

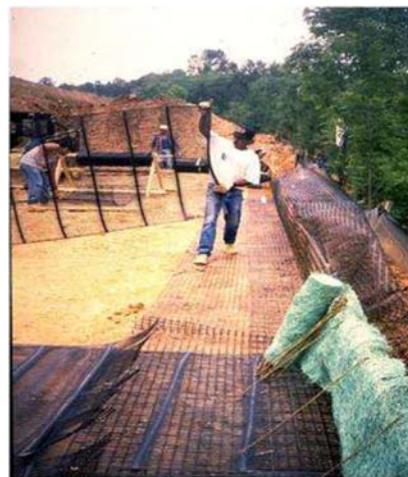
Roadway into and out of Drilling Site

- Roadways into and out of the drilling site have high priority and are necessary for ~30 years of service life.
- Our **GRIDTEXTILE PET** (geogrid composite) showed savings of 10 to 50% in the crushed stone thickness of base courses placed on soil subgrades. The functions of separation, stabilization and/or reinforcement are achieved by a single product and are clearly indicated in the literature since this application has been ongoing.
- GRIDTEXTIEL PET in multi-layers increases the bearing capacity of the base and sub-base layers of the access roads. It will distribute the vehicle loads uniformly on to the subgrade minimizing the differential settlement. The geotextile component of the composite will separate the engineered fill material and the exiting subgrade.



MSE Walls

- The drill pad site along with adjacent parking and staging areas must be level. To accomplish this in hilly terrain one needs to create stable soil slopes or even vertical walls. The concept of mechanically stabilized earth (MSE) slopes and walls using our **Uni-axial geogrid** is ideal in this regard.
- Not only are these situations the least expensive of all types of retaining structures, they are straightforward to construct, have no limitations as to curvature, height, or orientation, and have proven stable insofar as extreme surcharge loads are concerned.



Temporary Dams

- Temporary dams may be used for surface water control or for accidental spills associated with the drilling or containment operations.
- **EASYLINER LD** can readily provide such temporary containment and be adaptable to myriad applications.



Buried Pipelines Protection

- In the O&G industry pipelines are used for.
 - fresh water transmission
 - frac water transmission
 - gas transmission and
 - surface water transmission
- Pipelines are lifelines since they carry essential materials for the support of O&G industry. Therefore, they need to be protected from mechanical loads and environmental actions.
- **PIPEWRAP** is a HDPE extruded diamond shape grid geonet with a non-woven geotextile electro-mechanically laminated on one side for additional protection to pipelines coating. It protects the pipeline coatings from the impact of angular rocks during the backfill process and provides extended protection from the stones in proximity from the coated pipe. They are robust, durable, versatile in their application and easy to install.



Erosion Control Mats

- On sloping surfaces soil erosion is a concern and must be avoided. Geotextile silt fences are typically used to control soil erosion due to wind currents.
- Rather than containing the site's erosion after it occurs it is better to control and stabilize it before it starts. This has been traditionally provided by geosynthetic-erosion control materials like **EROMAT** (Geomat), **EROGGRID** (Geomat + PET geogrid) or **CONCRETE MAT**. The two major categories applicable for O&G industry are slopes, channel / ditch erosion.
- These are differentiated according to the flow capacities of 4.5 m/s, 6.0 m/s and 10 m/s respectively. Also, based on the resistance to shear stresses requirement as 0.75 kN/m², 0.95 kN/m² and 1.2 kN/m² respectively.



APEC Geosynthetic Composites for Oil & Gas Industry

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 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.



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

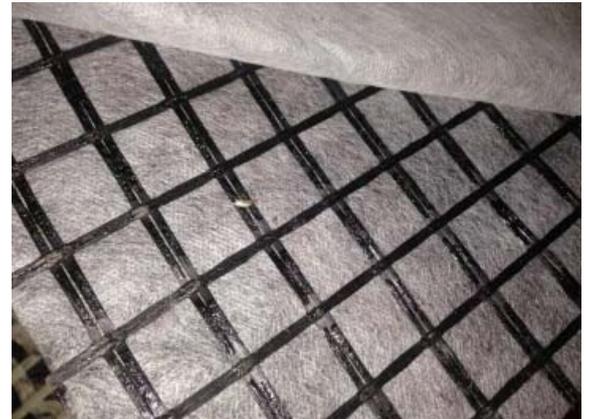
BENTOCLINEs 7.0m wide roll widths reduce the overlaps in the field, in-turn reduces the installation time, labor cost and overall project cost. Along with the BENTOCLINE (GM-GCL) we can produce standard BENTOCLINE GCLs with bentonite weight of 3kg, 4kg and 5kg needle punched between woven and non-woven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



BENTOCLINE GM-GCL

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.

NETLINER

NETLINER is a drainage composite that can be used as leak detection layer in the frack flowback water pond in oil & gas industry. Additionally, it has an ability of protection & waterproofing with the help of geomembrane laminated on one side. It contains the geonet core made with two over crossed strands at 60°, whose geometry create channels with a high flow capacity, also under pressure and at very low gradients. The core will be laminated by a non-woven polypropylene geotextile, acting as a filter and separator, on the other side.



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

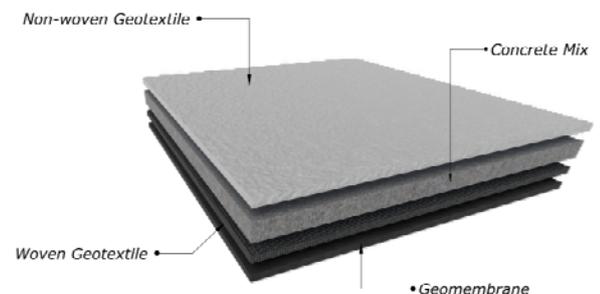
EROGRID is APEC Industries another Erosion Control System. It also delivers maximum soil reinforcement and slope stabilization, thanks to its lightweight and flexible 3D polyamide Geomat composite made from polymer monofilaments with integrated high-tensile strength polyester geogrid.

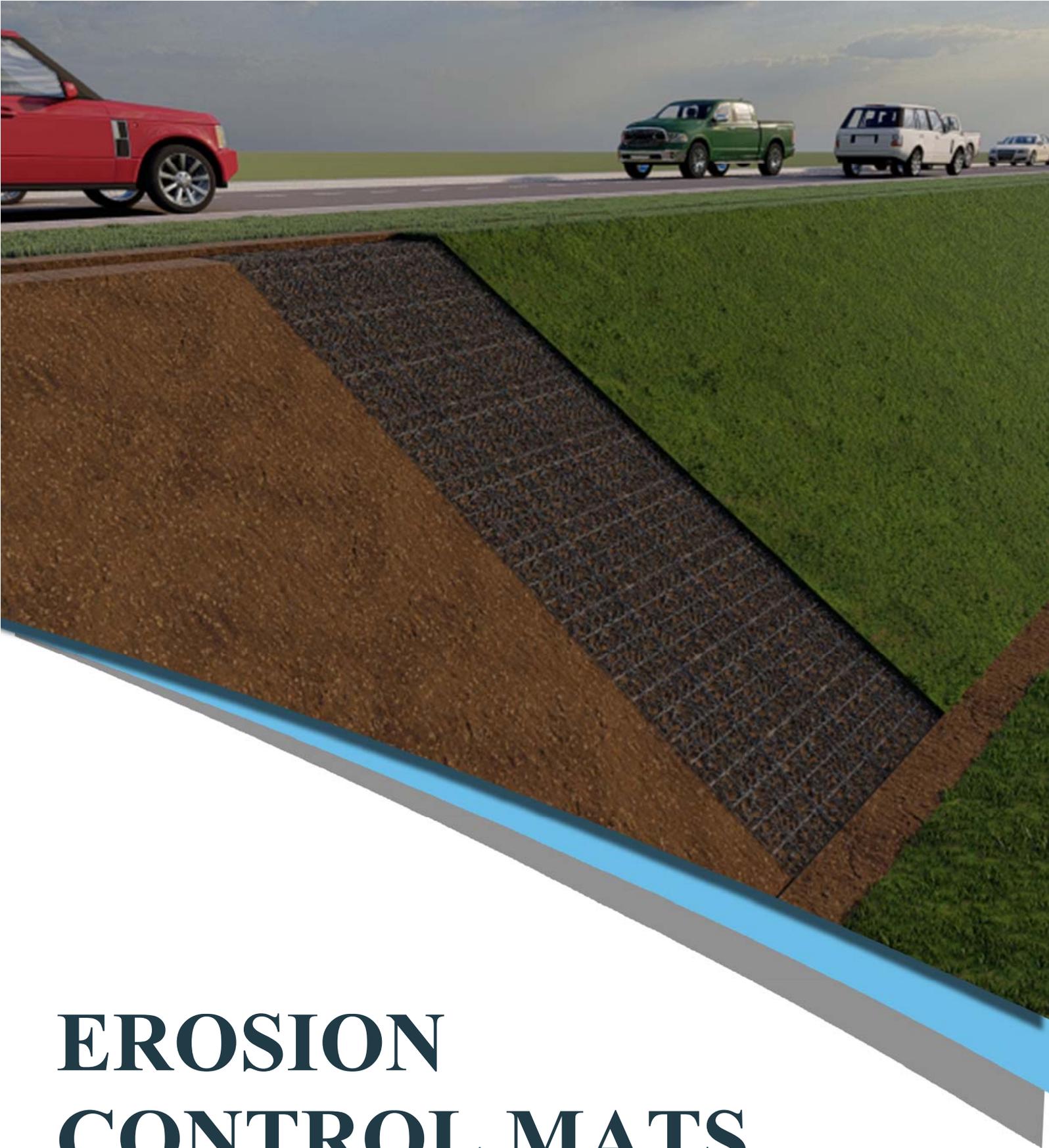
EROGRID can withstand higher shear stresses of 950 N/m^2 and is ideal for steeper slopes. It can resist flow velocities exceeding 6.0 m/s (2.5 times higher than just vegetation). Standard tensile strength of polyester geogrid is 40 kN/m . Dimensions similar to EROMAT.



CONCRETE MAT (Concrete in the form of roll)

When a greenery facing is of less important a concrete lining is used for permanent erosion control then an economical and unique alternative is Concrete Mat. It is a multi-layered composite material with non-woven geotextile as cap and woven geotextile as carrier layers followed by a PVC backing. The fabrics are needle punched and filled with unique mortar dry mix which is specially formulated. Once hydrated or fully immersed with water the dry mix will harden into impermeable concrete. The fibers reinforced concrete, preventing crack propagation absorbs energy from impacts and provides a stable failure mode. If properly anchored, it can withstand shear forces of 1.2 kPa & flow rates of 10 m/s .





EROSION CONTROL MATS

Extruded Geomat / Geomat Composites / Concrete Mat / Sand Mat



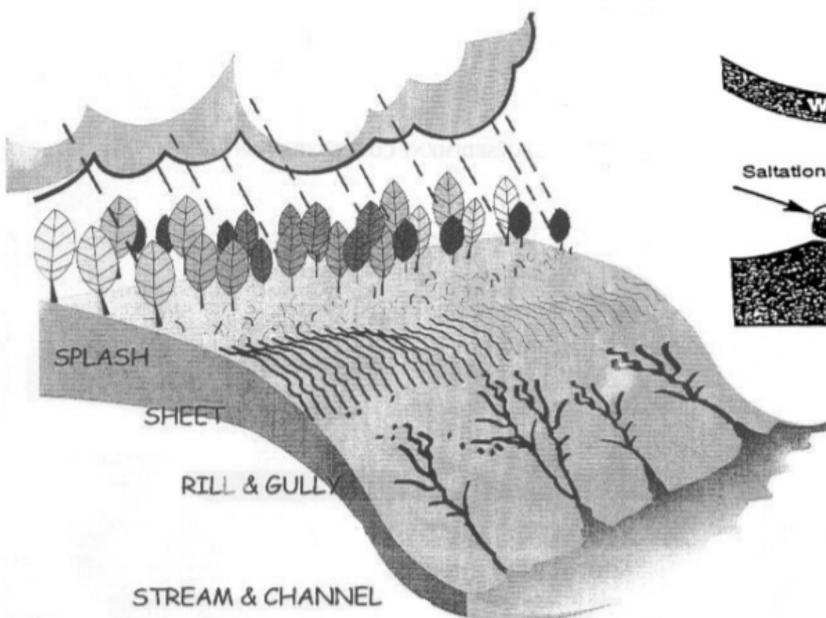
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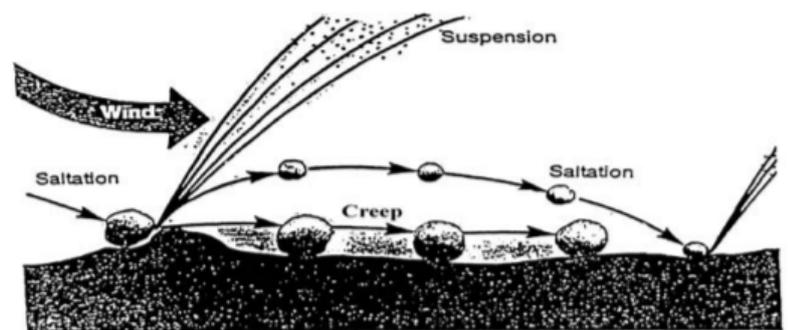
Certified to ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018

Introduction to APEC Rolled Erosion Control Mats (RECMs)

- The goal of erosion control is to protect the soil from splash, sheet, rill & gully, stream & channel erosion either indefinitely or until vegetation can establish itself. The interaction of water and wind threshold velocities and the size of the particles are the predominant factors gives rise to the sequence of soil erosion (detachment – transportation – deposition). The main areas where these erosion control solutions required are:
 - ❖ In agriculture
 - ❖ Land development
 - ❖ Coastal areas
 - ❖ Riverbanks
 - ❖ Construction
- Effective erosion control handles surface runoff and are important techniques in preventing water pollution, soil loss, wildlife habitat loss and property loss.
- APEC Erosion Control mats like EROMAT, EROGRID, CONCRETE MAT and SAND MAT are one of its kind with a huge advantage of manufactured locally.
- CONCRETE MAT is simply, concrete supplied in rolls which benefits the project by saving construction time, transportation, labor cost etc., It is the best alternative in most of the remedial projects.
- SAND MAT is another revolutionary product. No dewatering required for SAND MAT to install underwater. High installation damage resistance and riprap can be placed directly on top of sand mat.



Water Erosion



Wind Erosion

Principle Factors to be considered in Soil Erosion are:

- ❖ Climate
- ❖ Soil Characteristics
- ❖ Topography
- ❖ Soil Cover

Surface Erosion Solution with RECMs

- Natural slopes are critical to long-term performance. Disturbances due to man-made developments or nutrients loss in natural soils causes surface erosion in progressive manner and creates surface undulations. Since they are unprotected, the run-off flow concentrates and progress into deeper channels forming an eventual loss of stability.
- The natural solution to protect these slopes is by vegetation. However, the time until the seeds grow into plants and trees, the slopes are unprotected, and erosion can happen due to rains and heavy winds.
- Geosynthetically the issue can be tackled by the installation of various Rolled Erosion Control Mats (RECMs) like **EROMAT / EROGRID / CONCRETE MAT / SAND MAT**, reinforces to prevent soil from washing out of the slope face prior to the vegetation taking hold. Therefore, these reinforcements can withstand the rain drop impact energy, reduce surface runoff, and reduce total soil loss which ensures the growth of vegetation roots and provides additional mechanical strength to avoid slope failure.



Slope failure

EROMAT/EROGRID

When naturally growing greenery alone cannot prevent erosion, a three-dimensional open structure mat like EROMAT/EROGRID are the solution. The use of well rooted grass for erosion control is a natural and attractive idea. But natural vegetation on its own has limited soil retention qualities. When there is a high risk of erosion, grass and other vegetation will be ruled out. With the help of EROMAT/EROGRID, vegetation can withstand these risks.



EROMAT



EROGRID

EROMAT

EROMAT is a flexible, light weight 3D polyamide Geomat made from polymer monofilament yarns. It can resist shear stresses up to 0.75 kN/m² and flow velocities up to 4.5 m/s. It prevents erosion on embankments, riverbanks, canals, reservoirs and a stabilization grip layer on rocky slopes, smooth surfaces, and geomembranes.

EROGRID

EROGRID is a flexible, light weight 3D polyamide Geomat composite made from polymer monofilaments with integrated high tensile strength polyester geogrid of 40 kN/m. After extreme testing it is evident that EROGRID can resist shear stresses of 0.95kPa and flow velocities exceeding 6 m/s (>2.5 times than only vegetation). It prevents erosion on stormwater channels, watercourses, steep slopes, spillways, canals, and shoreline protection and where the wave action.

Benefits of EROMAT

- Thickness of EROMAT is up to 20mm and specific gravity >1 (means it will not float on water and installation in submerged conditions is possible).
- Remains locked to the ground by root systems.
- Blends discretely into the local environment.
- Advantage of installation below waterline.
- Open structure encourages vegetation.
- Flexible to adapt to any soil profile.
- Can be installed on steeper grades compared to riprap and armor rock.
- Three-dimensional Open structure of >95% free volume.

Benefits of EROGRID

- Thickness of EROGRID is up to 20mm, 3D Open structure of >95% free volume and Specific gravity >1 (means it will not float).
- Provides maximum reinforcement at low elongations.
- Withstands wheel loading and resists burrowing animals.
- Unparalleled resistance to hydraulic shear stresses.
- Remains locked to the ground by root systems.
- Blends discretely into the local environment.
- Open structure encourages vegetation, and it is flexible to adapt to any soil profile.
- High UV resistance.

CONCRETE MAT (Concrete in the form of roll)

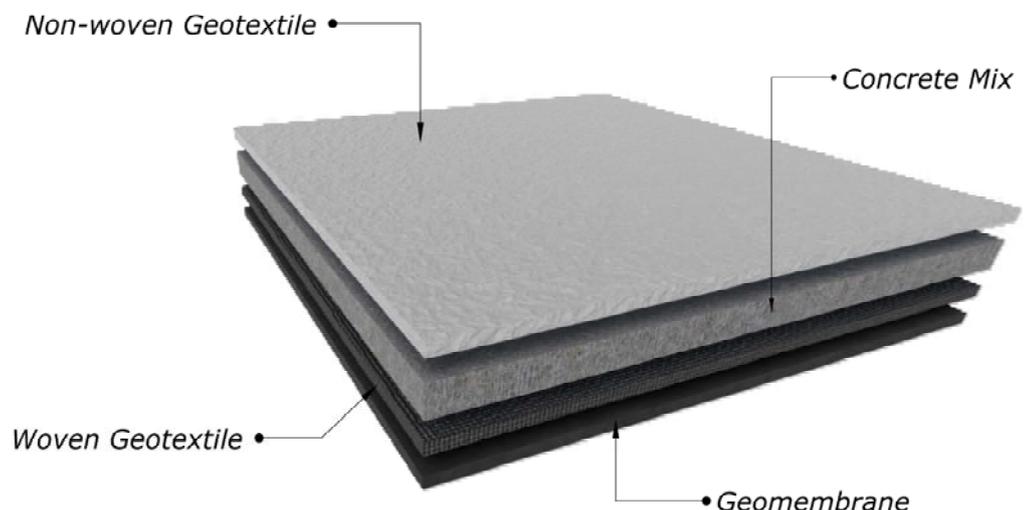
When a greenery facing is of less important a concrete lining is used for permanent erosion control then an economical and unique alternative is Concrete Mat. It is a multi-layered composite material with non-woven geotextile as cap and woven geotextile as carrier layers followed by a PVC backing. The fabrics are needle punched and filled with unique mortar dry mix which is specially formulated. Once hydrated or fully immersed with water the dry mix will harden into impermeable concrete. The fibers reinforced concrete, preventing crack propagation, absorbs energy from impacts and provides a stable failure mode. If properly anchored, it can withstand shear forces of 1.2kPa & flow rates of 10 m/s.

Benefits of CONCRETE MAT

- CONCRETE MAT is supplied in rolls, highly flexible when dry and follow the ground profile and fit around existing infrastructure.
- It is highly impermeable upon hydration and addition leakage safety is provided by PVC membrane.
- Rapid installation up to 230 m²/hr and 10 times faster than conventional concrete lining.
- No skilled labour required, easy to install, less traffic movement and lower projects cost.
- It has 7.5 times higher abrasion resistant compared to standard OPC concrete, excellent chemical resistance, weathering performance and UV resistance.
- High 24hrs compressive strength of 65Mpa.

Application Areas of CONCRETE MAT

- Channel Lining
- Slope Protection
- Bund Lining
- Remediation
- Weed Suppression



EROMAT/EROGIRD for Landscapes

As we know that water from rain or irrigation systems travels down slopes and erodes soils. If these slopes are in our yard, roads and highways, landfills etc., erosion can ruin the landscape design by carving gullies and uprooting plants. Traditional erosion control strategies like rain gardens, applying mulch and planting soil-stabilizing vegetation will be hardly effective until the plant roots locked into the soil structure. The 3D structure of the **EROMAT / EROGIRD** will hold the cover vegetative soil and accelerates the growth of plants and landscaping.



CONCRETE MAT for Steep Slopes

One of the main purposes of Concrete Mat is Slope Protection. It is possible for hassle free deployment in the limited access sites with concrete mat. It does not require heavy concrete plants like in the case of traditional poured or sprayed concrete.

- Roll sizes are customizable. Therefore, manual transportation is possible with small rolls and incase of bulk rolls it can be installed from slopes crest.
- 70% of the concretes compressive strength is achieved in less than 24 hrs.
- 10 times faster installation compared to conventional concrete solution.
- It has higher abrasive resistance compared to OPC concrete.
- It has excellent chemical resistance, good weathering performance and will not degrade in UV.
- Concrete Mat provides excellent weed suppression, reducing maintenance, life cycle costs and Occupational Health & Safety risks.
- It can be used economically for various concrete remediation works.

EROMAT / EROGRID / CONCRETE MAT for Channel Lining

When a greenery facing slope is planned and the flow capacities are ranging from 4.5 – 6.0 m/s then EROMAT / EROGRID is recommended for channel lining.



When a concrete finishing is planned, or the flow capacities are >10 m/s then CONCRETE MAT is recommended for channel lining.



APEC Erosion Control Blankets

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/m² 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.

CONCRETE MAT

It is a multi-layered composite material with non-woven geotextile as cap and woven geotextile as carrier layers followed by a PVC backing. The fabrics are needle punched and filled with unique mortar dry mix which is specially formulated. Once hydrated or fully



immersed with water the dry mix will harden into impermeable concrete. If properly anchored, it can withstand shear forces of 1200 N/m² & flow rates of 10 m/s. CONCRETE MAT is available in 3 different thicknesses 5mm, 8mm and 13mm. The initial setting time of concrete is ~60-120 min and 70% of concrete compressive strength is achieved in the first 24 hrs.

EROGRID



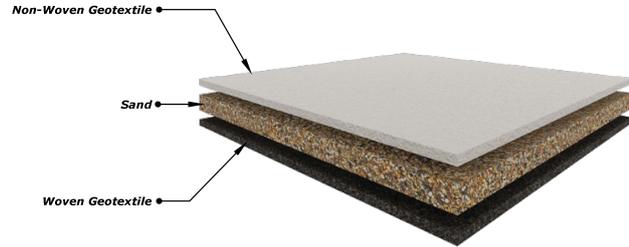
EROGRID is APEC Industries another Erosion Control System. It also delivers maximum soil reinforcement and slope stabilization, thanks to its lightweight and flexible 3D polyamide Geomat composite made from polymer monofilaments with integrated high-tensile strength polyester geogrid.

EROGRID can withstand higher shear stresses of 950 N/m² 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 Erosion Control Blankets (cont..)

SAND MAT (GCL with Bentonite core replaced with sand)

SAND MAT is a multi-layered needle-punched staple fibre nonwoven with a filling of quartz sand for application in hydraulic engineering. The product has been developed aiming for underwater installation. Geotextile functions are separation, filtration, and protection. It is mainly used in coastal and other sensitive environments. It is an ideal solution for use in waterways where high filtration efficiency, revetment stability and abrasion resistance due to wave action is required.



Benefits of SAND MAT

- SAND MAT achieved higher weight per unit area due to sand filling, simplifies installation and offers enhanced protection against displacement. This allows the trouble-free, filtration-stable installation of revetments even under water.
- Simplified installation under difficult hydraulic conditions.
- Topsoil, concrete blocks, riprap as well as armor rocks can all be placed directly on top of SAND MAT due to its proven strength and flexibility. Prevents erosion and displacement of subsoils in Coastal and other sensitive environments.
- It consists of a relatively stable matrix that retains its structure during handling, placement, and long-term service.
- Revetment thickness can be reduced.
- Rapid installation.
- Cheaper than more traditional solutions.
- In contact with soils they improve the overall long-term stability and integrity of a structure.
- Financial and ecological savings are achieved as SAND MAT removes the need to transport large quantities of natural soils or aggregates.

Applications

- Reservoirs, Dams
- Dykes
- Scour protection
- breakwaters
- Roads
- Tunnels and
- Weed Suppression



Product data sheets, Case Studies and Installation Guidelines are available upon requests and can be downloaded through our website www.APECIndustries.com. Please contact us for further design assistance for your specific project.

Disclaimer:

Please note that the information provided here are for conceptual purpose only. A detailed engineering design needs to be performed to determine the requirements and type of geocomposites suitable for the specific project.

APEC Industries Composite Polymeric Materials L.L.C. cannot be held responsible for any loss or damage resulting from the use or misuse of this guide. All materials are subject to approval by APEC Industries Composite Polymeric Materials L.L.C.



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