



**BentoShield®**

## **GEOSYNTHETIC CLAY LINER**

As Geomas, we serve the environmental and construction fields with our innovatively developed waterproofing products.

High production capacity of our fully automated facility and Turkey's strategic location are important factors in our ability to serve as the best available option to our clients in fast and cost efficient manner. Thus, we have a solid presence with return clients not only from Turkey but also from Europe, Russia, and Middle East.

As a subsidiary of the leading group, IZOMAS GROUP in Turkey, Geomas also improves its research and development operations on geosynthetic product range by vigorous commitment to quality.







**BentoShield®**  
GEOSYNTHETIC CLAY LINER

**GEOMAS provides professional solutions...**

From design to construction Geomas is available as your solution partner by providing:

- Manufacturing capabilities,
- Supervising and inspection service,
- Design assistance and technical expertise,
- Training programs consisting of theory and practice.



## BentoShield GCLs

The sealing technology of BentoShield, effectively combines the unique swelling performance of sodium bentonite granules with two high strength geotextiles. Once BentoShield is hydrated, it forms an impermeable barrier against liquids, water vapor and gases.

BentoShield geosynthetic clay liners (GCL's) are very effective sealing liners for wide variety of environmental projects from landfill to mining areas, lagoons and canals. Geomas presents the most economical and effective solution for all your specific requirements with factory controlled BentoShield geosynthetic clay liner range.



**Geomas, provides wide range of waterproofing solution with yearly 10 million m<sup>2</sup> production capacity**

## Sodium Bentonite

Bentonite is an extremely absorbent natural mineral that has versatile application areas from cosmetics to food industry, iron steel industry and nano technology. Sodium bentonite naturally formed in millions of years as a result of volcanic activation. When it comes to waterproofing, chemically stable and high swelling characteristics of sodium bentonite sets it apart from any other mineral available in nature.

### How do Sodium Bentonite act in BentoShield?



**2 gr sodium bentonite swell minimum 24 ml in pure water.**

The bentonite's high swelling capacity and low permeability provide an effective hydraulic seal for BentoShield. Upon contact with water, sodium ions between the platelets of bentonite attract positively charged water particles. Thus, the volume of natural sodium bentonite enlarges many times to its original dry volume and becomes an impermeable sealing layer by forming a dense and monolithic gel under confinement.

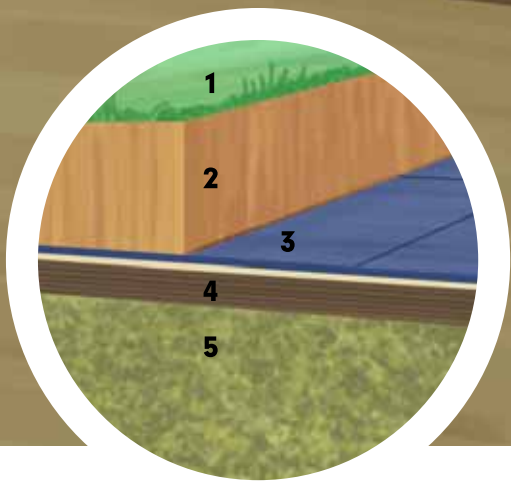
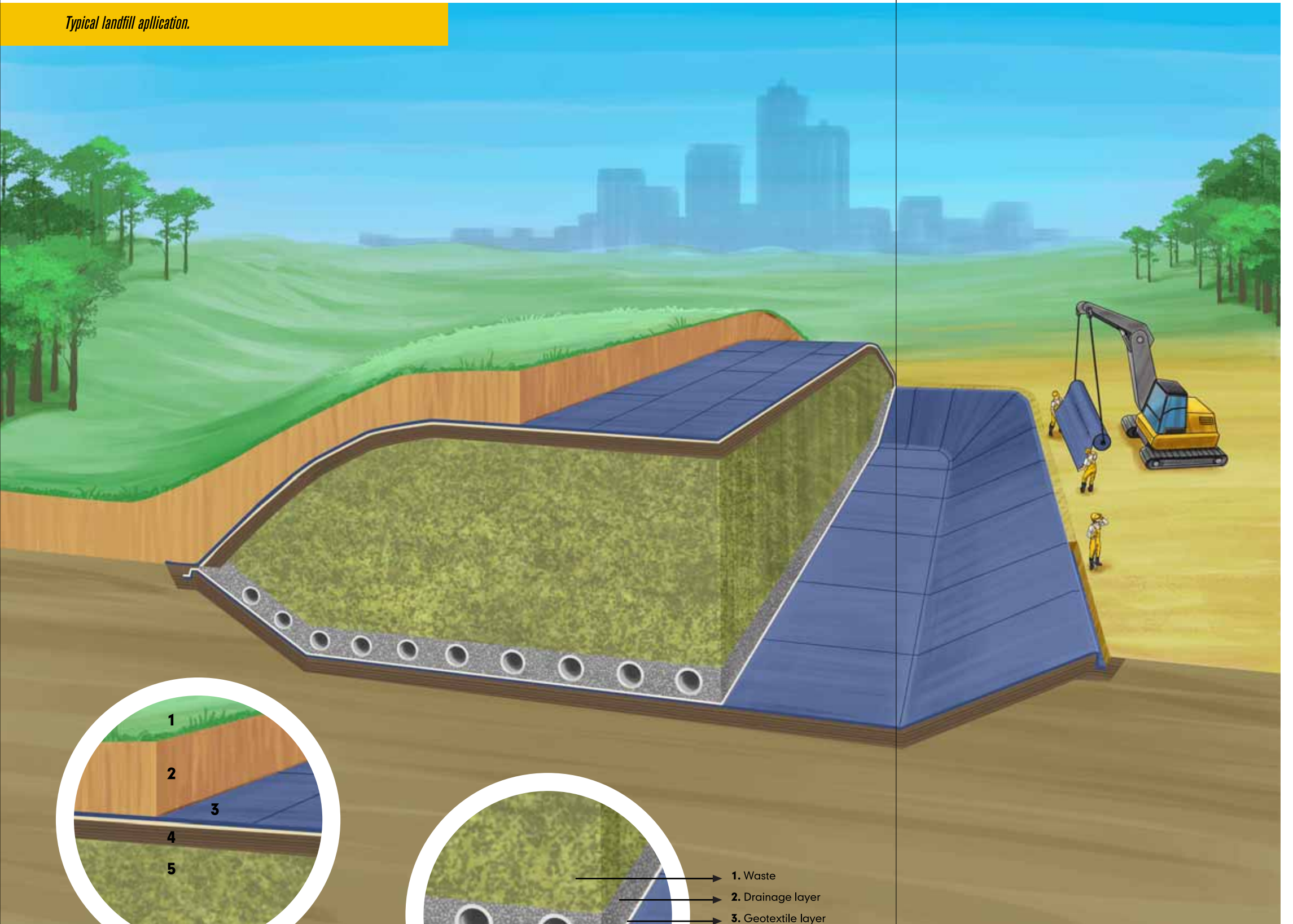
Once sodium bentonite granules hydrate, they never turn back to dry stage again and stay active through the life of the structure by means of the moisture in the environment. It is not adversely affected from freeze-thaw and desiccation-wetting cycles.

In other words, the swelling action of natural bentonite granules is totally result of a physical phenomenon, not a chemical reaction; so its expected effective life can be named as everlasting.

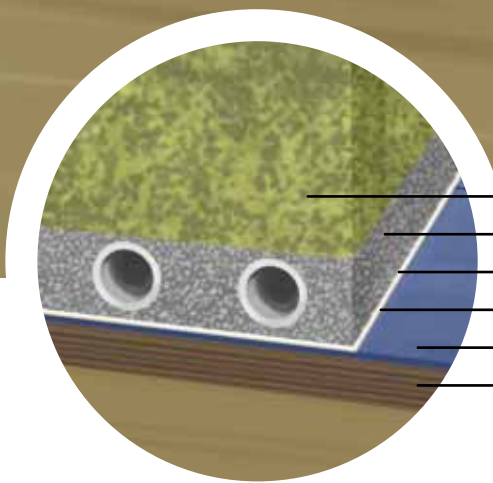


**Bentonite granules within BentoShield swell and form monolithic sealing layer in overlap zones.**

Typical landfill application.

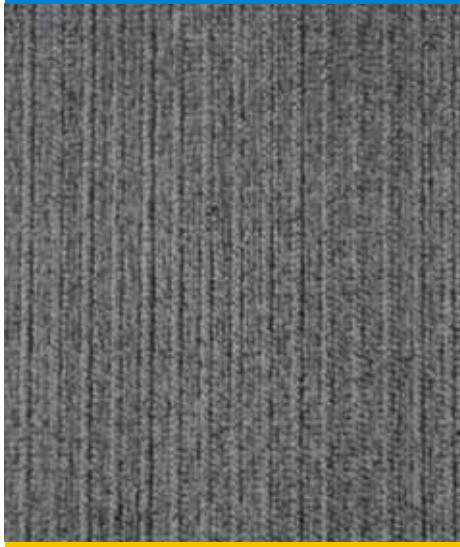


- 1. Landscape
- 2. Backfill material
- 3. **BentoShield**
- 4. Compacted substrate
- 5. Waste



- 1. Waste
- 2. Drainage layer
- 3. Geotextile layer
- 4. Geomembrane
- 5. **BentoShield**
- 6. Compacted substrate

# BentoShield®



**BentoShield provides high shear strength and excellent stability in challenging slope applications.**



**Needlepunched fibers restrain the lateral movement of sodium bentonite within BentoShield by providing uniform confinement.**



**Large rolls of BentoShield provide a fast, easy and cost effective installation.**

GEOSYNTHETIC CLAY LINER

BentoShield®

## Advantages GCL vs CCL

BentoShield presents remarkably higher hydraulic performance when compared to a meter of conventional compacted clay liner. In addition to superior hydraulic performance, BentoShield effectively overcomes the technical difficulties confronted during installation in compacted clay applications and provides a cost effective solution.

### Cost Effective Application

- BentoShield is delivered on site very efficiently. One truckload of BentoShield can cover **4.000 m<sup>2</sup>**, whereas same truck is able to cover only around **25 m<sup>2</sup>** compacted clay.
- BentoShield occupies little air space with less than **1 cm** thickness and provides extra storage capacity when compared to compacted clay liners.
- Factory controlled quality of BentoShield ensures the critical performance characteristics and minimizes the expensive and time consuming on-site CQA testing.

### Superior Hydraulic Performance

- Environmental stress of freeze-thaw cycles and differential settlements may cause to cracks leading significant leakage problems in CCL applications. But, BentoShield easily withstands these harsh conditions by means of high tensile strength and its self healing capability to seal cracks and voids.
- BentoShield offers minimum  $5 \times 10^{-11}$  m/sec permeability performance which is significantly better than compacted clay liners offering merely  $1 \times 10^{-9}$  m/sec.

### Innovative Needle punching Process

During manufacturing process, millions of fibers of non woven extending the woven geotextile form very strong mechanical bonds between the layers. Thus, BentoShield gains high shear strength properties by providing excellent stability in challenging slope applications.

### Ease of Application

- Due to the simplicity of BentoShield deployment technique, specialist labour and equipment is not required for installation.
- BentoShield installation is less sensitive to weather conditions. Whereas, the success of CCL application is directly affected from materials, equipment, weather and workmanship.

### Standart dimensions and packaging

<b>Dimension**</b>	5 m x 40 m	2.5 m x 40 m
<b>Area</b>	200 m <sup>2</sup>	100 m <sup>2</sup>
<b>Weight*</b>	1100 kg	550 kg

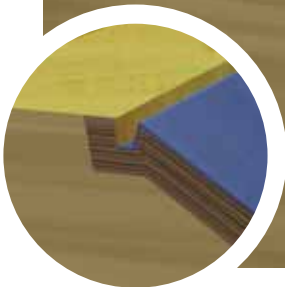
\* Those values are approximate and subject to change .

\*\* Depending on project requirements, BentoShield can also supplied in different dimensions.

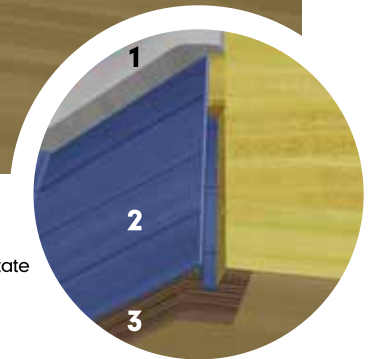


**BentoShield is packed according to site conditions.**

Typical canal application.



Anchor Trench



1. Concrete cover
2. BentoShield
3. Compacted substate

## Technical Properties

### BENTONITE LAYER

<b>Bentonite Content</b> ASTM D5993	5.0 kg/m <sup>2</sup>
<b>Free Swell</b> ASTM D5890	25 ml/2 gr
<b>Fluid Loss</b> ASTM D5891	18 ml

### GEOTEXTILE LAYERS

<b>Non-Woven Mass/Unit Area</b> ASTM D5261	200 g/m <sup>2</sup>
<b>Woven Mass/Unit Area</b> ASTM D5261	110 g/m <sup>2</sup>

### GEOCOMPOSITE

<b>Thickness</b> EN 964-1	6 mm
<b>Permeability</b> ASTM D5887	$5 \times 10^{-11}$ m/s
<b>Index Flux</b> ASTM D5887	$1 \times 10^{-8}$ m/s
<b>CBR</b> EN ISO 10319	1860 N
<b>Tensile Strength</b> ASTM D6768	13 kN/m
<b>Peel Strength</b> ASTM D6496	60 N/m
<b>Shear Strength</b> ASTM D6243-8	24 mPa

BentoShield product line is manufactured to suit the particular applications. The type and quantity of bentonite as well as the properties of geotextiles may vary according to project requirements.

# Application details

## Subgrade Preparation

The subgrade surface should be smooth enough and free of voids, sharp stones, standing water or construction debris. This is accomplished by final grading to fill remaining voids, leveling sharp irregularities extending more than 12 mm and compacting at least 85% of standard proctor density.

## BentoShield Placement

During installation, BentoShield rolls are suspended from the front of the vehicle and the vehicle moves slowly backwards by letting BentoShield rotate freely around the core.

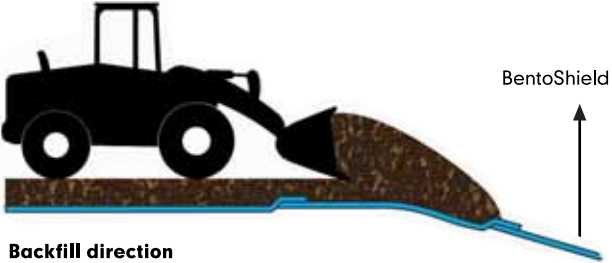


Installation should proceed from the highest elevation to the lowest to drain quickly to prevent possible precipitation accumulation before backfilling.



Two blue lines on the upper surface of BentoShield assist the applicator for proper overlap distances. Depending on site conditions, minimum overlapping of adjacent edges of BentoShield rolls should be minimum 15cm and overlapping direction should follow the direction of the slope.

In order to minimize the movement, BentoShield is secured by means of mechanical fasteners. The hydraulic performance of BentoShield is maximized in critical details and overlap zones by placing additional granular bentonite.



Depending on the project requirements, it is covered with concrete, earth or gravel. Thickness of min. 30cm earth provides the required confining stress for BentoShield and forms a safe platform for vehicle traffic.





## Anchor Trench

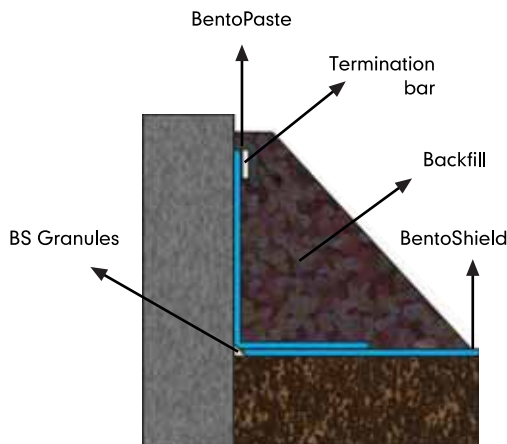
At the top of sloped areas, especially greater than 7H:1V, an anchor trench for the GCL should be excavated or an equivalent run out should be utilized in accordance with the project specifications. The anchor trench should be free of sharp edges, protrusions and loose soil and maintained in a dry condition. BentoShield should cover the entire trench floor in order to provide pull out resistance but not the rear trench wall.



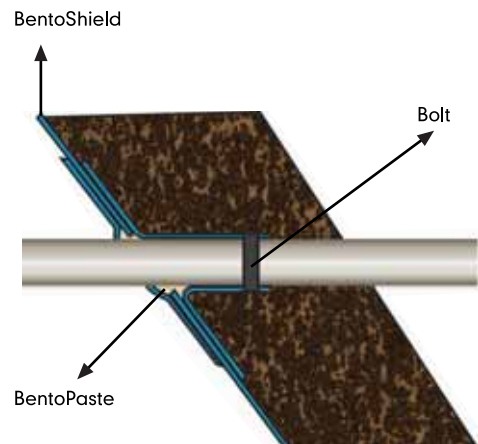
For more detailed information please refer to the Installation Assurance and Specification Handbook.

## Penetrations and Detail Work

BentoShield can be easily installed by cutting with a sharp utility knife to fit around penetrations such as gas vents, foundation walls, pipes, and drainage basins according to the contract drawings. By using granular bentonite, a cant should be formed between BentoShield and the structure.



Wall conjunction detail



Pipe detail



## Solid waste containment

### Landfill Base Liners

In industrial, hazardous or municipal waste landfills, BentoShield offers the ultimate sealing for the base of a landfill either used alone or in conjunction with a geomembrane layer. The overall technical and hydraulic performance, as well as the ease and speed of BentoShield installation is superior to a traditional compacted clay liners.

### Landfill Final Caps

BentoShield can be used as a sole hydraulic and gas barrier in landfill capping applications and provides reliable shear strength characteristics without need of a geotextile protection even in steep slopes.

BentoShield is unaffected by freeze-thaw and differential settlement which can lead to significant leakage in traditional compacted clay liners. BentoShield ensures the cost-effective solution for redeveloping brownfield sites into revitalized civil structures.

### Mining Industry

BentoShield can be effectively used either in lining or capping of process solution containment, leach pads, storm water containment and wastewater treatment areas of mining facilities.

Besides decreasing the construction costs and controlling the subsurface contamination, BentoShield also decreases the loss of profit by preventing the escape of pregnant leach solution.

## Liquid containment areas

### Ponds and Lagoons

BentoShield provides an exceptional liquid containment in decorative ponds, balancing ponds, golf courses, industrial and aeration lagoons. Besides providing long life warranty, it also provides extra airspace in reservoirs and lagoons during construction.

BentoShield can also be used to control leakage in wetlands constructed for storm water containment, municipal wastewater treatment and fishery enhancement where the compacted clay is not promoting an economic and effective solution.

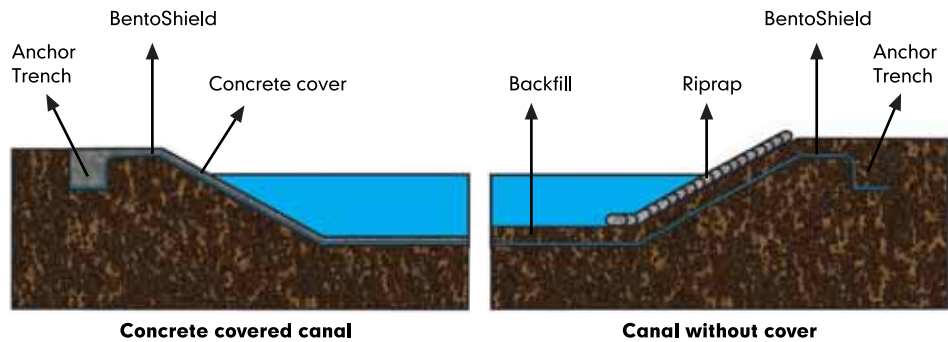
### Secondary Containment

BentoShield can be used as an effective hydraulic barrier in above ground storage tanks by providing good chemical resistance and durable service life.

In secondary containment applications, BentoShield ensures the reliable and cost effective solution to usual problematic detail works such as sealing of pipe penetrations and cut-off trenches.

### Canals

In canal design, sealing material should overcome the difficulties in lateral steep slopes and differential settlement along the canal length. BentoShield ensures the ideal sealing system for all those conditions and minimizes the water loss through new or existing canals and waterways.



**Factory  
production  
control**

All the steps of production from raw material supply to packaging is monitored according to the intensive GEOMAS Manufacturing Quality Control Plan integrated with the ISO 9001 management system. BentoShield and the raw materials are subjected to compliance tests in order to ensure the consistent properties throughout CE and GOST-R.

Besides well qualified Geomas Laboratory, some vital performance values of the product such as permeability and shear strength are also tested independently by GAI-LAP accredited laboratories in specific frequencies.



**BENTOSHIELD 5000**  
**Meeting all  
expectations**

BentoShield 5000 is the most preferred standard solution in our product range. Minimum 5 kg sodium bentonite layer is encapsulated between woven and non woven geotextiles by needlepunching method

**BENTOSHIELD LW**  
**Cost effective  
solution**

BentoShield LW consists of lighter bentonite layer in order to offer more economic solution in project basis by reducing transport costs.

**BENTOSHIELD SMAX**  
**High Shear strength  
characteristics**

BentoShield SMAX is a reinforced needlepunched GCL that has high internal shear strength, and provides excellent interface friction on both sides when there is no need for tensile strength properties of woven geotextile.

**BENTOSHIELD LM**  
**LDPE laminated  
GCL**

BentoShield LM is a geomembrane laminated GCL specially designed for liquid containment applications. It provides superior hydraulic performance and puncture resistance beyond other membrane.

**BentoShield®**



**GEOSYNTHETIC  
CLAY LINER**

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