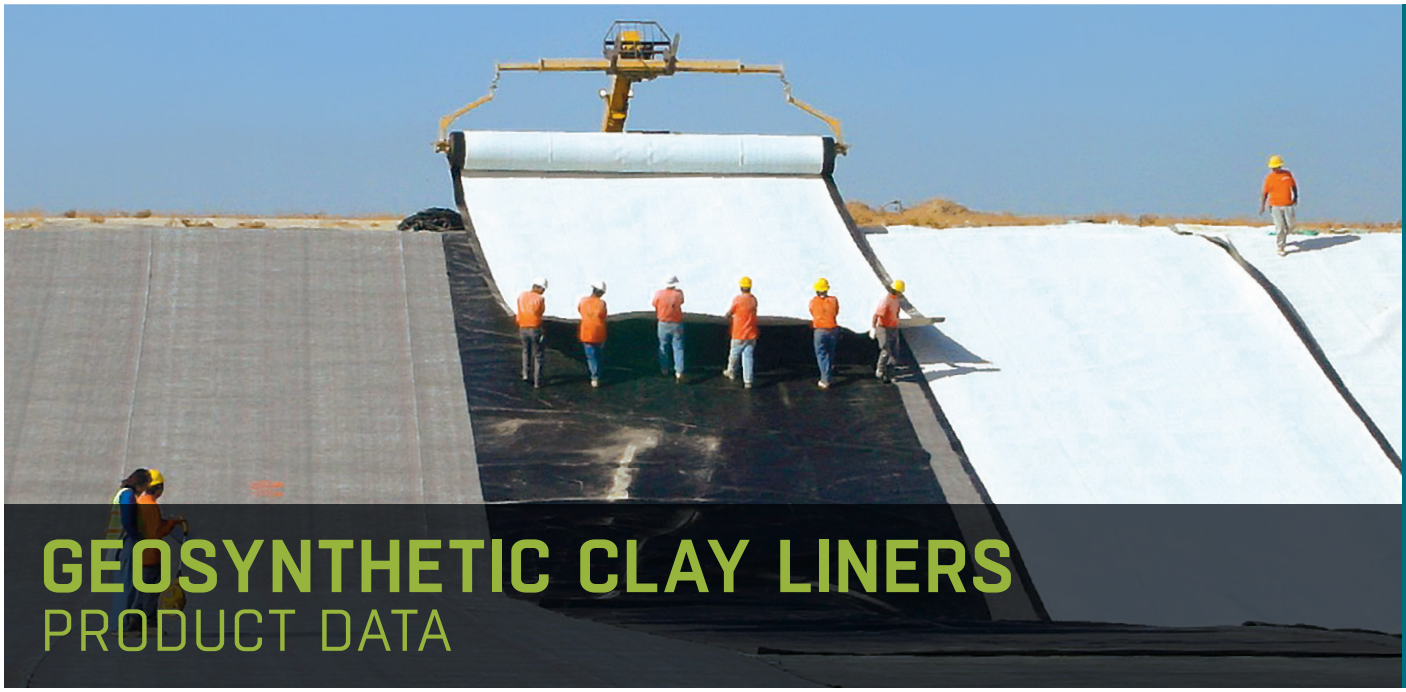

GEOSYNTHETIC CLAY LINERS
PRODUCT DATA

FOR MORE INFORMATION

Geosynthetics magazine has provided information on the geosynthetic clay liner specification charts for comparative purposes only. Designers should contact manufacturers for additional details and to discuss site-specific considerations.

Information on the use and specification of geosynthetic clay liners is also available from the Geosynthetic Materials Association (GMA).

GMA
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fred.chuck@textiles.org
GMAnow.com

PUBLISHER'S NOTE

Geosynthetics magazine compiled all information included in the *2023 Geosynthetics Specifier's Guide* from information submitted by firms in the geosynthetics industry. Companies provided specifications voluntarily, and specification accuracy is the responsibility of the manufacturer. The appearance of a listing in this directory is not an endorsement of the company or product by *Geosynthetics* magazine or the Advanced Textiles Association (ATA). The *2023 Geosynthetics Specifier's Guide* is intended as a guide, and *Geosynthetics* magazine and ATA encourage readers to contact the companies listed for further information.

By bonding clay to geosynthetic materials, manufacturers created an economical, long-term solution for many applications.

Geosynthetic clay liners (GCLs) are hydraulic barriers made of clay bonded to a single geosynthetic layer or to multiple geosynthetic layers. Because of its low permeability, swelling capacity and relative abundance, natural sodium bentonite is the preferred clay component of GCLs. A wide range of materials, including geotextiles and geomembranes, are used to carry and encapsulate the clay. Also, they provide the product with structural support.

GCLs are used primarily as substitutes for compacted clay liners (CCLs), providing significant advantages in cost, ease of installation and performance. Primary applications include surface impoundment, secondary containment and landfill lining.

GCLs use has grown steadily, and standards have been authored to address swell and fluid-loss index testing, determination of flux, manufacturing, sampling, installation and more.

Manufacturing process

GCLs are prefabricated sheets of processed bentonite clay available in multiple sizes. They are manufactured by encapsulating the clay between two or more layers of geotextile or by bonding the clay to one side of a geomembrane. The geotextile-supported products hold the clay in place by soluble adhesives, I-ties or barbed needlepunching that interlocks the geotextile fibers, or by periodic rows of heavy stitching through the clay and fabric.

The numbers

Companies that submitted product data chart lines were asked to provide data determined through industry-accepted testing methods. Companies were asked to sign a certificate of compliance verifying the accuracy of this data.

GEOSYNTHETIC CLAY LINERS

Product Name	Bonding Method	Needlepunched Peel Strength ASTM D6496, N/m (lb/in)	GCL Dimensional Properties			GCL Hydraulic Properties	Base Bentonite Properties		GCL Structural Components				Manufacturer's Suggested Applications [3]
									Upper Geosynthetic		Lower Geosynthetic		
			Panel Size Roll Width/ Length m/m (ft/ft)	Average Roll Weight kg (lb)	Bentonite Mass/Unit Area ASTM D5993 gm/m^2 (lb/ft^2)	Flux [1] ASTM D 5887 [2] m^3/m^2-s	Swell Index ASTM D 5890 (min) ml/2g	Fluid Loss ASTM D 5891 ml	Type or structure	Weight ASTM D5261 or Thickness ASTM D5199 g/m^2 or mm (oz/yd^2 or mil)	Type or structure	Weight ASTM D5261 or Thickness ASTM D5199 g/m^2 or mm (oz/yd^2 or mil)	
AGRU America | www.agruamerica.com													
Agru GeoClay® NN66	Needle punch	6.1 (3.5)	4.7/45.7 (15.5/150)	1700 (3750)	3600 (0.75)	1x10^{-8}	24	18	Nonwoven	200 (6.0)	Nonwoven	200 (6.0)	
Agru GeoClay® WN36	Needle punch	6.1 (3.5)	4.7/45.7 (15.5/150)	1590 (3500)	3600 (0.75)	1x10^{-8}	24	18	Nonwoven	200 (6.0)	Woven	105 (3.1)	
CETCO | www.cetco.com													
BENTOMAT 600CL	Needle-punched laminated	175 (1.0)	4.6/45.7 (15/150)	1250 (2750)	3660 (0.75)	1 x 10^{-9}	24	18	Geofilm/geotextile composite	NP	Woven	105 (3.2)	LL, LC, SIC, CL, SIL
BENTOMAT CL	Needle-punched laminated	610 (3.5)	4.6/45.7 (15/150)	1270 (2800)	3660 (0.75)	1 x 10^{-9}	24	18	Smooth FML/ geotextile composite	NP	Woven	105 (3.2)	LL, LC, SIC, CL, SIL
BENTOMAT CLT	Needle-punched laminated	610 (3.5)	4.6/45.7 (15/150)	1360 (3000)	3660 (0.75)	1 x 10^{-9}	24	18	Textured FML/ geotextile composite	NP	Woven	105 (3.2)	LL, LC, SIC, CL, SIL
BENTOMAT FLW	Needle-punched	610 (3.5)	4.6/45.7 (15/150)	1220 (2700)	3660 (0.75)	1 x 10^{-8}	24	18	Nonwoven	200 (6.0)	Scrim reinforced nonwoven	200 (6.0)	LL, LC, SIC
BENTOMAT DN	Needle-punched	610 (3.5)	4.4/45.7 (14.5/150)	1220 (2700)	3660 (0.75)	1 x 10^{-8}	24	18	Nonwoven	200 (6.0)	Nonwoven	200 (6.0)	LL, LC, SIC
BENTOMAT ST	Needle-punched	610 (3.5)	4.6/45.7 (15/150)	1220 (2700)	3660 (0.75)	1 x 10^{-8}	24	18	Nonwoven	200 (6.0)	Woven	105 (3.2)	LL, LC, SIC
BENTOMAT 200R	Needle-punched	175 (1.0)	4.6/45.7 (15/150)	1200 (2650)	3660 (0.75)	1 x 10^{-8}	24	18	Nonwoven	105 (3.2)	Woven	105 (3.2)	LL, LC, SIC
BENTOMAT LP	Needle-punched	Per design	4.6/45.7 (15/150)	1360 (3000)	4400 (1.0)	4 x 10^{-9}	NP	NP	Per design	Per design	Per design	Per design	LL, SIL, SIC
RESISTEX 100, 200, and 300 series	Needle-punched	Per design	4.4/45.7 (14.5/150)	1360 (3000)	4400 (1.0)	4 x 10^{-9}✧✧	NP	NP	Per design	Per design	Per design	Per design	LL, SIL*
RESISTEX U Series	Needle-punched	Per design	4.6/45.7 (15/150)	1220 (2700)	3660 (0.75)	4 x 10^{-9}✧✧	NP	NP	Per design	Per design	Per design	Per design	LL, SIL*
[1]: CETCO® RESISTEX®, geosynthetic clay liners are engineered to provide the highest level of chemical compatibility in extremely aggressive leachate environments such as coal combustion product storage facilities, mining operations, and industrial waste storage facilities. ✧✧RESISTEX® geosynthetic clay liners were tested against various leachates including, but not limited to, samples from Electric Power Research Institute (EPRI) and other industrial leachates, and should be considered as guide only. CETCO® offers project-specific compatibility testing to verify the suitability of CETCO® products. GCL mechanical properties can be tailored to meet project-specific geotechnical engineering requirements.													
Naue GmbH & Co. KG | www.naue.com													
Bentofix	Needle-punched	360 - 800 (2 - 4.6)	5/>40 (16.5 />130)	1,000 - 1,500 (2,200 - 3,300)	3,000 - 8,000 (0.6 - 1.7)	5 x 10^{-9}	24	18	Nonwoven	200 (6.0)	Woven	100 (3.0)	All
Bentofix X	Needle-punched/ PE extruded coating	360 - 800 (2 - 4.6)	4.85/40 (16 /130)	1,000 (2,200)	3,600 (0.75)	5 x 10^{-9} (bentonite); GCL < 10^{-14}	24	18	Nonwoven	200 (6.0)	Woven and PE extruded coating (200 - 1000 g/sqm)	100 (3.0)	All

[1] Flux is defined as "Flow rate/unit area" which can be converted to permeability using the equation: Permeability = flux/hydraulic gradient

[2] Report result at a maximum confining stress of 35 kPa (5 psi) and 14 kPa (2 psi) head pressure

[3] CL = Canal liner
LL = Landfill liner
SIC = Surface impoundment cover
LC = Landfill cover
SIL = Surface impoundment liner

NP = Not provided by manufacturer
NA = Not applicable, per manufacturer

Companies were requested to provide minimum roll values (MARV). All claims are the responsibility of the manufacturer.

« *Geosynthetics* recommends you contact the manufacturers before making any specifying/purchasing decisions »

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AUTHORIZED SIGNATURE DATE

Title (check one):
- ☐ Owner/Corporate Executive
- ☐ Chief/Staff Engineer
- ☐ Geotechnical Engineer
- ☐ Civil Engineer
- ☐ R&D Professional
- ☐ Other (please specify)

Primary business (check one):
- ☐ Engineering Firm/Engineer in Private Practice
- ☐ Contractor
- ☐ Geosynthetic Installer
- ☐ Installation/Fabrication Equipment Supplier
- ☐ Geosynthetic Producer/Distributor
- ☐ Other (please specify)

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GEOSYNTHETIC CLAY LINERS

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Solmax International Inc. | www.solmax.com													
Solmax BentoLiner® Series NS	needlepunched	610 (3.5)	4.7/46 (15.5/150)	1180 (2600)	3660 (0.75)	1 x 10^{-8}	24	18	nonwoven	200 (6.0)	woven	105 (3.1)	Medium Loads and Slopes
Solmax GundSeal® Series Smooth HDPE	adhesive	NA	5.3/61 (17.5/200)	1900 (4200)	3660 (0.75)	NA	24	18	smooth HDPE geomembrane	0.4-2.0mm (15-80mil)	spunbond geotextile	25 (0.75)	all
Terrafix Geosynthetics Inc./Terrafix Environmental Technology Inc. | www.terrafixgeo.com													
Bentofix NSL	Needle-punched / Bentonite	610 (3.5)	4.72m x 45.75m (15.5/150)	1050 (2300)	3660 (0.75)	5 x 10^{-9}	24	18	Nonwoven	200 (6.0)	Woven	105 (3.2)	LL, LC, SIL
Bentofix SRNWL	Needle-punched / Bentonite	610 (3.5)	4.72m x 45.75m (15.5/150)	1135 (2500)	3660 (0.75)	5 x 10^{-9}	24	18	Nonwoven	200 (6.0)	Scrim-nonwoven	200 (6.0)	LL, LC, SIL, Slopes
Bentofix CNSL	Needle-punched / Polypropylene coated / Bentonite	610 (3.5)	4.72m x 45.75m (15.5/150)	1135 (2500)	3660 (0.75)	1 x 10^{-9}	24	18	Nonwoven	200 (6.0)	PP Geofilm / woven	300 (8.8)	LL, LC, SIL

Note: Also available with polymer enhanced bentonite for high ionic leachates such as coal ash and brine resistant formulas.
Note: Solmax BenotLiner® is available with custom peel strength/bentonite mass.
Note: Solmax GundSeal® is also available with smooth and textured HDPE and LLDPE. Contact Solmax for detailed hydraulic information.

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[2] Report result at a maximum confining stress of 35 kPa (5 psi) and 14 kPa (2 psi) head pressure

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