

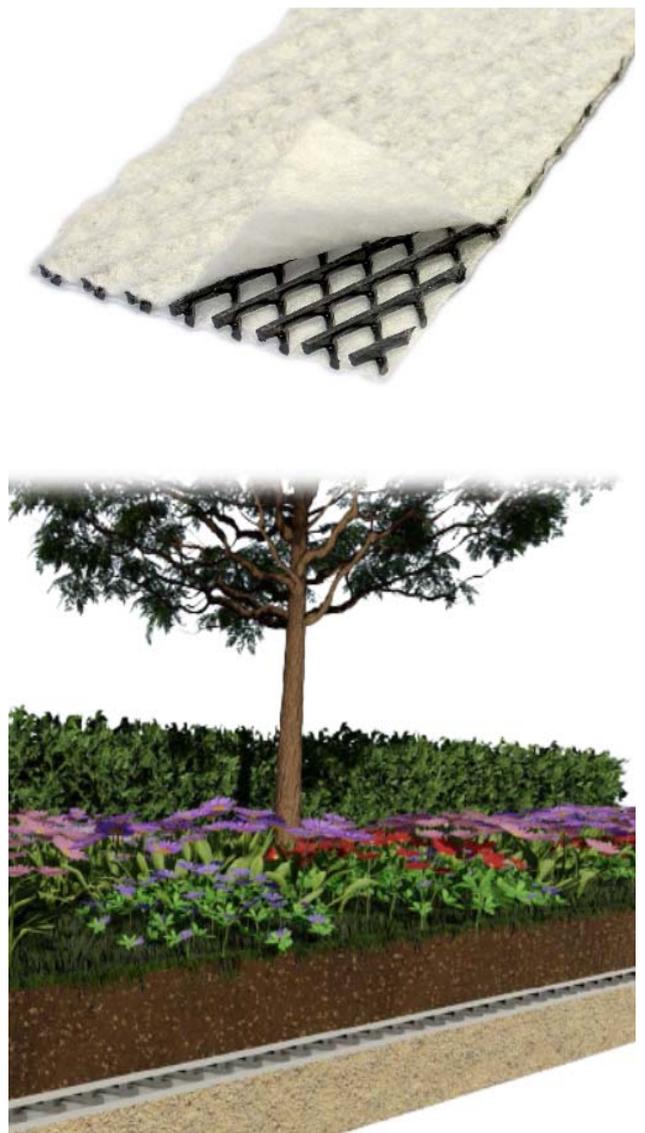


Capillary Breaker / Salt Barrier below Landscaping

Capillary rise of saline groundwater to sweet soil causes severe problems to vegetation as this will limit plant growth over the sweet soil. When unchecked, this will result to excessive soil erosion as there will be less or there will be no plants to hold the soils. This is particularly rampant in arid regions and coastal areas.

SALTSTOP is a geosynthetic composite salt barrier / capillary breaker consisting of geonet core bonded with filter fabric on both sides. SALTSTOP prevent the movement of saline water by capillary rise into the top vegetative soils, imported soils, road base & sub-base layers, and foundations. It also acts as a drainage layer to collect & discharge rainwater and surface spillage.

SALTSTOP replaces traditional capillary breaks made up of 300mm thick crushed stone layer making significant savings in construction cost and time. SALTSTOP maintains its drainage void throughout its service life providing a permanent solution to problems caused by capillary action and it can withstand differential settlements without loss of its performance.



Landscaping on top of Landfill / Mining Closure Capping System

At the time of closure of landfill / mine a **BENTOCLINE GM-GCL** composite liner is placed and a **NETFLOW / CUPFLOW** drainage composite is placed on top of liner to drain excess precipitation from the protective cover soil to enhance stability and help prevent infiltration of water through the landfill cap system.

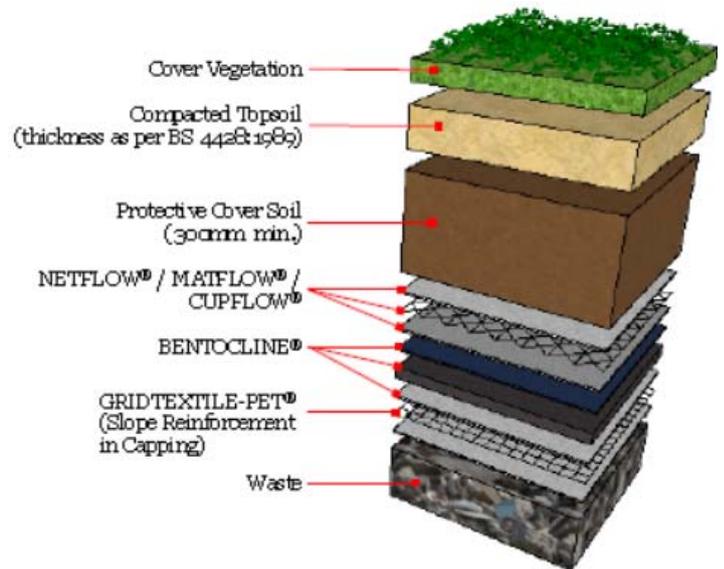
On top of these geosynthetic layers a protective topsoil of 300mm to 2000mm depending on the type of waste in the landfill or mine, covered with vegetative soil and greenery. The thickness of vegetative soil depends on the type of greenery planted as per BS 4428:1989.

Protective cover layer provides additional moisture retention to help support the greenery and top vegetative soil helps to support and maintain the growth of vegetation by retaining moisture and providing nutrients.

BENTOCLINE

BENTOCLINE is a Geosynthetic Clay Liner (GM-GCL) consists of a uniform layer of sodium bentonite powder encapsulated with non-woven geotextile on one side and woven geotextile and 0.5mm thick LLDPE geomembrane on the other side. It has self-healing capacity when hydrated with water and eliminates the conventionally required compacted clay liner in landfills and mining sectors. BENTOCLINE has effective rehydration capacity which makes it unique.

BENTOCLINEs 7.0m wide roll widths reduce the overlaps in the field, installation time, labor cost and overall project cost. Along with the BENTOC can produce standard BENTOCLINE GCLs with bentonite weight of 3kg, punched between woven and non-woven geotextiles.



Greenery	Min. Thickness of Vegetative Soil (mm)
Grass	100 to 150
Shrub	400
Trees	600

Thickness of vegetative soil as per BS 4428:1989

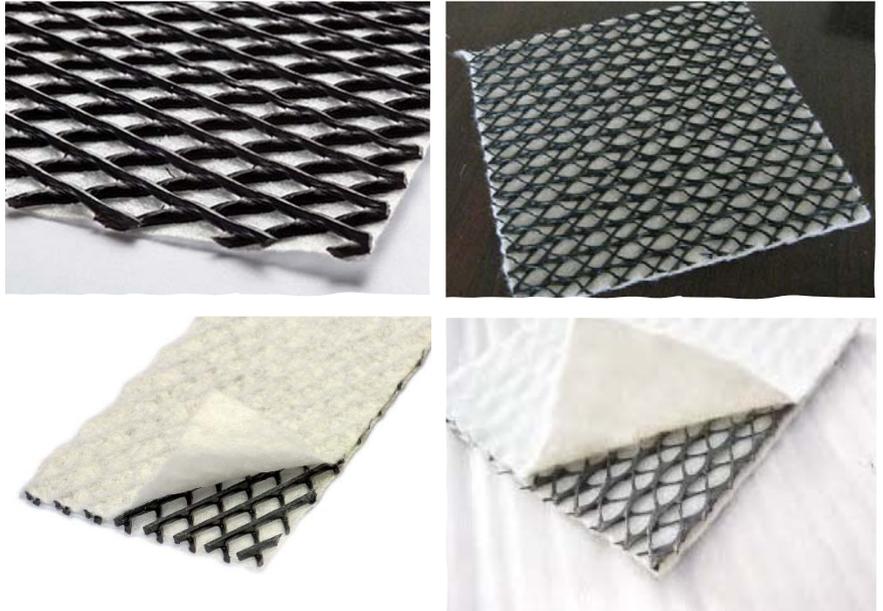


BENTOCLINE GCL

BENTOCLINE GM-GCL

NETFLOW

NETFLOW drainage composite can be used as effective filters and drains in landfill capping, leachate collection and leak detection systems. It contains a bi-planar or tri-planar core extruded from HDPE and allows very large quantities of liquid to flow within its structure; it thus acts as a drainage core. The core will be protected by a geotextile, acting as a filter and separator, on one or both sides.

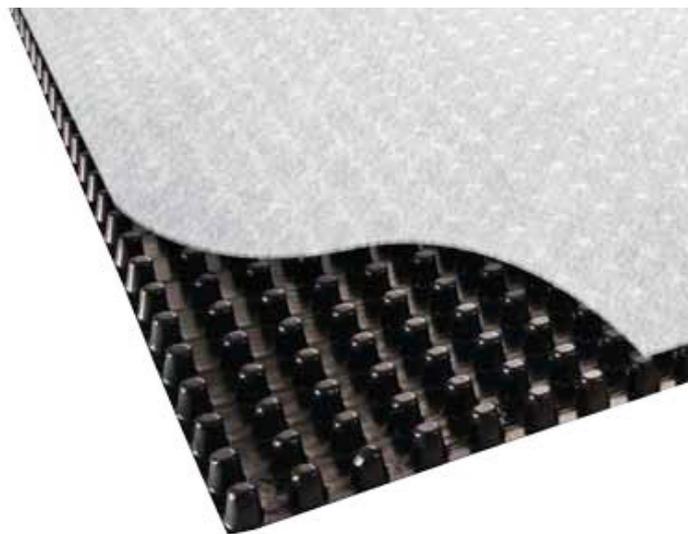


The emergence of such Geodrain composites, has all but eliminated traditional sand / stone / gravel drains with their better drainage capacity, effective mitigation of clogging, increases the friction characteristics and high compressive resistance. NETFLOW are cost effective, easier to apply, and are not limited by environmental legislations.

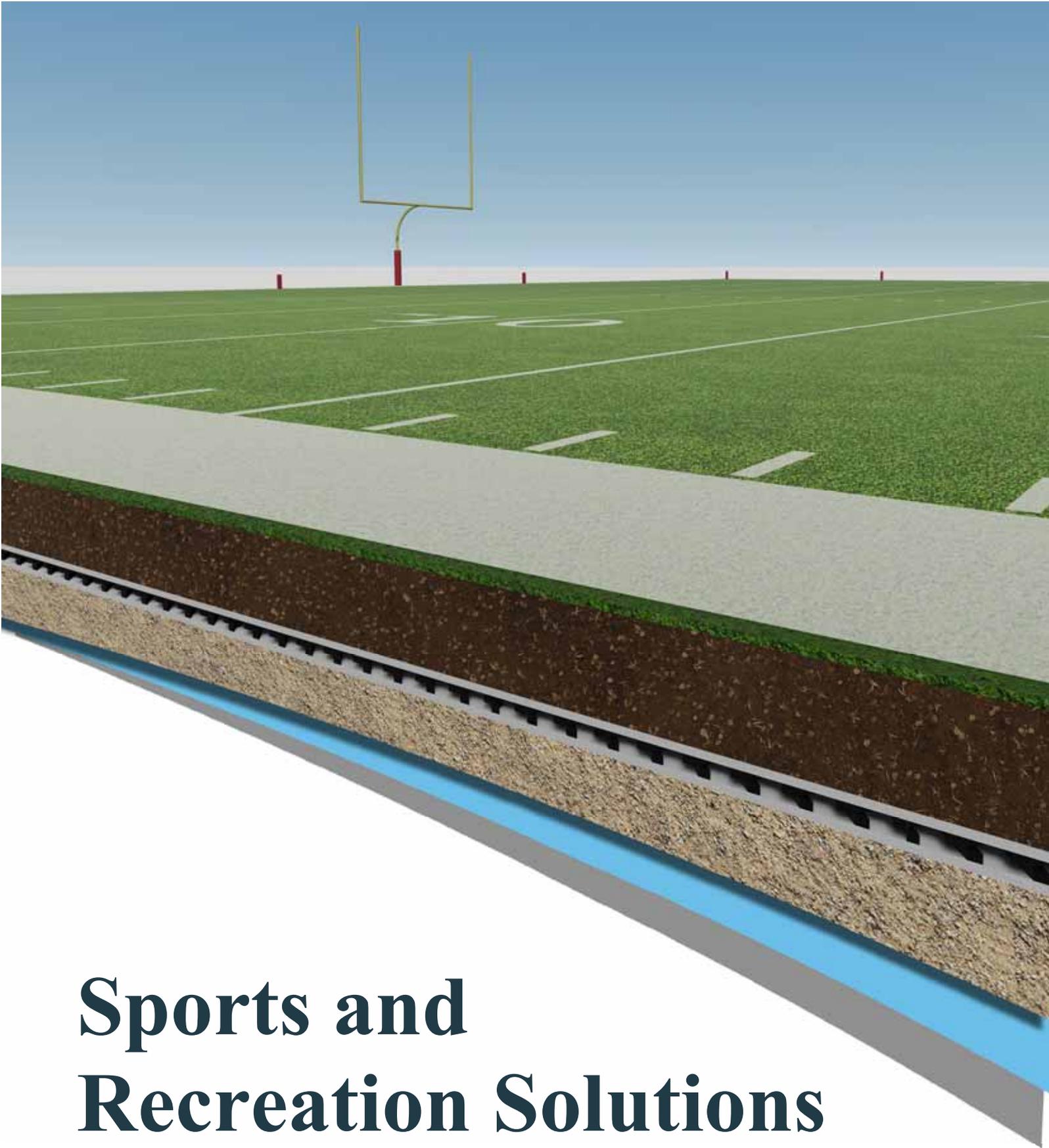
APEC offers a broad range of NETFLOW geonet drainage composites with various from 4.5mm to 8mm and with very high flow capacities. Our standard roll widths are 2m and 4m and roll lengths up to 100m. Customized roll dimensions are also available.

CUPFLOW

CUPFLOW drainage composite is a two-part prefabricated sheet drain consisting of a 3D polypropylene formed cusped / dimple core covered with a non-woven polypropylene filter fabric on one side. The formed dimple core provides a void to relieve hydrostatic pressure and build up. The filter fabric allows liquids and gases to pass into the drainage core while restricting the passage of soil particles. The filter fabric is bonded to each dimple to minimize fabric intrusion into the core resulting from backfill pressure. The polypropylene core resists chemical attack and degradation in soil. CUPFLOW is a cost-effective alternative to gravel / sand drains and a solution to many drainage problems.



APEC offers a broad range of CUPFLOW drainage composites with various dimple heights varying from 6mm to 25mm and with very high compressive strengths and flow capacities. Our standard roll widths are 1m, 2m & 4m and roll lengths up to 100m. Customized roll dimensions are also available.



Sports and Recreation Solutions

Innovative Geosynthetic Composite Solutions



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Certified to ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018

Introduction to APEC Geosynthetic Composites in Sports and Recreation Fields

The increasing popularity of sports and recreation fields for both indoor and outdoor events places growing demands and opportunities to geosynthetic composites.

Various applications of APEC Geosynthetic Composites in sports and recreational fields are listed below and discussed further:

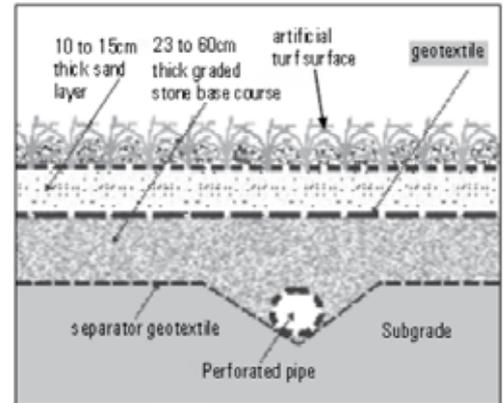
- **MATFLOW / CUPFLOW**: Proper drainage is perhaps the most productive investment in the long-term health and playability of all sports and recreational surfaces.
- **EASYLINER**: Geomembrane composite lining below the underground modular stormwater system used for detention, infiltration or harvesting stormwater runoff.
- **MATLINER**: Geodrain with liner used below the artificial turf sports fields to protect the synthetic grass system from the subgrade moisture variations which can lead to differential settlements.
- **Bunker MATLINER**: In golf course holding bunker sand on steep slopes is possible.
- **EASYLINER / BENTOCLINE**: Water hazards and ornamental lakes in parks, golf course and other recreational areas.

The main problem faced by sports and recreational fields is water clogging due to heavy rains. APEC industries aims to increase the drainage performance of sports and recreational field surfaces and to quickly bring them back to payable or usable condition even in wet climates.



Full Field Drainage Below the Artificial Turf

The conventional drainage system in sports and recreation fields consists of 23 to 60cm thick graded aggregate base course and 10 to 15cm thick sand bed layer on top of base course which are separated by a geotextile. However, this is a time consuming, costly solution and depends on the availability of graded aggregates and sands in the vicinity of the project. Also, heavy machinery and large quantity of CO₂ emissions are involved.



MATFLOW geodrain composite for the full field ensure new or refurbished recreational pitches, playgrounds and artificial turf pitches drain properly and minimize unplayable time. The polyolefin 3D extruded geomat core with open structure or V-profile, optimizing pressure resistance. It is electro-mechanically bonded with a nonwoven filter fabric on both sides to the geomat core. The filter fabric extends to each side, in opposite directions, to ensure joints cover securely.



MATLINER can be used in case of protecting the synthetic grass from subgrade moisture variations which can lead to differential settlements. It is a geodrain composite with geomat drainage core laminated with geotextile on one side and geomembrane liner on the other side.

Alternatively, we can also install **CUPFLOW** geodrain composite below the full field for an effective drainage. The added advantage is in-built impermeable base of CUPFLOW, it can protect the synthetic grass from subgrade moisture variations which can lead to differential settlements. CUPFLOW is laminated with non-woven filter fabric on one side. All geodrain composites act as shock pads below the turfs.

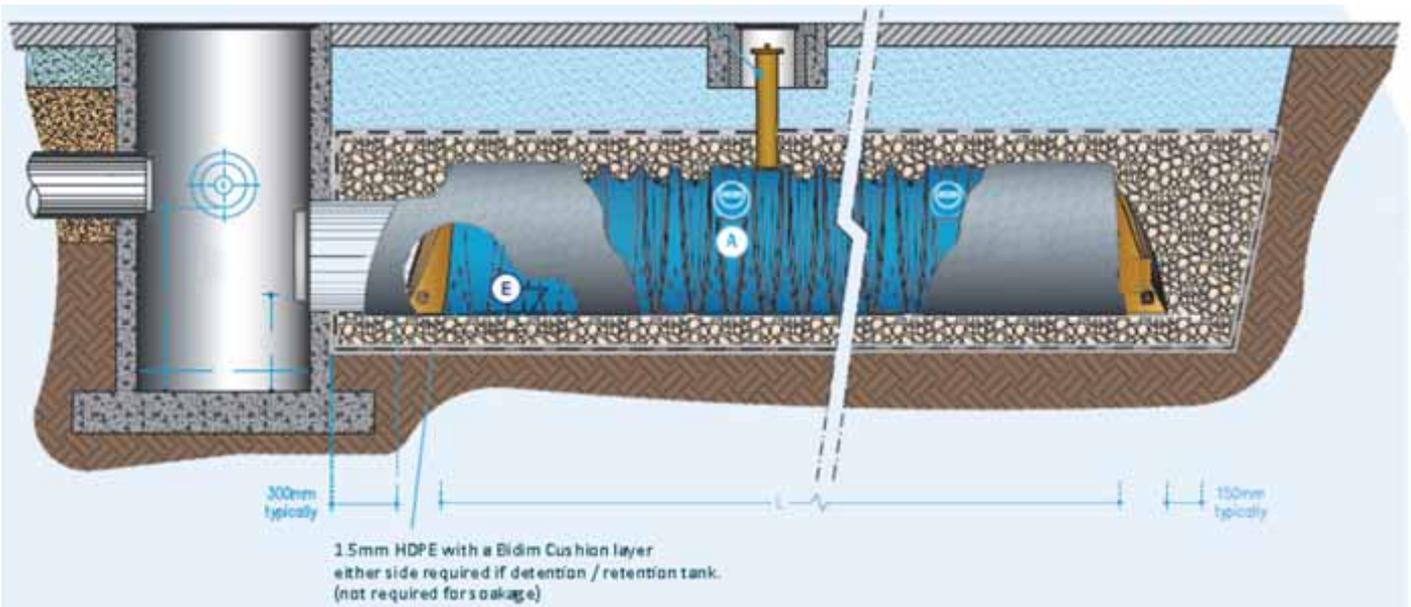


Liners below the Stormwater Storage Chambers

Due to continued increase of global temperatures, we are all constantly faced with reducing demand on portable water sources for irrigation of gardens, courses, and sports fields.

Therefore, underground stormwater storage chambers are the best solution to store the water for future irrigation purposes. These stormwater storage tanks are placed on top of geomembrane composite liners for water tightness and not to loss water from the chambers.

EASYLINER HD is an effective geocomposite liner to contain the water in storage tanks. It has a HDPE geomembrane electro-mechanically laminated with non-woven filter fabrics on both sides to increase the puncture resistance of the geomembrane layer and also to increase the friction with subgrade soil. The geomembrane component of EASYLINER HD composite exceeds the GRI GM13 specifications.



Typical cross section of the underground stormwater storage chamber with 1.5mm thick EASYLINER HD at the base of the storage chamber

Liners below the Water Hazards and Ornamental Lakes

Water hazards and ornamental lakes enhance the aesthetics of parks, golf courses and recreational areas. These ponds have to be designed the use of products that meet the technical requirements for water storage without losing the aesthetic appeal in a landscape area.

EASYLINER LD geomembrane composite / **BENTOCLINE** GCL composite are ideally suited for lining ponds as it offers an easy install solution with easy laying to match almost any pond profile.

EASYLINER LD geomembrane composite is made of low-density polyethylene virgin resins with various specifications to satisfy different environmental requirements. These are laminated with non-woven geotextiles on bottom side for additional puncture resistance. APEC offers a broad range of EASYLINER LD geomembrane composites. The geomembrane component of EASYLINER LD composite exceeds the GRI GM17 specifications.

BENTOCLINE is a Geosynthetic Clay Liner (GCL) consists of a uniform layer of sodium bentonite powder encapsulated with non-woven geotextile on one side and woven geotextile on the other side. It has self-healing capacity when hydrated with water and eliminates the conventionally required compacted clay liners. BENTOCLINE has effective rehydration capacity which makes it unique. BENTOCLINEs extra-large roll width of 7.0m reduce the overlaps in the field, in-turn reduces the installation time, labor cost and overall project cost. We produce GCLs with 3kg, 4kg and 5kg bentonite weight as per the standard market requirement.



Bunker Mats in Golf Courses

In the past creating Bunkers with more curves and steeper profiles meant higher maintenance costs as they were more difficult to maintain. Holding important bunker sand on steep slope is possible using **Bunker MATLINER**, a specially manufactured open synthetic mat which traps sand and keeps the bunker face intact.

Bunker MATLINER is a three component geosynthetic composite which contains extruded geomat filaments on the top to trap the sand and geomembrane base to contain and divert the rainwater into collection units and a geotextile to separate & protect the geomembrane from subgrade projections.

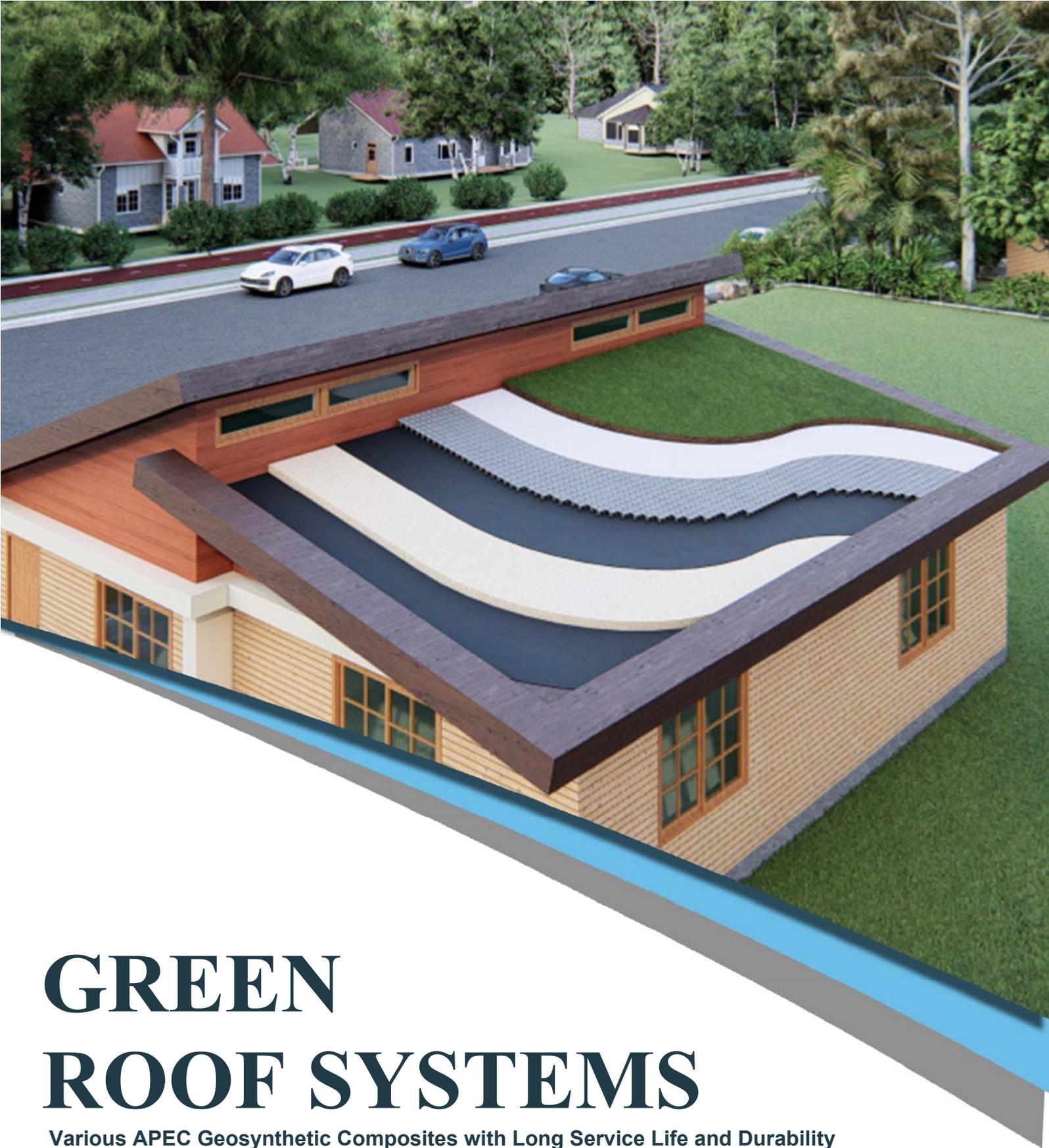


Roof Top Sports Fields or Other Recreation Areas

When there is a space constrain or a landscape requirement on top of concrete roofs a **MATLINER** with a geotextile filter fabric and 0.5mm PVC geomembrane base will solve the purpose. The geotextile filter fabric will provide the cushion and protect the geomembrane from puncture. The PVC waterproofing membrane will steer the stormwater into the proper drainage outlets and provides the watertightness to the concrete roof. The drainage composite proved a thinner and more lightweight alternative to drainage stone while keeping the synthetic turf free draining and dry. The drainboard was covered with woven filter fabric to provide a drainage layer.



Image showing the sports field on top of a car parking building. Space used for multi-purpose



GREEN ROOF SYSTEMS

Various APEC Geosynthetic Composites with Long Service Life and Durability



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Introduction

- A green roof system is an extension of the existing roof which involves, at a minimum, high quality waterproofing, root repellent system, drainage system, filter cloth, a lightweight growing medium, and plants.
- APEC Industries can provide a complete system (excluding growing medium and plants).

Waterproofing – **EASTLINER LLDPE** membrane composite

Root repellent system – **ROOTDIVERT LD** (this layer is optional if the drainage layer is capable of restricting plant roots penetration)

Insulation Foam – **INSULATION FOAM** rigid panels made from polystyrene

Drainage system & filter cloth – **CUPFLOW** drainage composite

- Green roof systems may be modular, with drainage layers, filter cloth, growing media, and plants already prepared in movable, often interlocking grids, or loose laid/built-up whereby each component of the system may be installed separately. Green roof development involves the creation of "contained" green space on top of a human-made structure. This green space could be below, at, or above grade, but in all cases, it exists separate from the ground. Green roofs can provide a wide range of public and private benefits and have been successfully installed in various countries around the world.



- There are 3 types of green roof systems:
 - ❖ extensive green roof system
 - ❖ intensive green roof system and
 - ❖ semi-intensive green roof system

Extensive Green Roof System

Extensive Green Roofs are the most common type and are relatively self-sufficient; they are not designed or constructed with the intention of being trafficked by pedestrians. Whilst not providing any kind of amenity area they do contribute to improving air quality, reducing the visual impact of the roof and assist in controlling rainwater run-off/ harvesting as well as contributing to the acoustic and thermal properties of the roof. These are planted with a variety of drought tolerant hardy plants. In general, it contains 75 to 150mm light weight growing medium. The typical load added due to this green roof system is 50 kg/m² to 200 kg/m². Extensive green roofs can be constructed on roofs with slopes up to 33%, and can be retrofitted onto existing structures with little, or most often, no additional structural support. They are less costly compared to other types of roof systems.

Advantages

- Its looks more natural
- Less costly
- Low maintenance and long life
- Less technical expertise needed
- It is very suitable for large areas
- Often suitable for retrofit projects
- Can leave vegetation to grow spontaneously
- Often no need for irrigation and specialized drainage systems
- Lightweight; the roof generally does not require reinforcement
- Easier for planning authority to demand as a condition of planning approvals



Intensive Green Roof System

Intensive Green Roofs often referred to as 'Roof Gardens', can be viewed very much like a garden area and may be landscaped to include trees, lawns, flower beds and paved areas. With an intensive roof the only real limit to its scope is the weight of the system and the structure necessary to support it. Different types of plants such as shrubs and trees and different types of depth can be used. In general, it contains 400 to 600mm growing medium. The typical load added due to this green roof system is 400 kg/m² to 600 kg/m². Intensive green roofs should have a flat roof surfaces which is 1% - 1.5% and the slope percentages can be 3%. More expensive, because of different layers used. The maintenance requirements are also much greater.

Advantages

- Longer membrane life
- Good insulation properties
- Can be made very attractive visually
- Greater diversity of plants and habitats
- Can simulate a wildlife garden on the ground
- Parks, playgrounds, or vegetable gardens are possible
- More energy efficiency and storm water retention capability
- Often accessible, with more diverse utilization of the roof. For example, for recreation, growing food, as open space



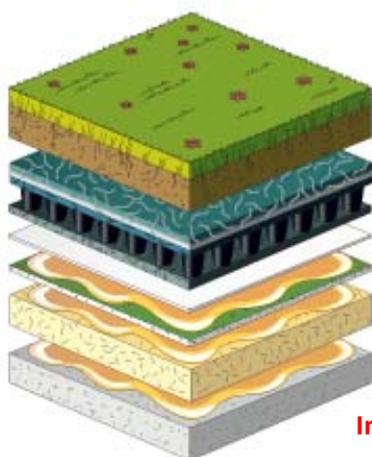
Semi Intensive Green Roofs

Semi-Intensive Green Roofs are combinations of both extensive and intensive green roofs and is typically adopted to harness both the environmental benefits of a green roof, as well as a diverse garden within a manageable maintenance budget. In general, it contains 150 to 400mm growing medium.

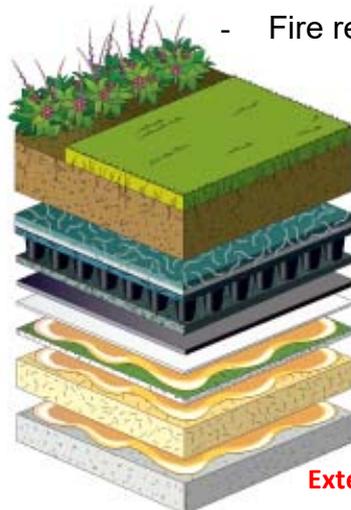


Benefits of APEC Green Roof System

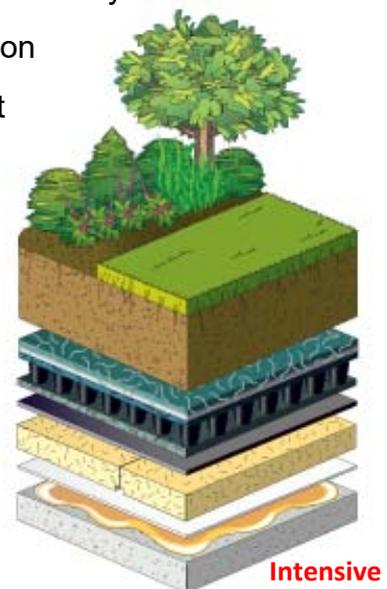
- Aesthetic improvement
- Waste diversion
- Stormwater management
- Modernization of urban heat island effect
- Improved air quality
- New amenity space
- Local job creation
- Energy efficiency
- Increased roof membrane durability
- Improved health and well being
- Reduction of electromagnetic radiation
- Urban agriculture opportunity
- Increased sales and marketing
- Increased biodiversity
- Noise reduction
- Fire retardant



Semi-Intensive



Extensive



Intensive

Note: The difference in plant species of various green roof systems are shown in above sample cross sections.

APEC Composites for Green Roof Systems

CUPFLOW 25



Cusped Sheet

CUPFLOW 25 is a 3 layered composite with 25mm thick perforated HDPE cusped core bonded with non-woven filter fabric on the water retention side and heavy protection geotextile on the drainage side.

The filter fabric prevents penetration of unwanted soils, fines etc., which can block the drain.

The perforated HDPE cusped core, allow free passage of surcharge water into drainage channels through perforations on the top, the wells formed by cusps of core allow for water storage to feed plants during periods of low rain fall and the channels in core allow free lateral drainage of water to discharge outlets.

The heavy protection geotextile will protect the underlying elements from damage.

Our CUPFLOW 25 has higher compressive strength of 200 kPa manufactured and supplied with customized roll widths up to 4m and roll lengths up to 100 m.

ROOT DIVERT LD



ROOTDIVERT LD geocomposite consisting of a LLDPE geomembrane bonded with woven geotextile on one or both sides. In green roof systems this layer can be ignored if the drainage core is capable of restricting roots penetration.

INSULATION FOAM



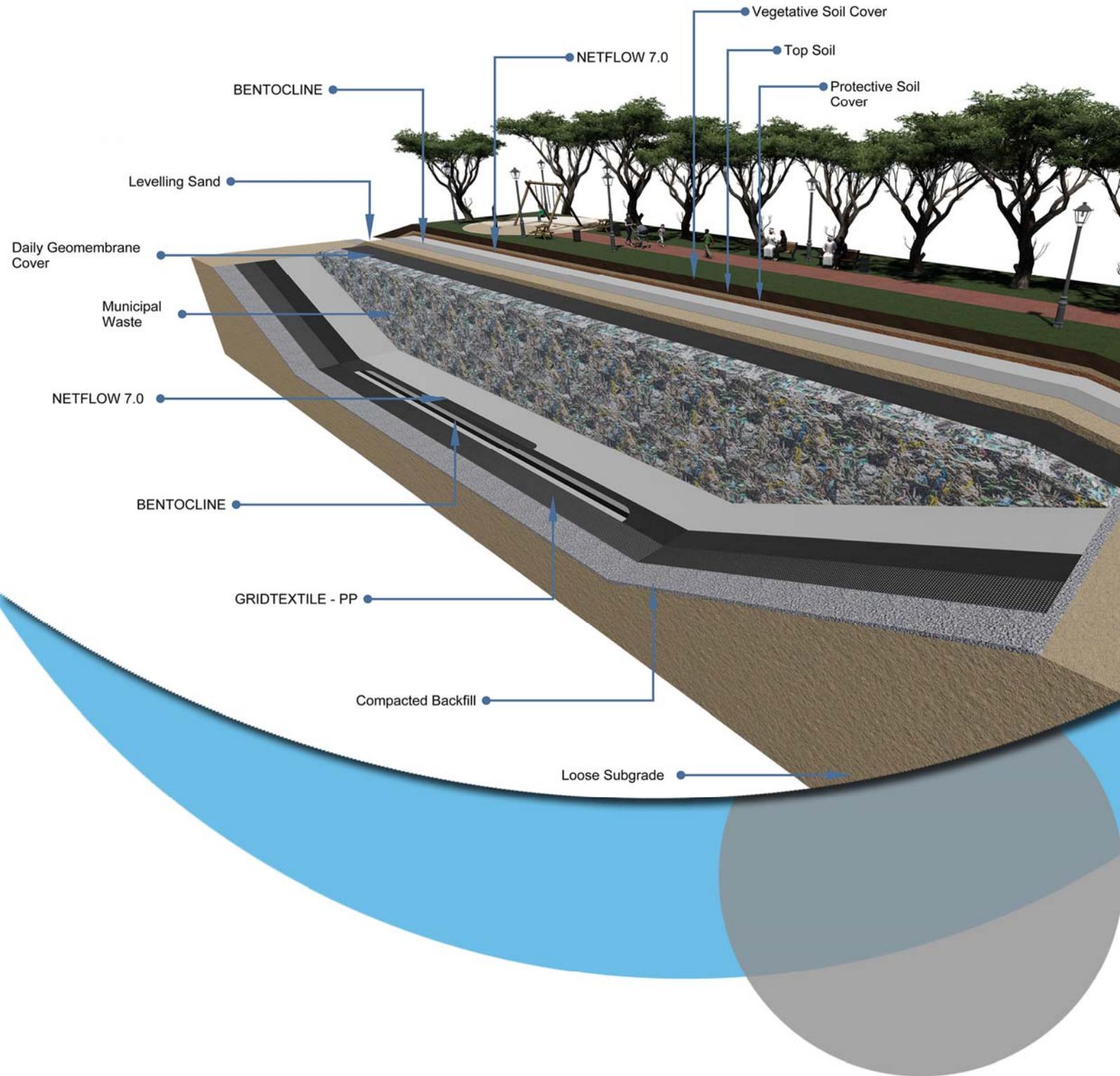
Insulation foam rigid panels made from polystyrene. Rigid panel continuous insulation is often used to provide a thermal break in the building envelope, thus reducing thermal bridging.

EASYLINER LLDPE

It is a waterproofing membrane composite of 2mm thick that can provide water tightness for the roof and can protect the structure before damage. It is laminated with geotextile one or both sides.



Typical Cross-Section for Landfill



LANDFILLS

Increased use of various Geosynthetic Composites in modern Landfills



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Introduction to Landfills and Geosynthetic Solutions

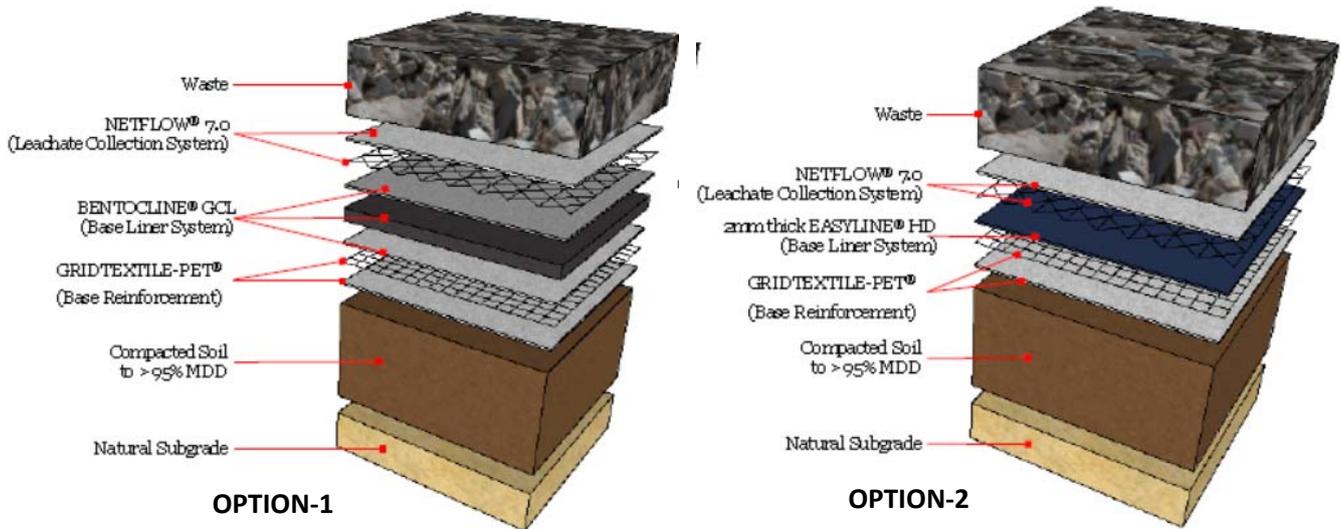
- A landfill is a site for the disposal of waste materials. Landfill is the oldest and most common form of waste disposal, although the systematic burial of the waste with daily, intermediate, and final covers began in 1940s.
- Modern landfills are highly engineered containment systems, designed to minimize the impact of solid waste (refuse, trash, and garbage) on the environment and human health. In modern landfills, the waste is contained by a liner system. The primary purpose of the liner system is to isolate the landfill contents from the environment and, therefore, to protect the soil and ground water from pollution originating in the landfill.
- The greatest threat to ground water posed by modern landfills is leachate. Leachate consists of water and water-soluble compounds in the refuse that accumulate as water moves through the landfill. This water may be from rainfall or from the waste itself. Leachate may migrate from the landfill and contaminate soil and ground water, thus presenting a risk to human and environmental health.
- Landfill liners are designed and constructed to create a barrier between the waste and the environment and to drain the leachate to collection and treatment facilities. This is done to prevent the uncontrolled release of leachate into the environment.
- Society produces many different solid wastes that pose different threats to the environment and to community health. Different disposal sites are available for these different types of waste. The potential threat posed by the waste determines the type of liner system required for each type of landfill.
- Different Liner systems are listed below and discussed in detail:
 - Single Liner system
 - Composite Liner system and
 - Double Liner system
- APEC unique composite materials have been at the forefront of providing value engineered geosynthetic solutions for leachate drainage, leakage detection, capping drainage and erosion control, slope veneer stabilization, gas collection and groundwater management in the landfill sector. Our composite products like BENTOCLINE and NETLINER are specifically developed for landfills.

Single Liner System

Single liner system consists of:

- **NETLINER** drainage composite backed with 2mm thick **EASYLINER HD** geomembrane or **NETFLOW** drainage composite followed by **BENTOCLINE** GCL Composite as liner.
- This system is mostly used in landfills designed to hold Construction and Demolition Debris (C&DD) resulted from building and demolition activities and includes concrete, asphalt, shingles, wood, bricks, and glass.
- These landfills are not constructed to contain paint, liquid tar or municipal garbage etc.
- Single liner systems are usually adequate to protect the environment from construction and demolition debris. It is cheaper to dispose of construction waste materials in a C&DD landfill than in an MSW landfill because C&DD landfills use only a single liner and are therefore cheaper to build and maintain than other landfills.
- Generally, landfills are constructed on low permeable soils.

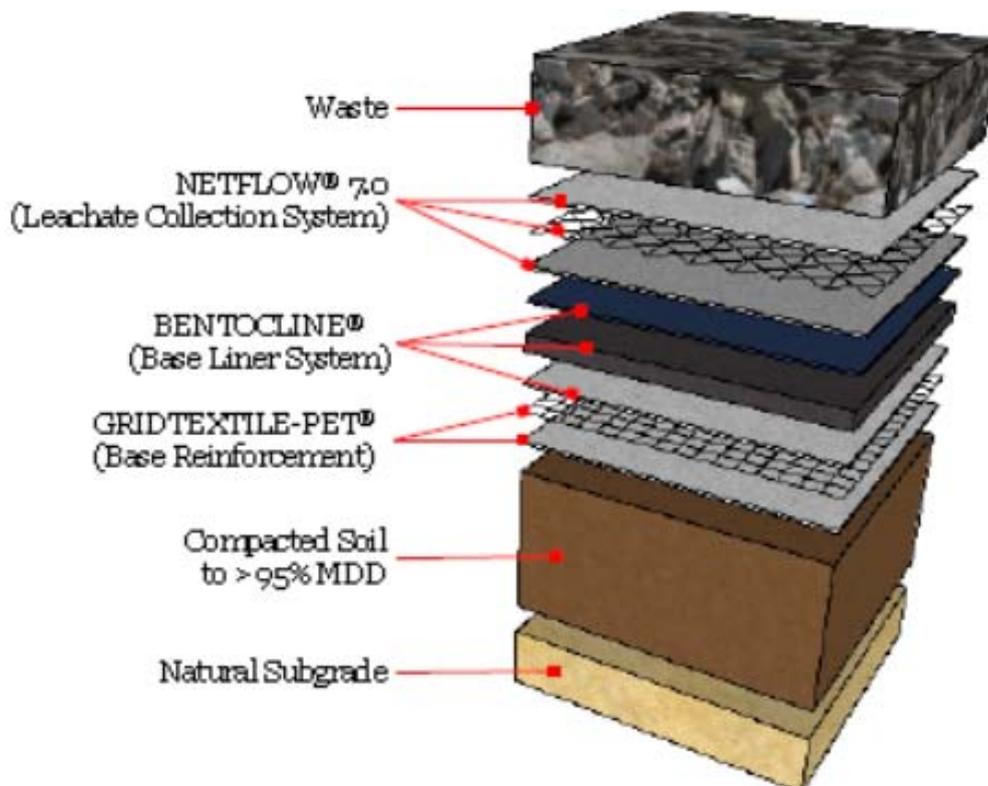
Single Liner System (cont..)



Composite Liner System

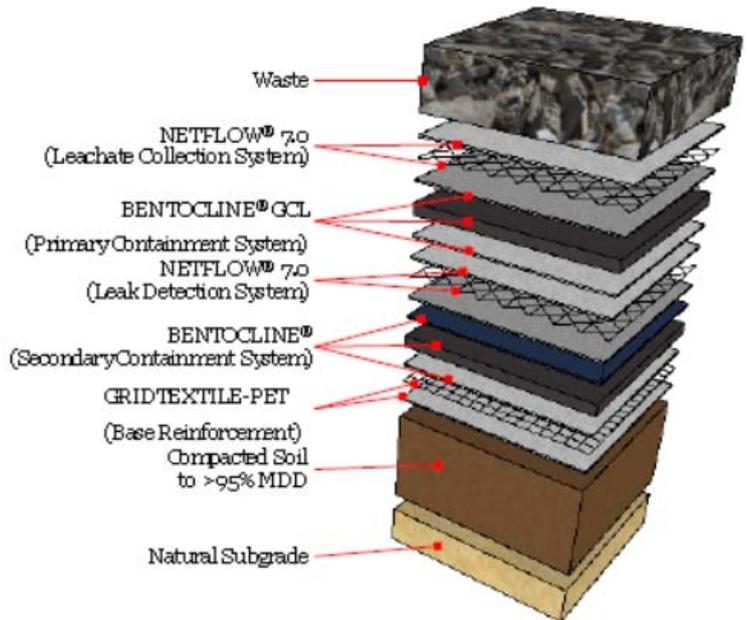
Composite liner system consists of:

- **NETFLOW** drainage composite followed by **BENTOCLINE** (GCL composite with geomembrane on one side) as base liner.
- Composite liner systems are more effective at limiting leachate migration into the subsoil than either a compacted clay liner or a single geomembrane layer.
- Municipal solid waste landfills contain waste collected from residential, commercial, and industrial sources. These landfills may also accept C&DD debris, but not hazardous waste. The minimum requirement for MSW landfills is a composite liner.



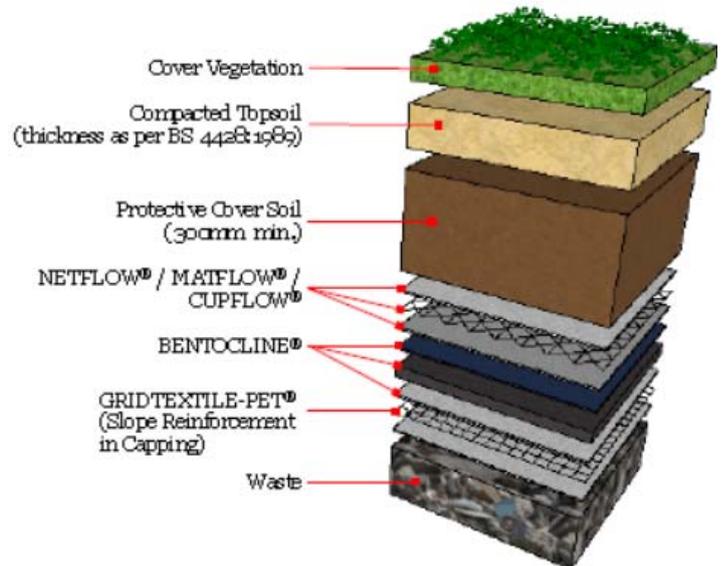
Double Liner System

- A double liner consists of either two single liners, two composite liners, or a single and a composite liner.
- The upper (primary) liner usually functions as leachate collection system, which contains **NETFLOW** drainage composite followed by **BENTOCLINE** GCL liner.
- The lower (secondary) liner acts as a leak-detection system and backup to the primary liner, which contains **NETFLOW** drainage composite for leak detection and **BENTOCLINE** as secondary liner.
- Double-liner systems are used in some municipal solid waste landfills and in all hazardous waste landfills.
- Hazardous Waste Landfills (Secure Landfills) are constructed for the disposal of wastes that were ignitable, corrosive, reactive, toxic and are designated as hazardous and may affect environment adversely.



Landfill Capping System

- In addition to base lining of landfills, geosynthetics are used extensively in closure / capping system of landfills.
- During the active period of landfills, after dumping days deposition of waste an **EASYLINER LD-W** geomembrane is used as daily cover to prevent the interaction between waste and the air and reduce odors.
- However, at the time of closure of landfill a **BENTOCLINE** barrier is placed and a **NETFLOW/CUPFLOW** drainage composite is placed on top of liner to drain excess precipitation from the protective cover soil to enhance stability and help prevent infiltration of water through the landfill cap system.
- On top of these geosynthetic layers a protective topsoil of 300mm to 2000mm depending on the type of waste in the landfill, covered with vegetative soil and greenery. The thickness of vegetative soil depends on the type of greenery planted. As per BS 4428:1989.



Greenery	Min. Thickness of Vegetative Soil (mm)
Grass	100 to 150
Shrub	400
Trees	600

Thickness of vegetative soil as per BS 4428:1989

Note: Protective cover layer provides additional moisture retention to help support the greenery and top vegetative soil helps to support and maintain the growth of vegetation by retaining moisture and providing nutrients.

Advantages of NETFLOW / CUPFLOW Drainage Composite in Landfills:

- The in-built top and bottom geotextile layers in NETFLOW/CUPFLOW drainage composites provides separation, filtration and restricts clogging of drainage path.
- Comparing to the drainage capacity and clogging nature of conventional sand or gravel drainage layer, NETFLOW/CUPFLOW have exceptionally high drainage capacity and are reliable in their performance long-term.
- Great savings in Air Space by eliminating ~300 mm of sand or gravel drainage layer. The thickness of NETFLOW/CUPFLOW is ~10mm. Therefore, ~30 times Air Space savings.
- Reduced excavation and backfilling. Massive reduction in traffic volume and proportionately ~70% of carbon emission.
- High impact and crush strength.
- Hazardous gas venting / methane venting from landfills.
- Compatible with geomembrane systems and acts as the protection layer to geomembrane liners.
- Ease and speed of installation without specialist equipment.
- Wide rolls are suited for rapid installation on large landfill and restoration projects.
- Chemically inert – resistant to petrol, oils, acid, alkalis, leachate and common chemicals.

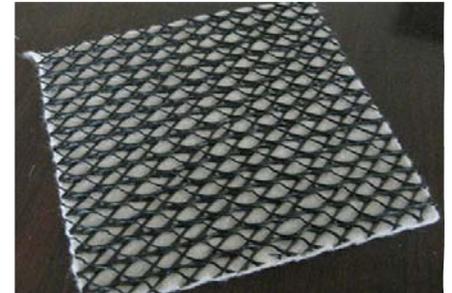
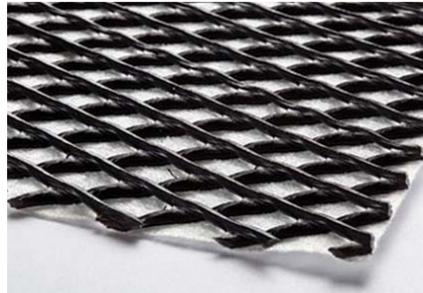
Advantages of BENTOCLINE GCL Composite in Landfills:

- The main advantage of BENTOCLINE is its geomembrane top layer (which is composed with bottom GCL). This gives additional liner ability.
- In landfills, eliminates ~1-2m thick Compacted Clay liner layer, increasing the air space, reducing excavation, backfilling and traffic volume and carbon emission.
- Sodium bentonite powder, having high swelling capacity, adds the self-healing property to our BENTOCLINE when hydrated.
- Our special needle-punch process increases the mechanical bond between top & bottom geotextiles. Increasing the internal shear resistance and the long-term creep resistance of BENTOCLINE.
- Not affected by differential settlement and distributes the loads uniformly.
- Not affected by freeze/thaw, wet/dry cycles.
- Excellent resistance to fertilizers, fuel oils, chemicals etc.
- Wide roll widths of up to 6.0m reduce the overlaps & installation time.

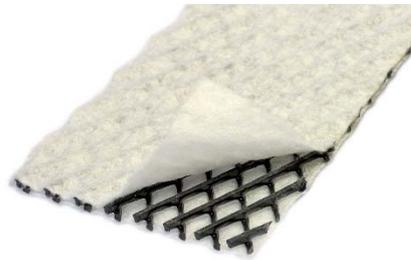
APEC Geosynthetic Composites in Landfills (cont..)

NETFLOW

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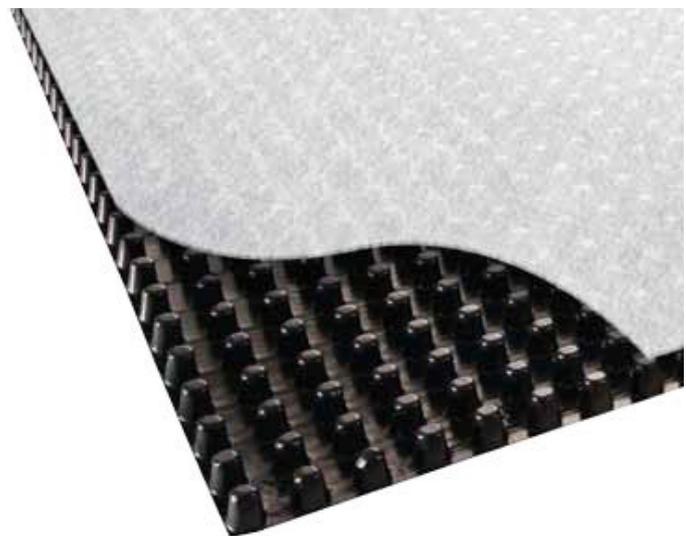
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APEC offers a broad range of NETFLOW geonet drainage composites with various from 4.5mm to 8mm and with very high flow capacities. Our standard roll widths are 2m and 4m and roll lengths up to 100m. Customized roll dimensions are also available.

CUPFLOW

CUPFLOW drainage composite is a two-part prefabricated sheet drain consisting of a 3D polypropylene formed cusped / dimple core covered with a non-woven polypropylene filter fabric on one side. The formed dimple core provides a void to relieve hydrostatic pressure and build up. The filter fabric allows liquids and gases to pass into the drainage core while restricting the passage of soil particles. The filter fabric is bonded to each dimple to minimize fabric intrusion into the core resulting from backfill pressure. The polypropylene core resists chemical attack and degradation in soil. CUPFLOW is a cost-effective alternative to gravel / sand drains and a solution to many drainage problems.



APEC offers a broad range of CUPFLOW drainage composites with various dimple heights varying from 6mm to 25mm and with very high compressive strengths and flow capacities. Our standard roll widths are 1m, 2m & 4m and roll lengths up to 100m. Customized roll dimensions are also available.

APEC Geosynthetic Composites in Landfills (cont..)

BENTOCLINE

BENTOCLINE is a Geosynthetic Clay Liner (GCL) consists of a uniform layer of sodium bentonite powder encapsulated with non-woven geotextile on one side and woven geotextile and 0.5mm thick LLDPE geomembrane on the other side. It has self-healing capacity when hydrated with water and eliminates the conventionally required compacted clay liner in landfills and mining sectors. BENTOCLINE has effective rehydration capacity which makes it unique.



BENTOCLINE GCL

BENTOCLINE GM-GCL

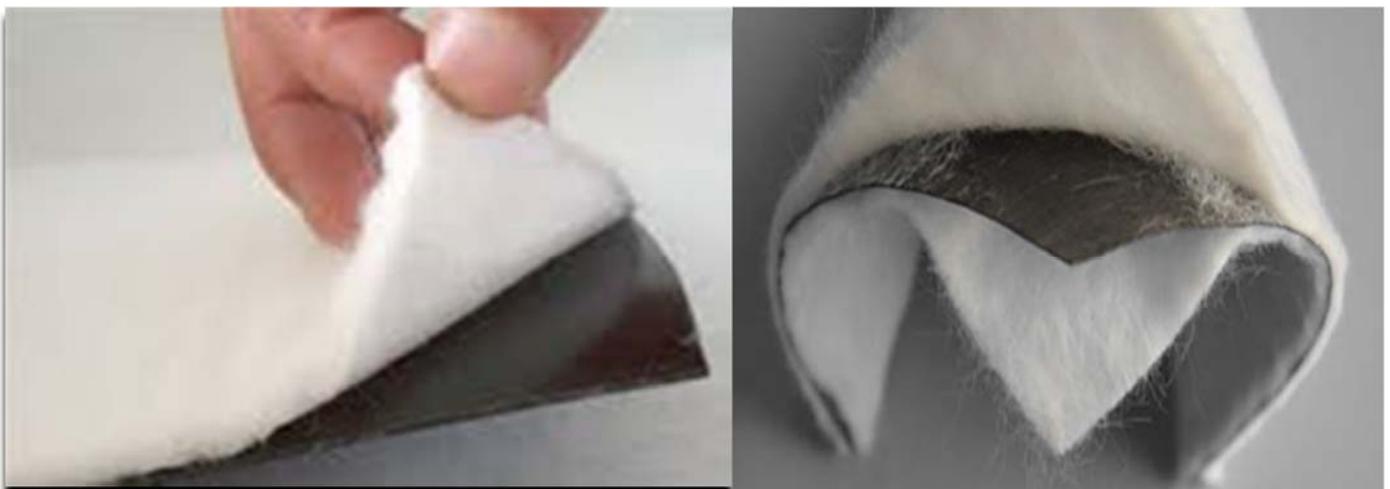
BENTOCLINEs 7.0m wide roll widths reduce the overlaps in the field, in-turn reduces the installation time, labor cost and overall project cost. Along with the BENTOCLINE (GM-GCL) we can produce standard BENTOCLINE GCLs with bentonite weight of 3kg, 4kg and 5kg needle punched between woven and non-woven geotextiles.

EASYLINER HD

EASYLINER HD geomembrane composite is made of premium polyethylene resins with various specifications to satisfy different environmental requirements. These are laminated with geotextiles on one or both sides.

It features outstanding tensile strength, elongation, dimensional stability, good service temperature range, impermeability and strong resistance against chemicals, corrosion, aging, ultraviolet and environmental stress cracks.

APEC offers a broad range of EASYLINER HD geomembrane composite with various thicknesses and weights of geomembrane & geotextile components based on the application & function they are recommended. Geomembrane component of EASYLINER HD exceeds the GRI GM13 specifications.



APEC Geosynthetic Composites in Landfills (cont..)

EROMAT

EROMAT is a highly effective Erosion Control System designed and manufactured by APEC Industries. It is a lightweight, flexible 3D polyamide Geomat made with polymer monofilament yarns. It builds a less maintenance system in slopes, spillways and lakes with its high durability and high resistance to UV, chemicals, and biodegradation.

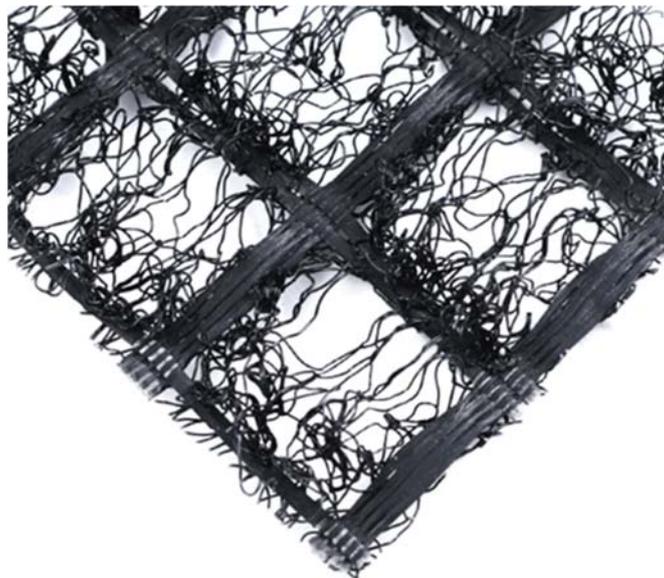
EROMAT can resist shear stresses up to 750 N/m^2 and flow velocities up to 4.5 m/s . EROMATs are available in various thicknesses ranging from 10-20mm, roll widths of 1.0 to 4.0m and roll lengths upto 150m.



EROGRID

EROGRID is APEC Industries another Erosion Control System. It also delivers maximum soil reinforcement and slope stabilization, thanks to its lightweight and flexible 3D polyamide Geomat composite made from polymer monofilaments with integrated high-tensile strength polyester geogrid.

EROGRID can withstand higher shear stresses of 950 N/m^2 and is ideal for steeper slopes. It can resist flow velocities exceeding 6.0 m/s (2.5 times higher than just vegetation). Standard tensile strength of polyester geogrid is 40 kN/m . Dimensions similar to EROMAT.



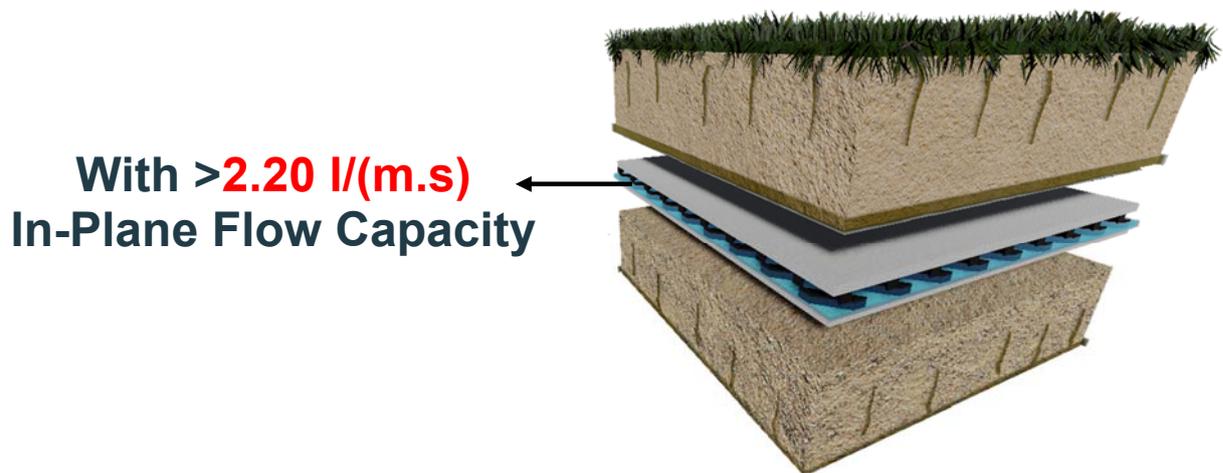
APEC Geosynthetic Composites in Landfills (cont..)

SALTSTOP

SALTSTOP is a geosynthetic composite capillary barrier consisting of geonet core bonded with filter fabric on both sides. In landfills it prevents the movement of saline water by capillary rise in to access road base layers and structure foundations. The combinations of geonet and filter fabric provides the needed separation of drainage layer in the structure.

SALTSTOP replaces traditional capillary barriers made of 300mm thick crushed stone layers making significant savings in construction cost and time. SALTSTOP maintains its drainage void throughout its service life providing a permanent solution to problems caused by capillary action and it can withstand differential settlements without loss of its performance.

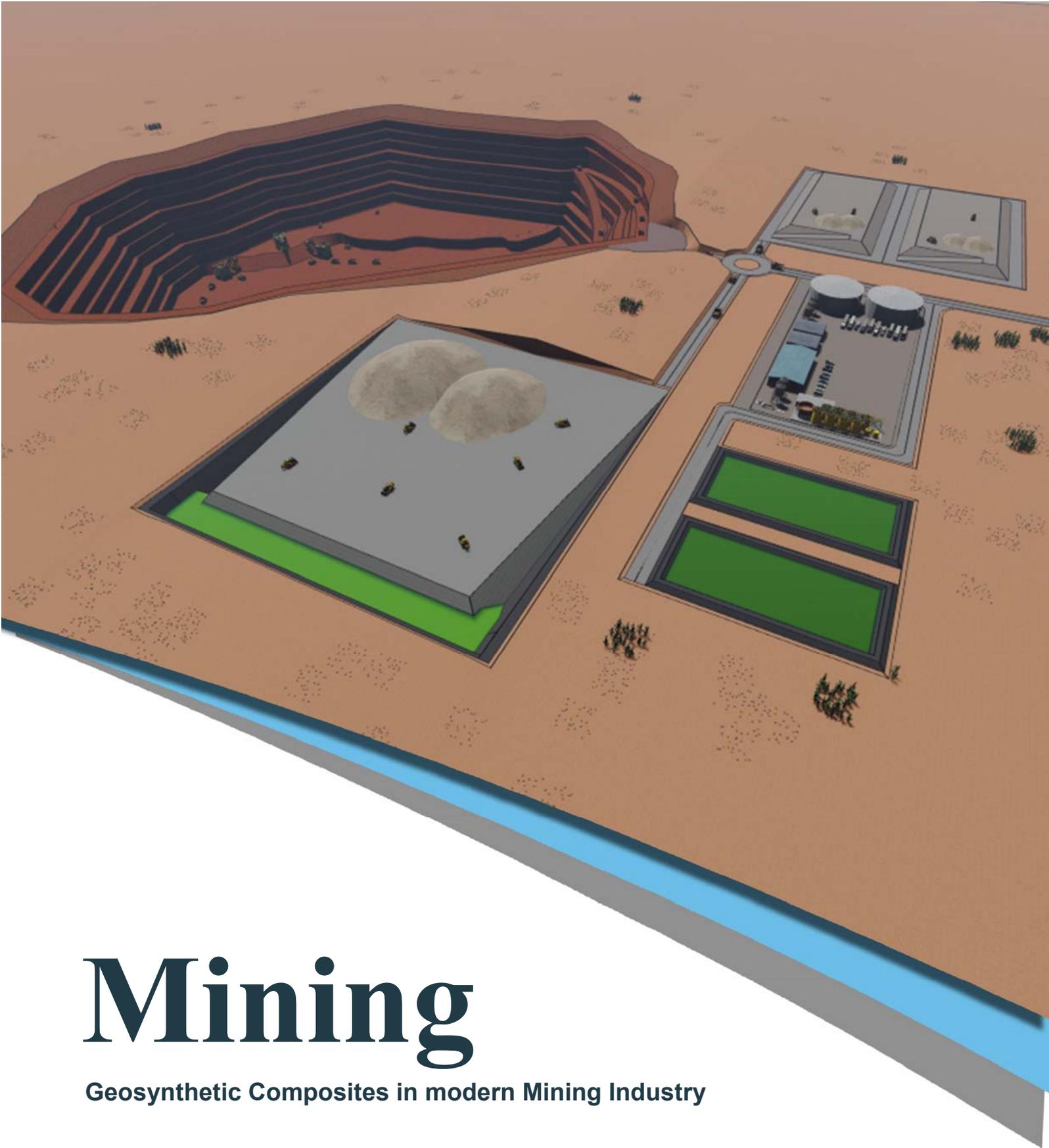
APEC offers a broad range of SALTSTOP composites with various thickness and sizes.



GRIDTEXTILE PET

GRIDTEXTILE PET is a biaxial geogrid composite made from woven high tenacity multifilament polyester yarns and bonded with non-woven geotextile on one side. GRIDTEXTILE PET offers the needed reinforcement and stabilization of very soft saturated subgrades. It also provides filtration and separation between different soil layers. With the combination of geogrid and geotextile, GRIDTEXTILE PET ensures the stabilization and reinforcement in the structure throughout its service life. It provides higher tensile strength at low elongations. APEC offers a broad range of GRIDTEXTILE PET composites with various tensile strengths from 50/50 kN/m to 150/150 kN/m and different aperture sizes. Our roll widths are ranging from 1.8 m to 5.3 m and roll lengths of upto 100m.





Mining

Geosynthetic Composites in modern Mining Industry



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Certified to ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018

Brief about Growth of Geosynthetic Composites in Mining Industry

- In the past 25 years it was found that the mining and mineral processing industry is moving more towards the use of geosynthetics for civil, geotechnical, and environmental engineering applications.
- The daily mining rates, scale of single-site operations, and costs associated with mining increase every year. Advances in mineral extraction technologies and use of various APEC unique composite products can greatly increase recovery rates from ore bodies.
- The service life of APEC unique composite products and their cost-effectiveness compared to other available alternatives are the main factors to be considered in mining and mineral processing industry, especially for their use in long-term geotechnical and environmental control.
- These are highly engineered composite products to enhance their preliminary functions along with additional features. Reduces construction cost, construction time and transportation cost. They are stable under heavy loads, resistance to chemical, biological, weathering and UV degradation. Since, they are factory manufactured under controlled measures, products of high quality are assured.

Principle Applications of Geosynthetics in Mining Industry

Composite Geosynthetic Material	APEC Products	Polymer Type	Principle Applications of Geosynthetics in Mining Industry
Geosynthetic Clay Liner	BENTOCLINE	Bentonite & LLDPE Geomembrane	Heap leach lining, tailing dams, engineered covers
Geomembrane	EASYLINER	HDPE, LLDPE, PVC	Heap leach lining, tailing dams, settling ponds, waste containment, sludge pond containment, evaporation ponds, engineered covers, floating covers, side slopes covering
Geonet Drainage	NETFLOW	HDPE	Heap leach lining, tailing dams,
Geonet Drainage with Geomembrane Base	NETLINER	HDPE with HDPE Geomembrane	Evaporation ponds, engineered covers
Geomat Drainage	MATFLOW	PP extruded	Side slopes drainage
Geogrid / Geogrid Composite	GRIDTEXTILE	PP, PET	Stabilization of soft soils, base reinforcement, Slope stabilization and reinforcement of retaining walls and tailing crests
Erosion Control Mat	EROGRID	PA Geomat with PET geogrid	Side slopes erosion control

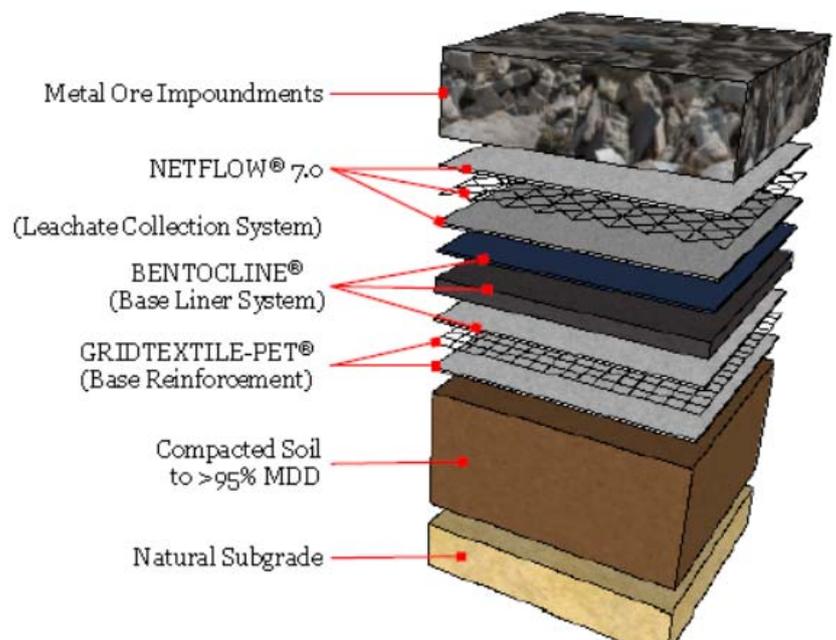
Heap Leaching Recovery with APEC Geosynthetic Composites

- Heap leaching is an industrial mining process used to extract precious metals like gold, copper, nickel, uranium, and other compounds from ore by spraying cyanide or sulfuric acid solution on top of the ore impoundments which dissolves the precious metals.
- The resulting pregnant leach solution trickles down to a leach pad, where it is collected and pumped to a recovery facility. In order to prevent the pregnant leach solution from leaking out, the leach pads are typically comprised of a composite clay liner (CCL) system with a geomembrane overlying a low permeability soil layer. In general, the weight and mass of the heap pile at the site challenges the ability of a single geomembrane liner as an effective barrier for the leach pad. In addition, absence of clay in the project vicinity increases vehicle movement and carbon emissions.
- To overcome all these obstacles our **BENTOCLINE®** (GM-GCL) lining system is a best solution. The geotextiles that are used to product BENTOCLINE yield a final product that provides high internal and interface shear strength that could meet the strenuous slope requirements of the project. The cushioning effect of the GCL also resulted in less puncture damage from the crushed ore placed on top of the geomembrane component of the BENTOCLINE.
- BENTOCLINE is a unique GCL composite lining material in the current market. A robust composite liner with self-healing capacity to heal the desiccation cracks, high swelling potential, better hydraulic conductivity 5×10^{-9} cm/s, high load bearing capacity and thickness is ~6.5mm and less susceptible to Ion exchange attack, wide pH acceptance range, swelling index $>20\text{ml}/2\text{g}/24\text{hr}$.
- According to the design requirements a up to 1.5m thick Compacted Clay Liner (CCL) system is constructed below the geomembrane liner alone. Its hydraulic conductivity is 1×10^{-6} cm/s. Their availability locally and desiccation during dry and wet cycles are the main concerns.
- BENTOCLINE eliminates the Compacted Clay Liner (CCL) and acts as base lining of heap leaching. BENTOCLINE composite contains an in-built geomembrane which is resistant to chemical, sulphuric acid attack, heavy stress from heaps, stress cracks, high temperatures and UV resistant. The space occupied by CCL of ~1.5m thick is a huge air space savings in mining. BENTOCLINE will provide continued protection even though there are leaks in top geomembrane layer.



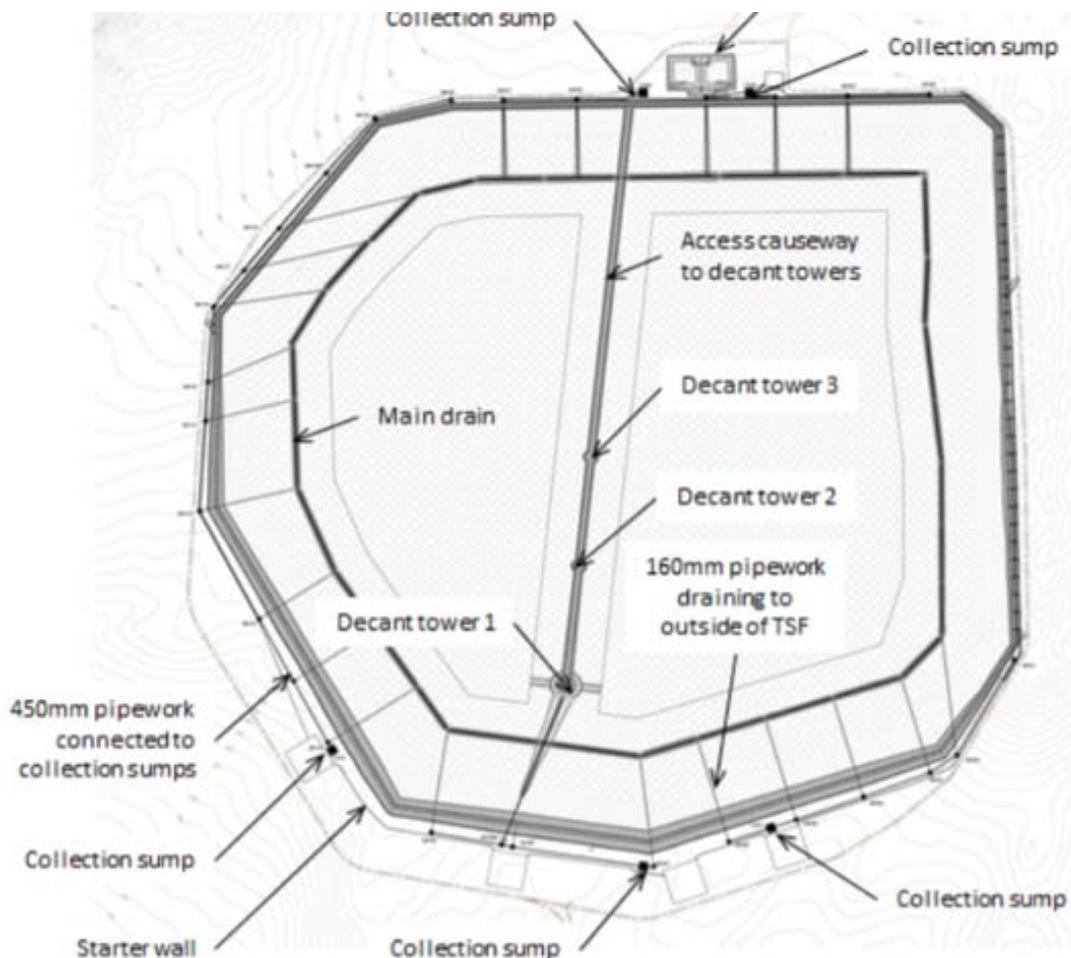
Heap Leaching Recovery with APEC Geosynthetic Composites (Cont...)

- The use of a BENTOCLINE allows for a much faster, easier, and lower cost installation than trucking clay from off-site locations (one truckload of BENTOCLINE is approximately equivalent to 150 trucks of clay) and was able to withstand the adverse weather conditions. The BENTOCLINE have higher friction co-efficient between geotextile and natural subgrade comparing to a geomembrane liner alone. In case of Leak detection system required, a drainage composite **NETFLOW** can be placed below the BENTOCLINE to check for any leakage or loss of metal leach.
- Heap Leaching process requires Geomembrane composites for pregnant solution trench liners, processing pits, onsite water storage, temporary raincoat covers over ore stacks to shed stormwater (rather than dilute the leach heap solution) and onsite wastewater management lining. Our **EASYLINER LD** (geomembrane+geotextile) composite feature exceptional resistance to chemicals, stress crack, high temperature resistant, highly flexible and UV resistance. They have the durability and chemical compatibility to withstand aggressive mining heap leach solutions in stacks and solution trenches.
- In heap leach pads, it is necessary to install an excellent drainage system in order to keep the leachate flowing freely to the collection ponds. Traditionally, crushed stone of a specific gradation is excavated and transported to the pad in what is often a time-consuming and expensive process. In addition, placing gravel directly against the geomembrane may cause damage. NETFLOW drainage composite is an innovative high-flow, high compressive strength drainage system that performs better than natural gravel and withstands the high loads of overburden ore or vehicle traffic. It can be installed quickly and protects the underlying GCL / BENTOCLINE composite from punctures. NETFLOW has 10 times higher drainage capacity compared to traditional crushed stone drainage.
- In case of soft subgrade below the heap pile, ground improvement techniques have to be considered to improve the bearing capacity of the existing subgrade soil. Our **GRIDTEXTILE PET** (geogrid+geotextile) composite can be used to improve the bearing capacity of the existing subgrade and to reduce the differential settlement. This doesn't require any excavation or replacing of existing soft subgrade soils.



Tailing Storage Facility (TSF)

- Tailings are the by-product of the crushing, milling and chemical extraction process used to recover the valuable mineral being mined. Tailings are generally sand sized or finer and are managed by pumping at low solids contents and depositing into built impoundments, known as Tailings Storage Facilities (TSFs). The height of TSFs are over 200m.
- TSFs are typically an earth-fill embankment dam. Tailings are usually highly toxic and potentially radioactive. The main objectives of the TSF design are to protect the environment and maximize water returns to the plant. The design of the TSF basin utilizes **EASYLINER LD** geomembrane composites to achieve these objectives.
- In TSF system there are locations considered to be at risk of damage by overlying structures, i.e. starter embankment with kicker berm, main drain, return-water dam, etc., a higher level of containment was considered necessary due to higher risk of construction damage, due to either the presence of oversize material or mechanical equipment. Therefore, **BENTOCLINE** GCL composite containment will reduce the risk of damage and significantly reduces the leakage rates.
- On top of the lining system **NETFLOW** drainage composite is installed to collect and discharge the waste liquids, instead of conventional gravel drains.



Layout of Tailing Storage Facility (TSF)

Settling Ponds



- Settlement Ponds are an important part of water filtration processes. The settling pond or lagoon uses sedimentation to remove unwanted solid matter from the water, reducing the water turbidity and, in turn, reducing possible solid contaminants from the water. Settlement lagoons and ponds are suitable for use in a wide range of applications including dairy waste, mining and aquaculture. It helps to obtain high water purity in outlet water, they can also be used for pH adjustment.
- Wastewater produced by mining industries contribute to the acidity, suspended material, and dissolved heavy metal ions in the aquatic environment, causing environmental problems for biological life and discoloration of the receiving waters.
- Settlement pond with high-quality lining is important to ensure no seepage of contaminated water occurs in the surrounding soil & water table and to improve the quality of water discharge from mining operations.
- A concrete lining will crack over time, expensive to repair and time consuming. The use of **EASYLINER HD** geomembrane composite lining system with appropriate welding will provide high quality, flexible and long-lasting liner that is much more efficient to replace. The composite will have higher friction co-efficient between geotextile and natural subgrade. The same can be used as floating covers.

APEC Liners for Evaporation Ponds Containment

- Evaporation ponds are shallow, lined earthen basins in which concentrate evaporates naturally as a result of solar irradiation. In mining industry these ponds are used to separate valuable materials from water or brines. The minerals in the concentrate are harvested periodically and processed into items usable in various industries. The waste is disposed in tailing impoundments.
- The Geosynthetic lining solutions like **EASYLINER HD** will provide environmental protection and prevent loss of valuable materials in seepage. Potentially aggressive nature of the material being mined by evaporation demands environmental care, especially with the concentrated masses that the evaporation process yields.



EASYLINER® HD geomembrane composite

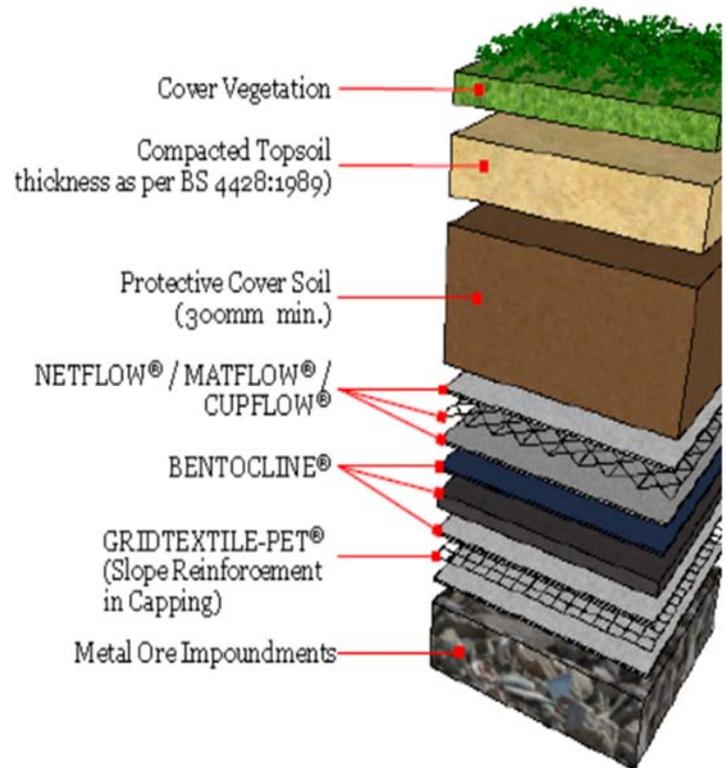
(Single Liner System for non-hazardous leach solutions)



Double liner system / Leak detection layer for toxic or hazardous leach solutions

Engineered Covers / Mine Closure

- The service life of mines varies from decades to centuries. There may be various reasons for the closure of mines. For what so reason the tailing impoundments, acid-producing waste rock, and spent heaps, are to be properly capped to minimize the intrusion of air and water, which can cause the sulfides to oxidize and release harmful chemicals and substances. Also, an engineered capping system is to prevent rainwater incursion to the polluted soil zone. Infiltration can lead to contaminated water, which subsequently can seep into groundwater or run off into area streams and lakes, thus contaminating water sources too.



- Soil-only caps are permeable to liquid and subject to erosion. Clay-only caps can crack and create channels for infiltration and polluted runoff. Studies showed that a composite cover system, consisting of a geomembrane, geosynthetic clay liner (GCL) and composite drainage systems, performs better than compacted clay liners or store-and-release covers.
- NETFLOW / CUPFLOW** drainage composite followed by **BENTOCLINE** GCL composite is the most durable, reliable composite cover system available in the market today. Dewatering of tailings are achieved by installing PVDs vertical to the surface and the top ends of these PVDs are connected to **NETFLOW / CUPFLOW** drainage composite laid horizontally.

Various Geogrid Applications in Mining Industry

Underground Mines: The safety of workers from the debris falling from underground mine roofs and walls is restricted by **GRIDTEXTILE PET** geogrid composite. These woven geogrids are strong, lightweight, high tensile strength and low elongation, excellent creep resistance, UV resistant, corrosion resistant, chemically and biologically inert, flexible and durable, safe and easy to install, resist installation damage and cost effective. They are superior alternative to wire mesh. The geotextile layer of the composite will restrict the falling of smaller than mesh size debris.



Various Geogrid Applications in Mining Industry

Basal Reinforcement: In case of low shear strength subsoils at tailing impoundments and heap leach pad areas, where the total effective stress / vertical load transferred on to the subsoil is very high and also for heavy construction machinery movement, a ground stabilization system with **GRIDTEXTILE PET** high strength geogrid composite as per BS 8006 along with an aggregate working platform is an economical solution comparing to stone columns, PVDs etc., The geotextile layer of the composite will separate the compacted aggregates from the engineered cushion sand layer placed on top of geogrid composite.



Crest of Tailing Impoundments: To prolong the life of existing TSF, raising the crest of tailing impoundments with a reinforced earthen wall of 2 to 4m high using **GRIDTEXTILE PET** geogrid composite is an effective solution. In these types of works, geotextile layers in the composite are applied, embracing compacted soil layers, about 20 to 40 cm (one or two compacted layers). After construction, the geotextile face is covered by **EASYLINER PVC** geomembrane to avoid exposure to UV that could degrade the geotextiles.

Reinforcement of Haul Roads and Access Roads on Embankment Berms: The massive vehicles used in mining today requires extremely strong roads. The roads must sustain repeated passing of these vehicles over years of mine activities. Extended interruption in access to the site can threaten the mine's continued operation, as investors and mine owners might no longer consider it economically viable. Therefore, **GRIDTEXTILE PET** geogrid composite having high long-term tensile strength are used to reinforce the base layers of the road and the geotextile layer in the composite will separate the fines and coarse aggregates. The increased road strength mitigates the risk of road erosion and rutting in wet or arid mining environments.

Stabilization of Tailing / Heap Leach Pad Surface: Since fine slurries are available on the mines surface, movement of vehicles for capping will be difficult. Therefore, tailing / heap leach pad surfaces are stabilized using **GRIDTEXTILE PET** geogrid composite having high flexural rigidity at low elongation as well as a high chemical and UV resistance. The geotextile will separate the fine slurry and the self-compacted gravel layer on top of the geogrids (working platform). The geosynthetics for capping of mines are discussed in mines closure section above.

Stabilization of Dump Side Slopes: The dumps are covered using a reinforced earth construction with **GRIDTEXTILE PP** geogrids used to stabilize their side slopes. The interlocking between the geogrids and soil will achieve the required factor of safety to retain slopes. Additionally, for slope protection **MATFLOW** drainage composite is installed on the backfill side of reinforced earth slope / on the top of natural slope to collect the surface and seepage water. The reinforced slope face is protected with **EROMAT / EROGRID** composite for erosion control and to protect embankment side slopes.

APEC Geosynthetic Composites for Mining Industry

BENTOCLINE

BENTOCLINE is a Geosynthetic Clay Liner (GCL) consists of a uniform layer of sodium bentonite powder encapsulated with non-woven geotextile on one side and woven geotextile and 0.5mm thick LLDPE geomembrane on the other side. It has self-healing capacity when hydrated with water and eliminates the conventionally required compacted clay liner in landfills and mining sectors. BENTOCLINE has effective rehydration capacity which makes it unique.



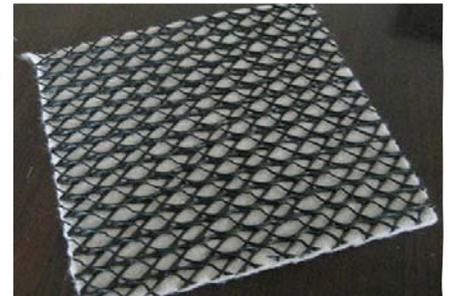
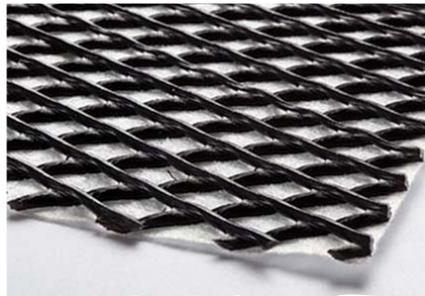
BENTOCLINE GCL

BENTOCLINE GM-GCL

BENTOCLINEs 7.0m wide roll widths reduce the overlaps in the field, in-turn reduces the installation time, labor cost and overall project cost. Along with the BENTOCLINE (GM-GCL) we can produce standard BENTOCLINE GCLs with bentonite weight of 3kg, 4kg and 5kg needle punched between woven and non-woven geotextiles.

NETFLOW

NETFLOW drainage composite can be used as effective filters and drains in landfill capping, leachate collection and leak detection systems. It contains a bi-planar or tri-planar core extruded from HDPE and allows very large quantities of liquid to flow within its structure; it thus acts as a drainage core. The core will be protected by a geotextile, acting as a filter and separator, on one or both sides.



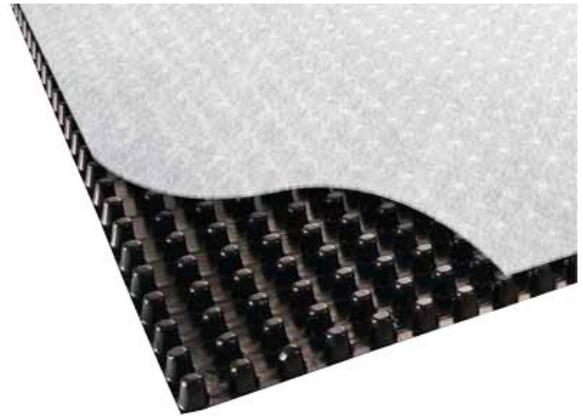
The emergence of such Geodrain composites, has all but eliminated traditional sand / stone / gravel

drains with their better drainage capacity, effective mitigation of clogging, increases the friction characteristics and high compressive resistance. NETFLOW are cost effective, easier to apply, and are not limited by environmental legislations.

APEC offers a broad range of NETFLOW geonet drainage composites with various thicknesses from 4.5mm to 8mm and with very high flow capacities. Our standard roll widths are 2m and 4m and roll lengths up to 100m. Customized roll dimensions are also available.

CUPFLOW

CUPFLOW drainage composite is a two-part prefabricated sheet drain consisting of a 3D polypropylene formed cusped / dimple core covered with a non-woven polypropylene filter fabric on one side. The formed dimple core provides a void to relieve hydrostatic pressure and build up. The filter fabric allows liquids and gases to pass into the drainage core while restricting the passage of soil particles. The filter fabric is bonded to each dimple to minimize fabric intrusion into the core resulting from backfill pressure. The polypropylene core resists chemical attack and degradation in soil. CUPFLOW is a cost-effective alternative to gravel / sand drains and a solution to many drainage problems.



APEC offers a broad range of CUPFLOW drainage composites with various dimple heights varying from 6mm to 25mm and with very high compressive strengths and flow capacities. Our standard roll widths are 1m, 2m & 4m and roll lengths up to 100m. Customized roll dimensions are also available.

EASYLINER LD

EASYLINER LD geomembrane composite is made of low-density polyethylene virgin resins with various specifications to satisfy different environmental requirements. These are laminated with woven/ non-woven geotextiles on one or both sides.

Liner Low Density Polyethylene (LLDDPE) not only has the superior features as HDPE but also provides excellent flexibility and multi-axial elongation. Its high degree of flexibility improves installation around complex shapes and geometries.

APEC offers a broad range of EASYLINER LD geomembrane composite with various thicknesses and weights of geomembrane & geotextile components based on the application & function they are recommended. The geomembrane component of EASYLINER LD composite exceeds the GRI GM17 specifications.



GRIDTEXTILE PET

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EASYLINER HD

EASYLINER HD geomembrane composite is made of premium polyethylene resins with various specifications to satisfy different environmental requirements. These are laminated with geotextiles on one or both sides.

It features outstanding tensile strength, elongation, dimensional stability, good service temperature range, impermeability and strong resistance against chemicals, corrosion, aging, ultraviolet and environmental stress cracks.

APEC offers a broad range of EASYLINER HD geomembrane composite with various thicknesses and weights of geomembrane & geotextile components based on the application & function they are recommended. Geomembrane component of EASYLINER HD exceeds the GRI GM13 specifications.



EASYLINER PVC

EASYLINER PVC geomembrane composite is made of poly vinyl chloride, which is highly flexible, non-reinforced, cost-effective, waterproofing geomembrane with many uses and advantages. It is laminated with filter fabric on one side to improve its tensile strength, tear, puncture and abrasion resistance.

It is resistant to several industrial chemicals and high temperatures. Because of its high flexibility PVC liners readily conform to subgrade contours and offer excellent interface friction.

The use of a PVC liner prevents contaminants from entering groundwater sources or streams, waterproofs the concrete structures and increases their service life. In addition, it conserves potable water resources by preventing seepage loss.



APEC offers a broad range of EASYLINER PVC geomembrane composite with various thicknesses and weights of geomembrane & geotextile components based on the application & function they are recommended.

MATFLOW

MATFLOW is flexible, light weight, high compressive resistance, three dimensional GeoDrain composite, consists of W-shaped channel structure, drainage core made from Polypropylene extruded monofilaments, electro-mechanically bonded with non-woven filter fabrics on one or both sides.

MATFLOW has better long-term performance compared to sand / stone / gravel drains. They are more reliable in mitigation of clogging compared to conventional drains. Behind concrete structures they eliminate hydrostatic pressure build-up.

APEC offers a broad range of MATFLOW geomat drainage composites with various thicknesses from 4.0mm to 20mm and with very high flow capacities. Our standard roll widths are 2m and 4m and roll lengths up to 100m. Customized roll dimensions are also available.



EROMAT

EROMAT is a highly effective Erosion Control System designed and manufactured by APEC Industries. It is a lightweight, flexible 3D polyamide Geomat made with polymer monofilament yarns. It builds a less maintenance system in slopes, spillways and lakes with its high durability and high resistance to UV, chemicals, and biodegradation.

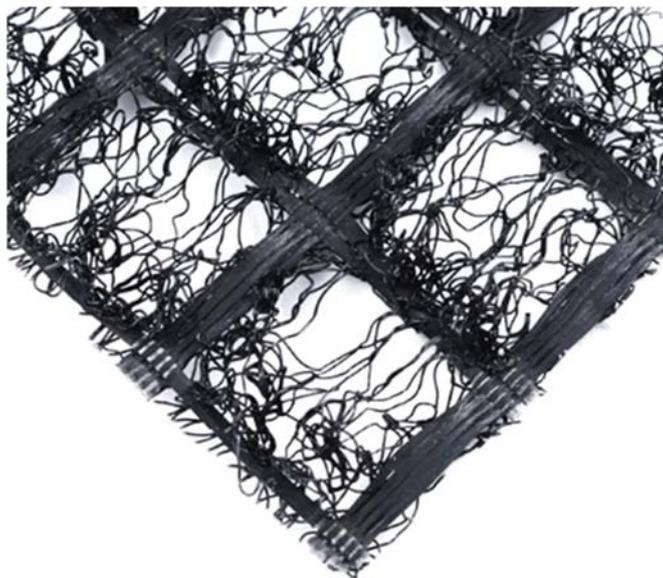
EROMAT can resist shear stresses up to 750 N/m^2 and flow velocities up to 4.5 m/s . EROMATs are available in various thicknesses ranging from 10-20mm, roll widths of 1.0 to 4.0m and roll lengths upto 150m.



EROGRID

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EROGRID can withstand higher shear stresses of 950 N/m^2 and is ideal for steeper slopes. It can resist flow velocities exceeding 6.0 m/s (2.5 times higher than just vegetation). Standard tensile strength of polyester geogrid is 40 kN/m . Dimensions similar to EROMAT.





Oil & Gas Industry

Application of Geosynthetic Composites in Oil & Gas Industry



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Certified to ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018

Application of Geosynthetic Composites in Oil & Gas Industry

- Oil & natural gas industry (O&G) is a fast-growing segment in both worlds economy and geosynthetic materials market. Horizontal drilling and hydraulic fracturing of shale deposits have opened large new market for oil and gas exploration in the recent times.
- This recent and rapid growth in the O&G market has presented both opportunities and challenges for the geosynthetics industry. The scope and range of geosynthetic material specifications varies depending on region, climate, environmental and safety regulations, ability to recycle materials, and producers' ongoing search for new cost-effective solutions.
- In addition to regular business challenges O&G industry is facing pressures from concerned citizens questioning the safety and environmental impact of oil and gas recovery methods. Therefore, need of reprocessing materials and reduced carbon emission techniques took highest priority and increased the market for geosynthetic materials which are easy to re-process and to re-use.
- APEC Industries understood the unique challenges of O&G industry and developed a complete package of composite geosynthetics used to protect soil, groundwater and surface water against the harshest contaminants in the most extreme conditions. Our products are designed to meet or exceed the most stringent regulations that governments develop. In addition to offering a durable product that lasts for years.
- The opportunities of geosynthetic composites in the O&G industry are subdivided according to:
 - (i) the drilling operations themselves
 - pad liners
 - above-ground and in-ground secondary containment
 - pit liners
 - frack flowback water ponds
 - fresh water pond liners and
 - floating covers
 - (ii) opportunities at permanent locations
 - roadways into and out of the drilling site
 - MSE walls to maintain level surface in hilly terrains for drill pad site along with adjacent
 - parking and staging areas
 - protection of natural gas or liquid transportation pipelines
 - (iii) opportunities at temporary locations
 - temporary dams
 - erosion controls for slopes, channels / ditches

Well Pad Liner



- Well pad liners provide a safe anti-slip surface for workers and protect the well site environment from equipment failures, leaks, and spills.
- **EASYLINER HD** is best suitable for the installation on the ground surface for the well drilling, completion, and production phases.
- Typically, geotextiles are placed on natural ground and followed by a 0.6mm - 1mm thick geomembrane. EASYLINER composite has both geomembrane and geotextiles electro-mechanically laminated together and can perform functions like containment, separation and added punching resistance with geotextile layer.
- EASYLINER geomembrane composites are chemically inert, highly resistant to UV degradation and can withstand the harsh conditions of a fracking job site.

Secondary Containment

- Above-ground and in-ground secondary containment is used to protect against spills during hydraulic fracturing (“hydrofracking” or just “fracking”) operations for frack tanks, chemical and mud tanks, fuel tanks and equipment.
- Containment areas are constructed with earthen berms or multiple above-ground materials ranging from straw bales to engineered plastic containment walls. Plastic secondary containment walls are a new and rapidly growing market for secondary containment. Typically, geotextile and then a 0.6mm geomembrane are installed over the containment walls and bottom when used as containment for frack tanks.
- **EASYLINER LD** geomembrane composites are the best fit for the secondary containment applications. They are flexible, chemically inert, and high temperature resistant.



Pit Liner

- Containment of cuttings from the drilling operation and spoils extracted from the well hole concerned proper safe and secure disposal.
- APEC **EASYLINER HD** geomembrane composite lining systems are used to line the storage pits and protect groundwater against potential impact.
- A decontaminant agent like addition of charcoal, activated carbon, phosphoric rock, or organoclays will treat the effluents and the rest is released to dump in landfills.



Freshwater Pond Liners

The process of hydrofracking uses up to 3800 m³ volume of water per well; therefore, having a readily available source of fresh water is crucial to maintaining production schedules and ensuring overall project success. When a well is constructed in a region where water is scarce, energy companies can install large holding ponds to capture and store water for future needs. Our highly engineered, **EASYLINER LD** geomembrane composite can be used to line ponds and reservoirs, protecting valuable water resources from contamination and leakage.



Frack Flowback Water Ponds

- During the fracking process, up to 90% of the water used flows back to the surface. These high brine content fluids must be captured and contained in an environmentally responsible manner prior to treatment or re-use. These highly critical applications often are subject to stringent government regulations, and only the most reliable products will do.
- APEC composites like **EASYLINER LD + NETLINER** (cross section bottom to top) is the only composite in the Middle East market that allows you to conduct leak surveys on both covered and exposed applications, and it is specifically intended for applications where you can't afford a leak. The geonet contains an air void and the ends are connected to a discharge collection unit. Once we observe any fluids flowing out of this drainage core, it is evident that the top geomembrane layer is leaking, and the maintenance is required.
- Alternatively, our **BENTOCLINE GM-GCL** composite can stand up to flowback waters that contain high brine content / most chemically laden solutions.



Floating Covers

- Floating covers are another geosynthetic application that is gaining acceptance, especially for water storage and safety. The covers are made by sandwiching a sheet of foam board between two sheets of 0.60 to 0.75mm **EASYLINER LD** geomembrane. These covers can reduce water evaporation in summer and help limit water freezing in winter months, which can inhibit drilling.
- The cost of replacing water evaporation per month in arid areas can be significant, especially if the water is hauled by truck to the impoundment area. In addition, drilling operations are extended later into the winter by adding floating covers and heaters to the water containment area. Floating covers can also replace bird netting in some areas.

