



TenCate Solutions with Enviromat® Geosynthetic Clay Liners



TenCate Polyfelt® Enviromat® Geosynthetic Clay Liners

Enviromat® geosynthetic clay liners (GCL's) consist of a layer of quality granular sodium bentonite clay incorporated between a spunbonded nonwoven geotextile and a woven geotextile. The GCL's are then internally reinforced by the needle-punching of PP fibres through the three component layers with the fibres thermally locked at the lower GCL surface to ensure it remains structurally stable.

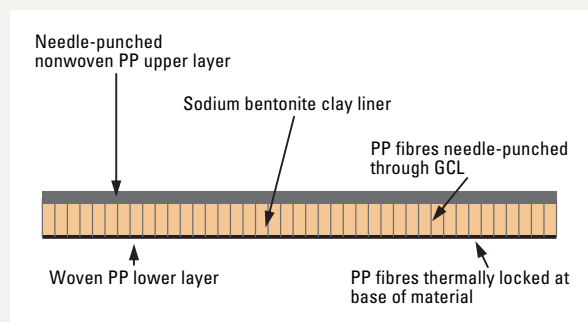
Enviromat® GCL's act as a barrier layer preventing the passage of liquids and gases. When installed in the ground, the sodium bentonite in Enviromat® GCL absorbs surrounding soil moisture. It hydrates and expands significantly into a gel-like material, resulting in an effective barrier layer of very low hydraulic conductivity to prevent the seepage of liquids. The performance of GCL's has since gained popularity in environmental engineering applications.

Applications for Enviromat® GCL's include:

- Landfill cap closures / base liners
- Dams / dykes
- Vertical trench cut-off barriers
- Groundwater protection covers
- Golf course ponds
- Stormwater ponds
- Recreational ponds
- Environmental protection barrier under roads and railways
- Secondary containment for above-ground tanks



Geosynthetic Clay Liner (GCL)



Structure of Enviromat® GCL's

Enviromat® GCL's are manufactured to meet international standards. Their engineering behaviour has been designed in accordance with recognised international requirements, specifically GRI-GCL3 (2010) which is an internationally recognised standard for the engineering behaviour of GCL's.



Performance Features of Enviromat® GCL's

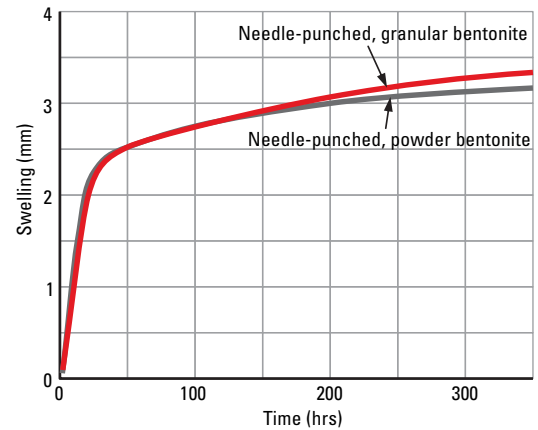
Consistent low hydraulic conductivity, which is the rate at which liquid passes through a material, is an important performance criteria for GCL's as an effective barrier layer. This is achieved with good quality sodium bentonite, using clean water for its hydration and maintaining the GCL in a confined state during the hydration process.

Quality granular sodium bentonite - the ultimate hydraulic conductivity is the same between granular and powder bentonite with granular bentonite presenting additional benefits:

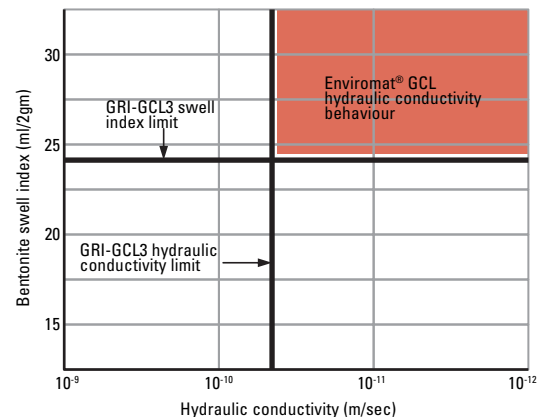
- Better moisture absorbency and does not leach out easily during installation.
- The mass per unit area of sodium bentonite used is evenly distributed over the area of the GCL for an evenly distributed low hydraulic conductivity throughout the GCL.
- Suitable even for applications in a hydraulic environment.

Reinforced geotextile composites - robust with superior tensile strength enables:

- Increased internal shear resistance and long term creep resistance.
- Retains the granular sodium bentonite within the Enviromat® GCL structure.
- Prevents stretching and contracting during shipment and installation to ensure continuity and uniformity of the bentonite layer throughout the GCL.
- Structurally stable when installed on slopes.



Comparison of confined swelling of GCL's using granular and powder bentonite (After Vangpaisal and Bouazza, 2004)



Hydraulic conductivity behaviour of Enviromat® GCL's

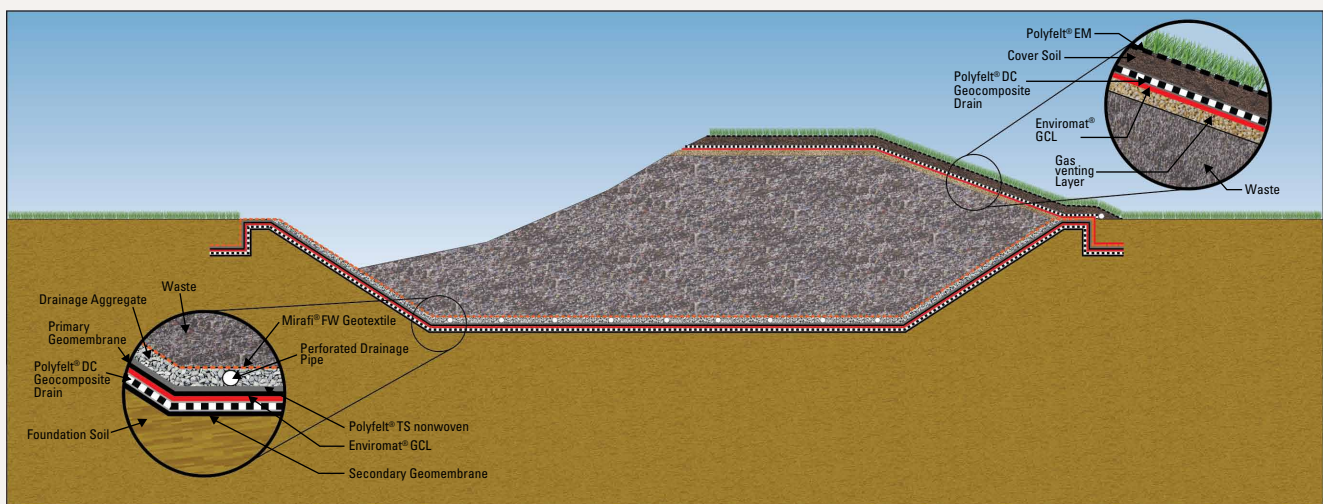


Applications of Geosynthetic Clay Liners

Landfill Base Liners and Cap Closures

GCL's are commonly used to line the base of landfills as a barrier system to liquids. With the implementation of environmental legislations, seepage from landfills must be collected and disposed of appropriately to prevent contamination of ground water. Due to its low hydraulic conductivity and stability in structure, Enviromat® GCL's work effectively as a barrier layer in limiting the seepage of liquids, leachates and gases out of landfills.

When installed on slopes, Enviromat® GCL's exhibit good internal shear resistance even at large shear strains. This is primarily due to the needle-punch bonding and thermal-locking of fibres which internally reinforces the GCL's. The upper and bottom geotextile layers of Enviromat® GCL's also interact with the soil to provide external shear resistance to ensure the soil overburden does not slide over the GCL surface while the GCL itself does not slide over the foundation slope surface.



Typical section of landfill base liner and cap closure systems



Enviromat® GCL's are also useful as landfill covers or cap closures as well as remediation barriers to inhibit the ingress of water and limit the escape of gases.

The various advantages of GCL's have added to the popularity of its applications in landfill engineering. The absorbency and swelling properties of sodium bentonite even enable the GCL's to self-seal any holes or tears to ensure a full containment effect. This allows the GCL's to retain its properties that make it an effective barrier system for landfill applications.

Landfill operators can install GCL's significantly faster and much more easily than traditional systems such as compacted clay liners. It is a cost effective solution especially in locations where availability of suitable clay is scarce and where speed of construction is required.

Aside from its favourable mechanical and hydraulic properties, GCL's are much thinner than compacted clay liners. This allows landfill designers to maximize the containment capacity of the landfills.



Enviromat® GCL laid as base liner



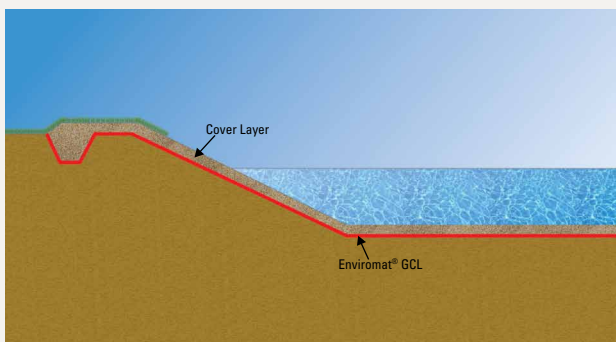
Enviromat® GCL laid over slope



Detention & Recreational Ponds

To reduce flooding and erosion problems, detention ponds are included as a solution in stormwater management. Enviromat® GCL's are commonly applied as a base liner in these detention ponds to effectively prevent water leakage from the base and sides of the ponds. Enviromat® GCL's are also used in landscape and recreational ponds, golf course ponds, dams, reservoirs, canals and other water impoundments for the same function.

Enviromat® GCL is a flexible material which makes it a product that is versatile to work with especially for ponds designed with irregular shapes. The GCL can be easily laid on non-uniform shaped areas and perform effectively as a water barrier. It is an environmental friendly solution that saves cost and time as compared to conventional methods of fully concreting a pond structure.



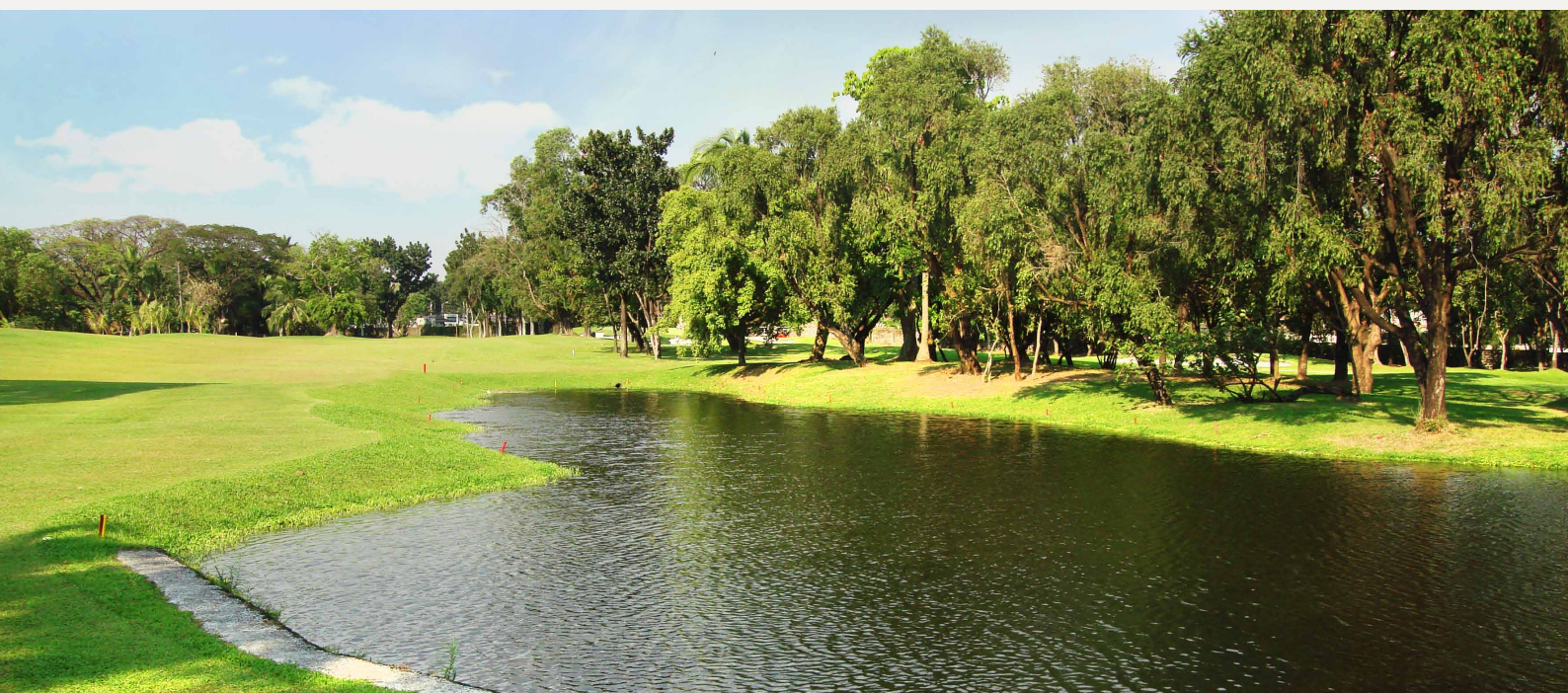
Typical section of detention and recreational ponds



Detention pond lined with Enviromat® GCL



Recreational pond lined with Enviromat® GCL

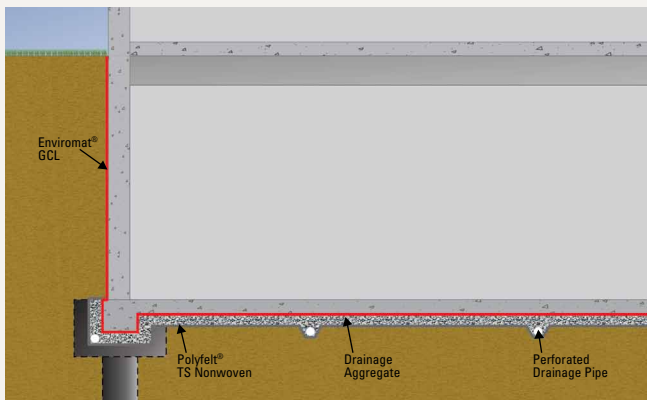


Other GCL Applications

Although GCL's are essentially used to protect the ground environment from contamination of leachate in landfills and prevent seepage from water impoundments, there are also other applications where GCL's are used as a solution to mitigate fluid migration.

Other applications include:

- Secondary containment or storage facilities eg. above-ground tanks
- Vertical trench cut-off barriers
- Engineered wetlands
- Environmental protection barrier under roads and railways
- Other industrial and mining applications



Typical section of basement water proofing



Enviromat® GCL attached to basement wall prior to backfilling



Enviromat® GCL laid prior to casting of basement slab



TenCate develops and produces quality products that increase performance, reduce cost, and deliver measurable results by working with our customers to provide advanced solutions.

TenCate Geosynthetics Asia Sdn Bhd

Registration No. 199301009495 (264232-U)

14 Jalan Sementa 27/91 Seksyen 27
40400 Shah Alam
Selangor Darul Ehsan
Malaysia

Tel: +60 3 5192 8568
Fax: +60 3 5192 8575
Email: info.asia@tencategeo.com

www.tencategeo.asia

TenCate Geosynthetics North America

365 South Holland Drive
Pendergrass
Georgia 30567
United States of America

Tel: +1 706 693 2226
Fax: +1 706 693 4400
Email: spec@tencategeo.com

TenCate Geosynthetics Austria GmbH

Schachermayerstrasse 18
A-4021 Linz
Austria

Tel: +43 732 6983 0
Fax: +43 732 6983 5353
Email: service.at@tencategeo.com



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