

Advantages of needle-punched
BENTOFIX[®]
Geosynthetic Clay Liners (GCLs)




The Inventor of needle-punched Geosynthetic Clay Liners.
Material science - Engineering - Innovation

BENTOFIX[®] - The Original!



BENTOFIX®

Bentofix® Thermal Lock geosynthetic clay liners (GCLs) - also known as geosynthetic clay barriers (GBR-C) - are needle-punched, reinforced composites that combine two durable geotextile outer layers and a uniform core of high-swelling powder sodium bentonite clay. This forms a uniform, multi-directional, shear-resistant hydraulic barrier with self-sealing and re-healing characteristics.

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- ✓ Versatile sealing applications possible
 - ✓ Excellent sealing efficiency due to high swellable sodium bentonite powder
 - ✓ Immediate sealing and long-term performance with sodium bentonite powder
 - ✓ More cost-effective and withstands differential settlement better than compacted clay liners
 - ✓ Robust geotextiles encapsulate and contain the bentonite
 - ✓ Uniform needle-punching provides multi-directional shear strength
 - ✓ Thermal Lock process increases internal shear strength and interface friction angles
 - ✓ Self-sealing length overlaps; with BFG types all overlaps self seal
 - ✓ Installation advantages with up to 5.0m wide rolls
 - ✓ Quick, easy and cost effective to install

Bentofix® geosynthetic clay liners (GCL) exemplify how geosynthetics perform best: by interacting with natural elements to create something stronger or more secure.

Needle-punching revolutionised

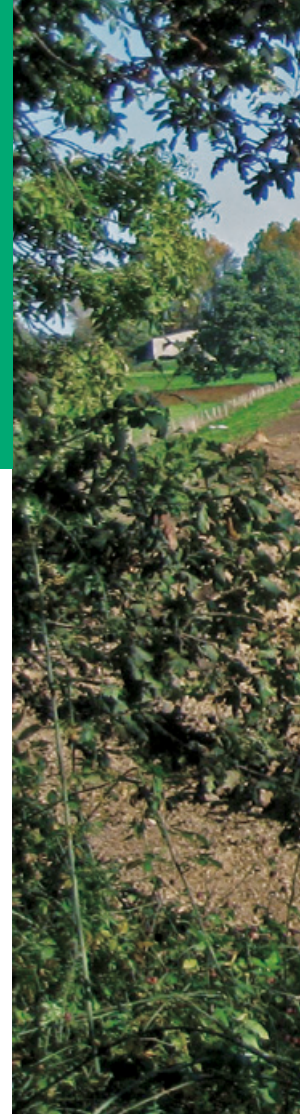
The needle-punched manufacturing technology greatly increased the internal and external shear strength of GCLs and expanded the range of applications in which GCLs could be used. The needle-punching process firmly bonds the three unique layers of Bentofix® – two outer encapsulating geotextiles and the core of sodium bentonite. This bond creates a single, engineered barrier that utilises the best of both synthetic and natural materials.

The Power of Powder Bentonite

Bentofix® GCLs outperform significantly thicker layers of compacted clay. The exceptional, immediate swelling characteristic of powdered sodium bentonite provides a long-term barrier that can “self-seal and re-heal” (e.g., swell to fill potential punctured/damaged zones) and rehydrate to renew the barrier even if it has been exposed to desiccation. The highly engineered geotextile outer layers provide outstanding protection against piping of the bentonite, durability to resist damage, and strength to manage the challenges inherent in barrier designs, such as for security on slopes and against fluctuating heads.

The Thermal Lock process permanently locks the needle-punched fibres of the nonwoven geotextile layer with the Bentofix® carrier layer of GCL-types without PE coating and improves the hydraulic conductivity performance at low confining stresses. It also increases the pullout resistance of the fibres - a durability-improving measure that increases interface friction, ensures long-term shear resistance and immediate fibre-strength during hydration.

Bentofix® “X” types are additionally extrusion-coated with a polyethylene liner ensuring an immediate and enhanced barrier to gas and radon while protecting against desiccation and critical substances.





ADVANTAGE 1

Bentofix® Thermal Lock replaces other GCLs as well as other soil barriers on steep side slopes and assures low permeability without sacrificing slope stability. Explanation: Bentofix® is uniformly needle-punched with over 2 million fibres/m². This results in a uniform, directionally-independent shear stress transfer. Thermal Lock additionally improves the pull-out resistance and the interface friction.

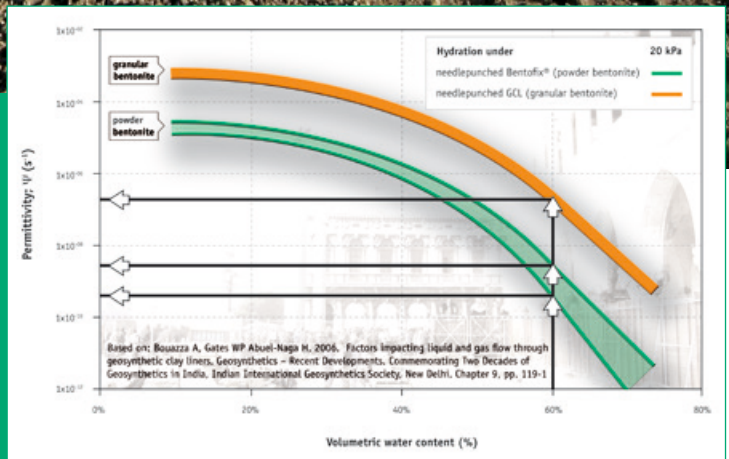


Figure 2 Performance of powdered Bentofix® bentonite compared to granular bentonite in correlation to water content and gas permittivity

- (1) The nonwoven protects against installation stress and increases the interface friction performance.
- (2) The bentonite powder acts as an immediate barrier.
- (3) The slit-film woven gives the product the dimension stability and makes the product stable for installation handling. The result of this trio, combined with the needle-punching and Thermal Lock: a durable, low-permeable sealing system.

Figure 3 Precipitation, drainage run-off and permeation values of GCLs under 1m cover soil in German climate

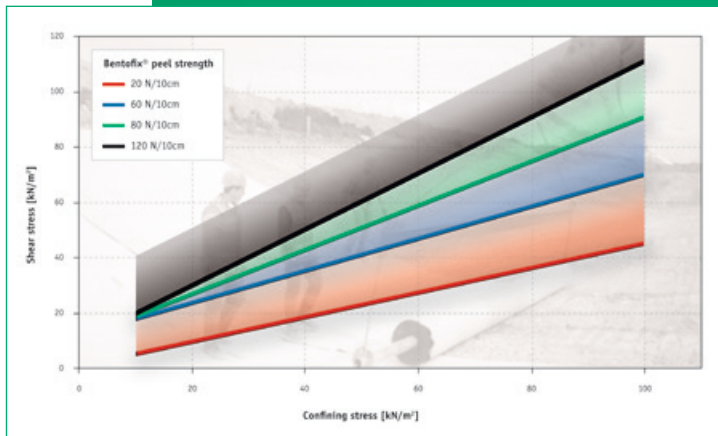


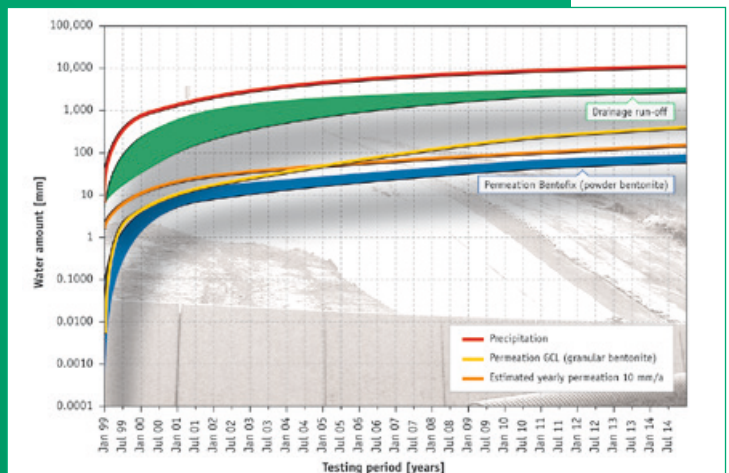
Figure 1 Conservative correlation of internal shear stress, dependent on the Bentofix® peel strength (hydrated under low confining stress)

ADVANTAGE 2

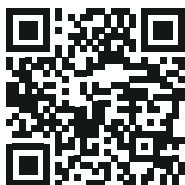
Bentofix® acts immediately as a sealing element. The explanation: high-swelling bentonite powder, uniformly distributed bentonite powder, large bentonite swelling surface and smaller air voids to close.

ADVANTAGE 3

Bentofix® utilises the advantages of three high-performance components in one geocomposite:



BENTOFIX®



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Bentofix® Sealing Applications:

- Landfill caps, closures and base seal
- Environmental protection under roads, railways, airports
- Dams and dykes
- Water containment and pond applications
- Structural waterproofing
- Secondary containment
- Mining applications
- Tunnels



Bund/Länder-Arbeitsgemeinschaft Abfall

BBA certified waterproofing systems (Bentofix® BFG 5000 + Bentofix® X2 BFG 5300)

LAGA application assesment for use as mineral sealing system in German landfill caps and closures for the landfill class I and II for Bentofix® types: BZ 6000 LAGA, B 4000 und NSP 4900



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