applications as an alternative to traditional compacted clay liners (CCL). BentoLiner GCL products consist of two layers of geotextiles encompassing a layer of sodium bentonite.

GSE BentoLiner GCLs

GSE BentoLiner GCLs are produced by distributing a uniform layer of the bentonite between two geotextiles. Fibers from upper nonwoven geotextile are needle-punched through the lower geotextile and incorporated into the lower geotextile (either a woven or a scrim nonwoven). This process results in a strong mechanical bond between fabrics that increases the internal shear resistance of the GCL.

The bentonite clay utilized in GSE BentoLiner GCL is a clay mineral that swells as water enters between the clay platelets. When hydrated under confinement, the bentonite swells to form a low permeability clay layer with a hydraulic conductivity value of < 5 x 10^-9 cm/sec. This equates to approximately 0.6 m of compacted clay with a hydraulic conductivity of 1 x 10^-7 cm/sec.

What makes a GSE BentoLiner GCL unique is that it consists of a woven geotextile for dimensional stability and is reinforced for increased internal shear strength. GSE BentoLiner GCL products offer an array of different features for applications requiring a wide range of load and slope conditions in landfill, mining, and pond applications.
GCL Benefits

**Increased Airspace and Liner Performance**
For environmental containment systems, GSE BentoLiner GCLs can be used to completely replace or significantly reduce the required thickness of the CCL. This results in less excavation and re-compaction which saves time and money, and in most applications, increased air space means increased revenue.

GSE BentoLiner GCLs are part of a trend towards the combined use of geosynthetics and clay materials in containment applications. In a geomembrane/GCL composite liner system, the geomembrane and GCL work synergistically to maximize liner system integrity. In the USEPA study of 199 landfills, the geomembrane/GCL composite liner system outperformed all other liner systems as shown in Figure 1.

**Installation Efficiency**
GSE BentoLiner GCLs can be easily transported with fewer trucks than traditional CCLs. It can also be rapidly installed on a project which reduces overall project schedule and costs.

**GCL Slope Performance**
GSE BentoLiner needle-punching provides an increased internal shear strength that overcomes the low internal shear strength of the sodium bentonite clay which allows the use of these products on steeper slopes. A range of reinforcement can be achieved on products based on project specific requirements when requested.

**Quality Assurance**
The controlled environment of our production facility allows for greater control over critical performance characteristics. The intensive manufacturing quality control program ensures consistent hydraulic and physical properties through the latest testing procedures. Thorough manufacturing quality control minimizes the expensive and time consuming on-site quality assurance testing required for compacted clay liners.

**GCL APPLICATIONS**

**SOLID WASTE**
GCLs are used in both base liner systems and closures to replace expensive compacted clay liners in order to save time and money while increasing performance.

**MINING**
GSE BentoLiner products provide a cushioning and self-sealing layer underneath the geomembrane liner leading to less punctures, less solution loss and increased returns.

**INDUSTRIAL PONDS**
BentoLiner GCLs are often the choice of engineers in composite liner systems due to cost savings and ease of installation versus clay liners.

**RESERVOIRS AND CANALS**
GSE Bentoliner minimizes water loss in existing and new canals due to its superior self-healing properties and ability to be installed on steep slopes.

**WASTE WATER**
In addition to providing extra protection to minimize leakage, GSE Bentoliner GCLs are not subject to deterioration from differential settlement and freeze-thaw cycles which can damage traditional compacted clay liners.

**POWER UTILITIES**
GCLs are becoming an important component of lining systems because of the benefits they provide in cost effective construction, improved quality and the lack of suitable soil options.
WORLDWIDE LOCATIONS

Our business is global because our customers are global. Headquartered in the U.S. and with manufacturing facilities in Chile, Germany, Thailand and Egypt, as well as engineering and sales professionals in numerous countries, GSE can provide local service to our worldwide customers.

- Houston - United States
- Hamburg - Germany
- Bangkok - Thailand
- Cairo - Egypt
- Santiago - Chile

THIS IS WHAT WE’RE MADE OF

Being an industry leader takes substance, and our substance runs deep. That’s why people around the world have trusted GSE to make their projects easier and better. And our unstoppable commitment to innovation means we never stop collaborating with our customers to develop new products that meet their needs.

GSE lining products are known throughout the world as a mark of quality and reliability. Our customers depend on us to deliver geosynthetic lining products that withstand virtually every threat and danger imaginable, and we take that responsibility seriously, testing and retesting until we exceed industry standards — and everyone’s expectations.

ENGINEERING SUPPORT

The GSE Engineering Support Staff is comprised of multidisciplinary product professionals to support every aspect of your project design, from concept to installation. Rely on our project team to help you solve your design challenges. Our extensive network of industry experts offer comprehensive:

- Alternative solution development and assessment
- Project management
- Technical support
- Design tools
- Customer Service

“GSE OFFER AN EXCELLENT PRODUCT AND SERVICE THAT CAN ALWAYS BE RELIED UPON TO MEET OUR REQUIREMENTS AND DELIVER THE PERFORMANCE WE REQUIRE.”

MARK ROBSON
Biffa Waste Services Ltd

FOR MORE INFORMATION
visit our website at www.GSEworld.com
GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We’ve built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

For more information on this product and others, please visit us at GSEworld.com, or contact us at:

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Collaboration is Key

We didn’t get to where we are by chance. Without the partnership and inspiration of our customers, and without continual communication and cooperation within our company, we couldn’t have become the industry leaders that we are.

The driving force behind GSE is the knowledge that what we do matters. If we don’t come through for our customers, it could negatively impact the success of their project and the environment. So we make it our goal to not just meet our customers’ needs, but to exceed them, every day in everything we do.

Part of reaching that goal is building strong relationships with our clients, discussing their needs and working with them to develop a purpose-fit solution for their specific needs. And that collaboration extends to within GSE, with every department coming together to solve a customer problem.

When innovation, inspiration and hard work collide, great things happen.