

## EDILMODULO XP Clay Geosynthetic Barriers for Waterproofing

### Bentonite

Bentonite is a clay mineral of the smectite group and is composed mainly of montmorillonite. The smectites are a group of minerals that swell as they absorb water or organic molecules within the structural layers; they also have considerable cationic exchange properties.



The clay mineral they are composed of in the crystalline state is derived from the devitrification, and consequent chemical change, of glass of magmatic origin, usually tufa or volcanic ash (definition by Ross and Shannon, 1926).

The nature and volcanic origins of bentonite deposits give rise to varieties of the mineral that are often extremely heterogeneous. The bentonites that are thus formed that can be described as sodium, calcium and acid bentonites.

The crystallographic basis of the montmorillonite (bentonite) is typical of phyllosilicates: sheets of AlX octahedrons (X=oxygen or oxydril) between two sheets of SiO<sub>4</sub> tetrahedrons.

In the octahedron layer the Aluminum may be replaced by magnesium, thus giving rise to an excess negative charge: the negative charge in excess is compensated for by various mono and bivalent cations (Ca<sup>++</sup>, Mg<sup>++</sup>, Na<sup>+</sup>...).

This elementary particle is a lamella: the various lamellas are held together in "packets" by Van der Waals force, but they can be "delamellised" and dispersed in water

in submicronic particles until a specific superficial area of 800 m<sup>2</sup>/g is developed.

A reliable barrier system is realized with the use of sodium bentonite, which has a high grade for swelling (higher than 24 ml/2g) and water absorption (higher than 600%), and gives rise to a gelling with excellent waterproofing properties.

### Introduction

The problem of waterproofing underground structures is one that cannot be ignored in the area of civil engineering in underground structures.

Water can cause the premature deterioration of structures due to physical effects and to degradation by chemicals: water is normally present as a saline solution of chemical agents that can interact with, and attack, the cement matrix of the building.

Anyway, the final result is the unforeseen deterioration and damage of the structure in terms of its static resistance and functioning.

Correct waterproofing, which will ensure complete correspondence to operating variables for the entire average life of the building, is therefore an essential requirement.

An analysis of the possible solutions for waterproofing below-grade horizontal and vertical surfaces leads to a distinction being made between "passive" barrier systems", which act exclusively as a barrier to prevent structure/fluid contact, and "active barrier systems", which are able to interact with the fluid and prevent any infiltration, even when the work is at an advanced stage.

Clay Geosynthetic Barriers (mostly known as GCL) belong to this second category.

## Product Description

A GCL (Geosynthetic Clay Liner) can be described as a hydraulic barrier consisting of a layer of low permeability bentonite supported by geotextiles or geomembranes, assembled with different systems.

In any case, a GCL can therefore be considered as being a “bentonite box”: the bentonite representing the waterproofing system and the geotextiles provide superior protection to the barrier system with its mechanical strength.

EDILMODULO XP is a needle-punched Clay Geosynthetic Barrier made of one non-woven polypropylene geotextile as cover layer, a one woven polypropylene geotextile as carrier layer, which encapsulate a uniform layer of natural sodium bentonite.

A reliable barrier system is realized with the use of natural sodium bentonite, which has a high grade for swelling (higher than 26 ml/2g) and water absorption (higher than 600%), and gives rise to a gelling with excellent waterproofing properties.



The connection between the cover and carrier geotextile is achieved by needle-punching system which enable the two geotextiles to be joined by thousands of fibres through the bentonite layer. This kind of reinforcement is especially made in order to cut down internal shear forces acting on the

barrier, making Edilmodulo XP a perfect solution for application on vertical surfaces, and giving the barrier a pre-confinement which increase the barrier capability to remain exposed before the finale confinement is reached.

The dimension of the particles of the bentonite together with the open size of the non-woven geotextile are carefully calibrated in order to achieve a full saturation of the geotextiles, once the barrier is fully hydrated, increasing the self-seaming of the rolls on the overlapping area.

This special solution ensures both the complete adhesion of the bentonite to the two geotextiles, and the homogeneous swelling of the natural sodium bentonite, even in contact with waters of low salinity content.

## How GCL works

When the bentonite comes into contact with water, the bentonite mass swells and prevents any water intrusion. At interstitial level, this phenomenon produces an osmotic back pressure that is equal to, and even higher than, the external pressure of the water.

An extremely interesting aspect of geosynthetic clay liner is its capability to reduce water permeability as water pressure increases. An increase in hydrostatic pressure corresponds to a decrease in the distance between the platelets of the solid matrix. The increase in pressure there-fore produces higher confinement by the bentonite system; the compacting of the bentonite matrix is therefore more homogenous; the decrease in volume of the interstitial spaces also ensured for the reduced permeability of a solid matrix by fluids.

The total functionality of the Edilmodulo XP as a waterproofing barrier is essentially reached by a “correct” confinement of the product, both during construction and during the working life of the structures under load. The confinement ensures a homogeneous contact between the geosynthetic clay barrier and the concrete structure; micro-particles of bentonite can saturate the cover non-woven geotextiles and saturate the micro-pores that form in concrete during the concrete setting.

Another fundamental aspect to reach a total functionality of the clay barrier is the preparation of the laying surfaces.

In horizontal applications, it is normally recommended to prepare the laying surface with a poor concrete layer; this layer has the function to create a suitable and homogeneous surface for the application of the barrier. If the barrier is laid directly on soil, it is important to compact the soil (90 % Modified Proctor) to reach a uniform surface. It is also necessary to take away every “cutting stone” and to fill the holes that could be present.

In vertical application, it is necessary to lay the geosynthetic clay barrier on a regular surface, both in pre-casting and post-casting application of the waterproofing system.

The Edilmodulo XP has to be fixed using large head nails to ensure a deep contact between the barrier and the concrete structure.

### Product Advantages

The high swelling capability of the sodium bentonite, combined with the mechanical characteristics of the confining geotextiles, turn EDILMODULO XP a reliable product for below-grade waterproofing, even where boundary environmental conditions change (swelling/drying and freezing/thawing cycles), or where there are interacting polluted fluids.

The simplicity and the rapidity of installation is also very important and it is due to the extreme adaptability of the Edilmodulo XP to every surfaces. It can be simply installed with nails with wide heads and LDPE washers.

Its extreme adaptability also allows the passage of connecting or reinforced-concrete rods and the product can be cut and shaped in accordance with the configuration of the structure to be protected.

Saturation of non-woven geotextile operated by the bentonite particles ensures self-seaming overlaps, simply by overlapping; overlaps do not require any welding or mechanical intervention.



The reinforcing system of Edilmodulo XP makes a pre-confinement of the barrier and makes it useful especially for pre-casting applications (e.g. against diaphragm walls). It allows also the GCL capable of staying unconfined for a while without the final protection of the concrete layer.

Simplicity of handling and installation, even in special applications for which it is obviously necessary to cut and/or shape the GCL, make the material adaptable to the most difficult installation conditions.

The financial side of handling GCL cannot be underestimated; if moderate accidental damage occurs during the loading/unloading of the material when the waterproofing stage has begun, Edilmodulo XP is self-healing and does not require any outside intervention.

Finally, strict and rigorous quality controls in the production stage (constant and continuous sampling to check the chemical-physical as well as the mechanical characteristics of the product) offer considerable financial savings and the removal of expensive tests carried out on site.

All product are CE marked with reference to European Harmonized Standards for Geosynthetics and to European Regulation on Construction Products.

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