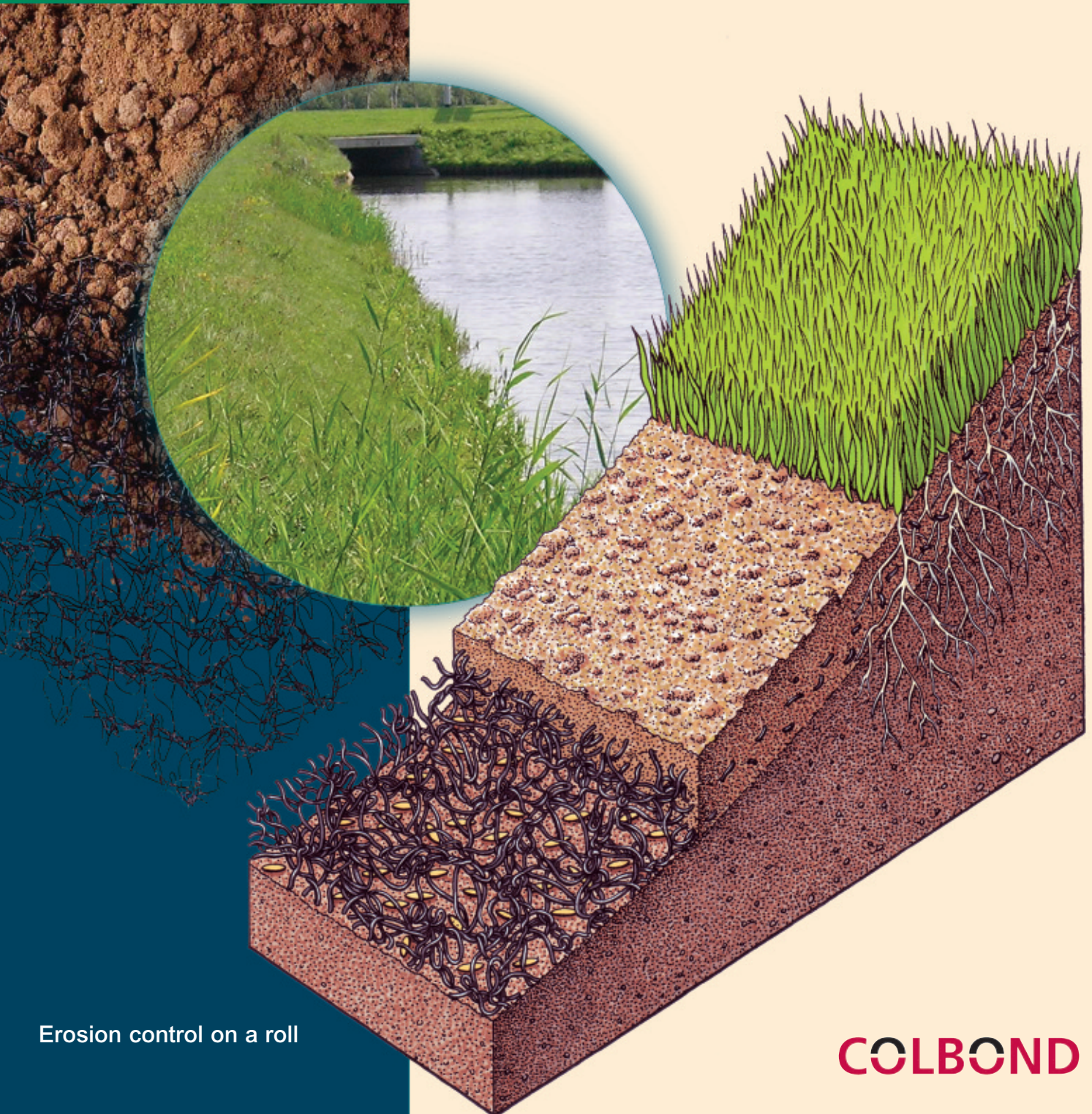


Enkamat[®]

EROSION CONTROL



Erosion control on a roll

COLBOND

Enkamat

Erosion - the best solution is a green solution



Enkamat with soil fill



Houston USA, during installation



Houston USA, after installation

Wind and water – the two elements that are most often the cause of erosion of our natural or engineered environment. When naturally growing vegetation alone cannot prevent erosion, Enkamat is 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 Enkamat, vegetation can withstand these risks. Green *and* permanent solutions are thus created for places where otherwise erosion would have its way.

Solid erosion protection

Enkamat is a strong three-dimensional polyamide (PA) mat with an open structure. It functions as a protective, reinforcing and integrated intermediate layer between natural vegetation and soil, enabling root systems to grow and gain a secure hold on the ground beneath.

Always the right solution

Enkamat can be used effectively in many situations. Whether erosion control is required above, at, or below the water level or on dry slopes, a suitable Enkamat variant is available for any condition. Enkamat is also used as a grip layer to stabilize soil on rocky slopes or on smooth surfaces such as geomembranes.

Proven performance

Enkamat was introduced in the Seventies by geosynthetics pioneer Colbond; since then more than 25 million m² have been installed worldwide. And Colbond continually develops and improves Enkamat, ensuring that its strength and performance remains unrivalled.

Colbond

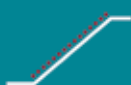
Colbond is a leading producer and supplier of high-quality three-dimensional polymeric mats and composites for civil engineering, building and industrial applications and of synthetic nonwovens for flooring, automotive and construction applications.

The company's production facilities are based in Emmen and Arnhem (Netherlands), Obernburg (Germany) and Asheville (USA), with regional sales offices located around the world. For product and application development, the company maintains a Development and Application Centre at the Arnhem head office and a Development Laboratory in Asheville.

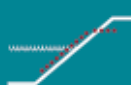
Colbond is a subsidiary of Low & Bonar PLC - a group of global leading manufacturers and suppliers of advanced technical textiles.

The range of geosynthetic products manufactured by Colbond for civil engineering includes Enkamat®, Enkadrain®, Enkagrid®, Colbondrain® and Armater®. These products are used all over the world for reliable erosion control, drainage, soil reinforcement, stabilization and consolidation.

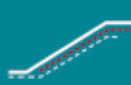
Applications



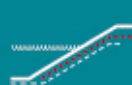
dry slopes



waterbanks



lined slopes



lined slope in ponds



vegetated face wraps



pregrown vegetation for industrial buildings



green roofs



rock face vegetation

Enkamat

Enkamat prevents erosion on embankments, slopes and river banks. On steep or rocky slopes and on smooth surfaces, Enkamat is an effective and dependable grip layer that retains soil and supports protective vegetation. The product has been in use successfully for decades worldwide. Why is Enkamat such a good solution for erosion related problems?

Integrated system - Enkamat provides perfect conditions for vegetative root systems to develop. Embedded with soil, roots and vegetation, Enkamat forms an integrated and robust system to control erosion.

Permanent solution - Enkamat is manufactured from high quality polyamide (PA), and is both durable and environmentally friendly.

Fast vegetation - The three-dimensional open structure of Enkamat encourages the swift growth of vegetation.

Immediate protection - Even before vegetation starts to develop, Enkamat alone provides immediate protection.

Easy to install - As Enkamat is a polyamide (PA) mat, it is of light weight and high flexibility. In contrast to polypropylene (PP) or polyethylene (PE) mats, Enkamat does not float in water. These qualities provide easy handling - both in dry conditions and when operating under water.

Wide choice - Enkamat is available in many different thicknesses and structures. The range also includes types with a reinforcing grid and a particular variant pre-filled with 2-6 mm stone chippings bound with bitumen. Standard widths range from 1 to 4 m. Large quantities can be customized.

Maintenance – No maintenance is needed after installation. But if grass growing through Enkamat needs cutting, mowing equipment can be used safely as the Enkamat will stay firmly secured in the ground.

Economic - No post-installation maintenance is needed. The width of Enkamat saves labor and material because few overlaps are required. And Enkamat is produced in large quantities, so benefiting from economies of scale. This helps to ensure competitive prices and low through-life costs.

Support - Working with a worldwide network of distributors, Colbond can ensure that each project receives full technical back-up.

More product qualities

- Excellent bonding of individual filaments
- Over 90% voids
- High resistance to weathering and UV radiation
- Resists temperatures down to minus 40°C
- Does not attract rodents, no nutritional value
- Low flammability – does not support combustion



Dipidio, Malaysia



Grevelingenkanaal, Netherlands



Naples, Italy



road ditches

runways

landfill cappings

spillways

culvert protection

embankments

railroad banks

stepped waterbanks

Enkamat

At a glance

Erosion protection

Fully vegetated eros

Dry slope
Low erosion risk

Enkamat 10 mm plus soil, (hydro)seeding or mulching for increasing protection

Dry slope
High erosion risk

Enkamat 20 mm plus soil, (hydro)seeding or mulching for increasing protection or
Enkamat J for immediate protection

Wet channels
Low erosion risk

Enkamat 20 mm plus soil, (hydro)seeding or mulching or
Enkamat 10 mm filled with stone chippings

Wet channels
High erosion risk

Enkamat 20 mm filled with stone chippings or
Enkamat A20



High or low erosion risk

Whether the risk of erosion is high or low will be individually determined for each project, depending on several variables. These might include the type of climate in which a project is situated, local weather conditions, exposure to wind, rain, hydraulic loadings or sun, soil type, and the incline and shape of the slope.

Immediate high level or increasing erosion protection

For immediate and effective protection on shorelines and riverbanks, Enkamat A20 or Enkamat filled with stone chippings are the right solutions, as is Enkamat J for dry slopes. After installation, vegetation growth will further increase the already high level of protection.

Enkamat A20 contains a mineral filter of chippings bound with bitumen.

Enkamat J is a composite of Enkamat with a biodegradable geotextile backing, for use when hydraulic loadings or other erosion risks are expected before vegetation has developed.

When immediate risks are low, adequate protection is provided from the start by Enkamat plus soil and seedings. Full and permanent protection will be achieved within a few months, when the vegetation has fully developed.

Enkamat

ion protected slopes



Soil stabilization

Reinforced Enkamat plus soil, (hydro)seeding or mulching

Steep/rocky slopes

Reinforced Enkamat plus soil cover

Soil covered geomembranes

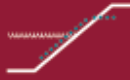
Geomembranes or steep/rocky surfaces

When covering smooth geomembranes or steep/rocky surfaces with soil, a grip layer is often needed to prevent the soil cover from slipping - exactly what reinforced Enkamat can do. On rocky slopes, Enkamat will also prevent weathering of the surface.

Tailor-made advice

Colbond or its experienced distributors will be happy to advise you which Enkamat variant is most suitable to solve your erosion problem. A technical design guide for Enkamat is also available, as well as an installation guide. Copies may be downloaded at www.colbond-geosynthetics.com/downloads.

Applications



Enkamat

Applications

Erosion control for embankments and slopes

To protect new or repaired embankments from erosion, standard Enkamat is used. Various types of slopes, such as road and railway embankments or spillways can be protected.

Enkamat, either seeded and filled with topsoil, hydroseeded or mulched after installation, keeps the fertile soil and germinating seeds in place, preventing the fill from being washed out by heavy rain and encouraging active plant growth.

Vulnerable areas, at risk of damage by rain or wind, are thus transformed into stable, fully grown, green surfaces with no need for maintenance after installation.

Standard Enkamat with proper filling is the most efficient, but Enkamat may also – under special circumstances – be installed unfilled. The matting must then be secured with extra pegs to ensure firm contact with the subsoil.

For the highest level of immediate protection on dry slopes, Colbond recommends the use of Enkamat J, which has the additional protection of a biodegradable geotextile layer.

Immediate protection of wet slopes against hydraulic loadings

Green, densely vegetated banks develop when Enkamat is used to protect wet slopes from eroding. Enkamat stops erosion at, below and above the waterline of channels, rivers, canals, lakes and water reservoirs. Its flexibility makes it also very suitable to protect the area around culverts.

Depending on water velocities, Enkamat with stone chippings or Enkamat A20 is the right choice. From approximately 0.5 m above the water level, standard Enkamat may be used.

As green banks blend harmoniously into the landscape, Enkamat is often incorporated as bank protection in residential and recreational areas, improving the habitat of these areas.

Enkamat delivers a green solution right down to the water level, even with seasonal changes of water level.

Enkamat does not float – simplifying installation on or below the water level.

The pre-filled Enkamat A20 is, as with all other Enkamat types, non-toxic, does not leach, and is approved for use in potable water reservoirs.



Nederweert, Netherlands



San Antonio USA, during installation



San Antonio USA, after installation

Enkamat



Schalksmühle, Germany



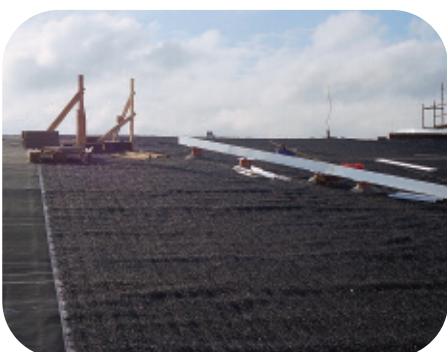
Béziers, France

Reinforced soil stabilization on steep/rocky slopes and on geomembranes

To stabilize soil on steep/rocky slopes and on geomembranes or geosynthetic clay layers, Colbond has developed the reinforced Enkamat W – an open structured Enkamat sewn to a reinforcing open grid or woven fabric, both of which are available in different strengths. Enkamat functions as a grip layer for soil while the grid or fabric absorbs and transfers the forces generated by soil and vegetation cover – a system both simple and reliable.

On rocky slopes, the reinforced and flexible Enkamat W is pinned to ensure close contact with the ground. It functions as a flexible grip layer in which soil is retained and seeds germinate easily. When a slope is very steep, Enkamat W may be mulched.

When geomembranes are used to cover landfill cappings, retention ponds or lined impounding reservoirs for instance, they need to be protected against UV and mechanical damage, usually by a layer of soil. Also for aesthetic reasons coverage with a layer of soil is desirable. But the friction between a smooth geomembrane and the soil is often too low, allowing the soil to slide off. In these cases, Enkamat W provides both stability and support for vegetative growth.



Pforzheim Germany, during installation



Pforzheim Germany, after installation

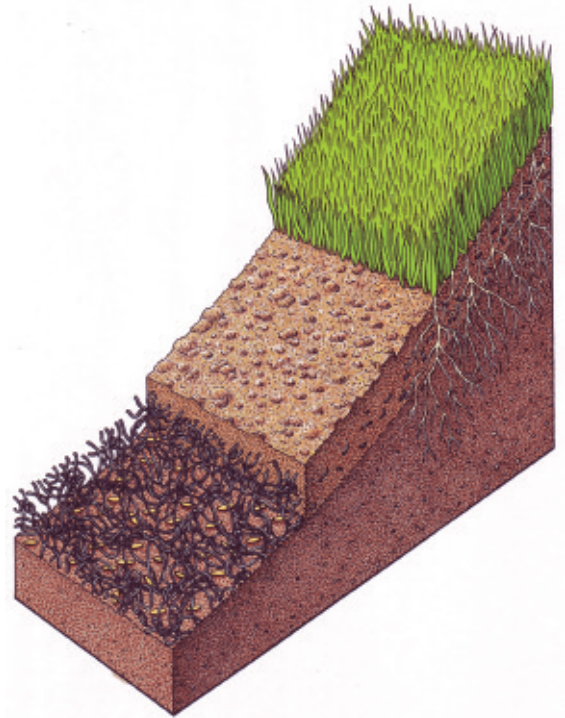
Applications



Enkamat

Product range

All Enkamat product types are three-dimensional open structured polyamide mats made of monofilaments fused together where they intersect. The full Enkamat product range consists of tailor-made solutions for a wide range of applications. The Enkamat product family is divided into groups as follows:



Enkamat

- Structure - open top and bottom
- Particularly suitable for dry slopes
- Prevents soil erosion by wind and rain
- Up to 20 mm thick
- Creates artificial root structure, up to 1,810 m filament/m²

Enkamat J

- Structure - open Enkamat sewn to a biodegradable backing
- Suitable for dry slopes where severe hydraulic loadings are expected within 3 to 4 months
- Prevents soil erosion by wind and rain; offers immediate protection for early hydraulic loadings
- Up to 10 mm thick
- Creates artificial root structure up to 1,810 m filament/m²

Enkamat flatback

- Structure - open on top, flat monofilament mat structure on bottom
- Particularly suitable for wet slopes and in flood areas to retain stone fill
- Prevents erosion on slopes and banks with medium water velocities
- Up to 20 mm thick
- Creates artificial root structure, up to 2,980 m filament/m²

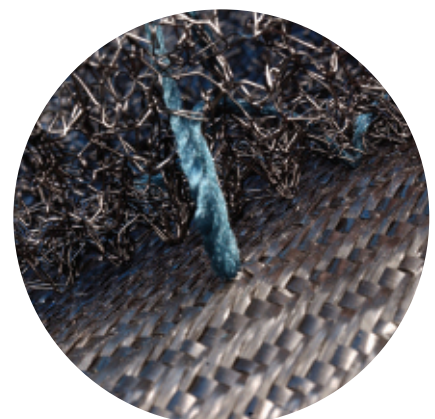
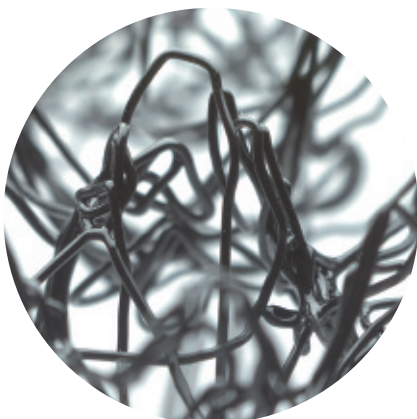
Enkamat A20

- Structure - prefilled with a bitumen-bound mineral filter of stone chippings
- Suitable for surfaces permanently subjected to water impact
- Offers immediate erosion protection from high velocities and small wave attack
- 22 mm thick, weight 20 kg/m²
- Water permeability of 30 l/(s.m²) at 100 mm head

Enkamat W

- Structure - open Enkamat sewn to a reinforcing grid or woven fabric
- Suitable for slopes covered with a geomembrane and for steep and/ or rocky slopes
- Stabilizes soil and vegetation cover, stops weathering of slopes
- Up to 20 mm thick
- Up to 200 kN/m

More technical data on our standard Enkamat products can be downloaded from our website www.colbond-geosynthetics.com/downloads



Enkamat

Green quality

Tested performance

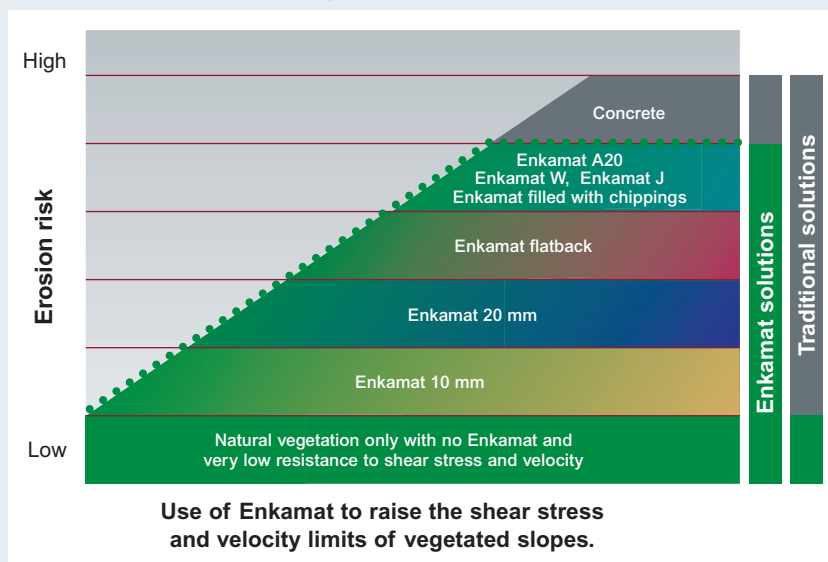


Colbond developed Enkamat more than three decades ago. It has set the essential criteria for optimal performance – criteria which are still the benchmarks used today. These include: **conformity** (the ability to follow and adapt to any ground surface), **interaction** (the ability for the soil, root structure and mat to combine as one system), **survivability** (resistance to damage during and after construction) and **performance** (the ability to minimize soil movement and root damage under hydraulic loading conditions).

Enkamat has been tested by many independent organizations, such as:

- Construction Industry Research Information Association (CIRIA), UK
 - Bundesanstalt für Wasserbau (BAW), Germany
 - Süddeutsches Kunststoff Zentrum (SKZ), Germany
 - Materialforschungs und Prüfungsanstalt Weimar (MFPA Weimar), Germany
 - tBU, Münster, Germany
 - Rijkswaterstaat, the Netherlands,
- and many more.

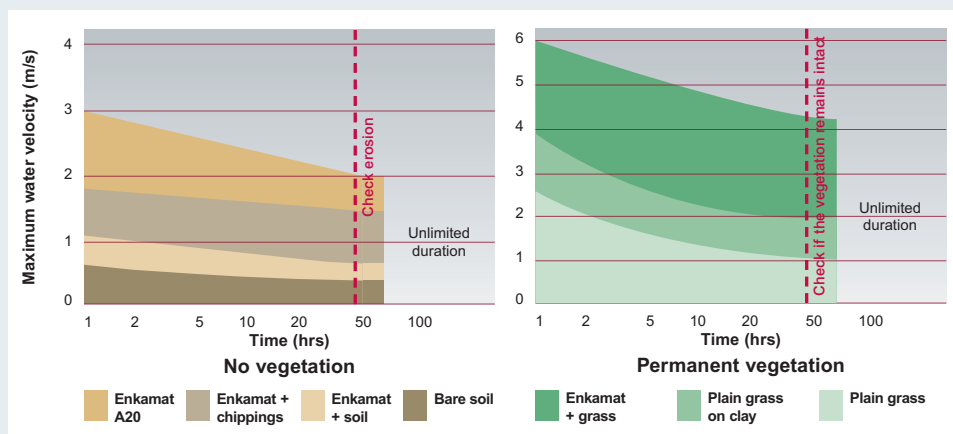
The best solution is a green solution



Instead of using rock or concrete as traditional erosion prevention, the use of Enkamat enables you to create green and permanent solutions, even when erosion risks are high.

Design guide

Detailed information on designing with Enkamat can be found in the Enkamat design guide, which is available for download from our website. The graphics about the use of Enkamat show the design values of Enkamat in relation to time and water velocity in conditions with and without vegetation.



More information

To obtain the Enkamat design guide, the installation guide or detailed product data sheets, please go to our website at www.colbond-geosynthetics.com/downloads

Enkamat

Projects



Batter protection

Enkamat 7018
New South Wales, Australia

In New South Wales a new highway was constructed in an area of low-lying farms. Much of the new highway was formed using earth embankments. One particular section, created with 1 in 1 slopes, was showing localized signs of failure during construction. It was decided to address this failure and provide long-term stable erosion resistance by using Enkamat. Amongst other reasons, Enkamat was selected for its flexibility and low weight. The matting was pinned to the surface so that intimate contact was maintained with the cutting. Adjacent rolls were overlapped and pinned together providing a continuous coverage and consistent reinforcement of the subsequent natural vegetation.



Waterway protection

Enkamat A20
Vathorst, The Netherlands

An industrial estate was constructed near a new residential area in Vathorst. To minimize its impact on the neighboring area, the plan for the industrial estate included several waterscapes to help to make it a more spacious and attractive area.

The slopes of the waterways were very susceptible to erosion due to exposure to wind and water because the only work done at that point was to prepare the site for construction.

To prevent erosion and the ensuing slope damage, Enkamat A20 was installed. Immediate protection followed and after three months a full vegetation cover had developed.

Protection is permanent. Enkamat A is pre-filled with 2-6 mm chippings and sealed with bitumen. With voids of more than 40%, vegetation can develop in it as strongly as with regular Enkamat.



Landfill capping

Enkamat 7010W/200.50PET
Enkadrain 5006H/T110PP
Forcalquier, France

In this project in Forcalquier in the South East of France, a landfill of 19,000 m² was covered with a geosynthetic clay liner. Between the berms, the inclination of the landfill slopes is 2V/3H, with slopes up to 4 m high.

The geosynthetic clay liner was to be covered with 30 cm of soil, so to ensure the stability of the soil cover 13,000 m² of 10 mm Enkamat reinforced with a polyester woven (giving a tensile strength of 200 kN/m) were installed between the liner and the soil.

21,000 m² of Enkadrain was also installed on the landfill to meet the need for significant drainage reliably.

Enkamat



Natural water filter
Enkamat 7010W/80.30PP
Speicher, Germany

The municipality of Speicher was looking for an economic way to deal with a surplus of sewage sludge. A natural water filter was chosen, using reed to dewater and consolidate the sludge.

Neither ground nor groundwater may be charged with sewage sludge, so the water filter basin must be fully sealed with a geomembrane. To prevent any soil slippage on the smooth geomembranes covering the basin's banks, about 4,000 m² of Enkamat 7010W/80.30PP were installed.

Enkamat W has three functions – to:

- Provide friction between soil and liner for soil retention
- Transfer forces imposed by the soil cover away from the liner
- Protect the geomembrane



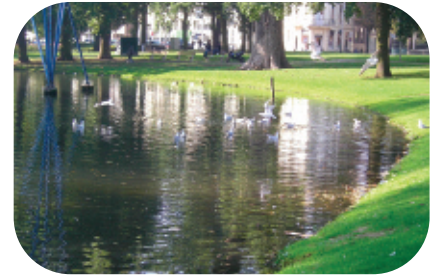
River dike protection against flooding
Enkamat J
Vauvert, France

To protect the clay riverbank against erosion and flooding, Enkamat J was selected.

First, the stony clay riverbank was covered with a 10 cm thick layer of seeded soil. Then Enkamat J was installed. Two weeks later - in October - vegetation had visibly grown.

Enkamat J is a light-weight, flexible and semi-permanent erosion prevention composite. In this variant, Enkamat is firmly stitched to a biodegradable fabric, providing instant temporary protection against erosion and against the impact of rainfall. It also offers thermal protection and holds water to enhance vegetation growth. The three dimensional structure of Enkamat J provides a long-term artificial root system for permanent reinforcement as it helps nature to develop strong vegetation at this vulnerable erosion-sensitive area.

Enkamat J is installed with its three-dimensional open structure facing down and the biodegradable backing upwards.



Every Enkamat product is manufactured to the highest standards, with the assurance of ISO 9001:2008 accreditation (certificate no. 935136). From raw material through manufacture, shipping, on-site storage, installation and service, Enkamat products benefit from Colbond's years of experience and extensive resources.

Enkamat

Around the world



The Netherlands

Colbond bv
Postbus 9600
6800 TC Arnhem
The Netherlands

Phone: +31 26 366 4600
Fax: +31 26 366 5812
Email: geosynthetics@colbond.com
Web: www.colbond-geosynthetics.nl

Germany

Colbond GmbH & Co. KG
Postfach
63784 Obernburg
Germany

Phone: +49 6022 812020
Fax: +49 6022 812800
Email: geosynthetics@colbond.com
Web: www.colbond-geosynthetics.de

France

Colbond Geosynthetics
Tour Pleyel, 153 bld Anatole France
93521 St Denis Cedex
France

Phone: +33 1 49 46 24 30
Fax: +33 1 49 46 24 35
Email: colbond.france@colbond.com
Web: www.colbond-geosynthetics.fr

USA

Colbond Inc
Sand Hill Road / PO Box 1057
Enka, North Carolina 28728
USA

Phone: +1 828 665 5050
Fax: +1 828 665 5009
Email: info@colbond-usa.com
Web: www.colbond-usa.com

www.colbond.com

www.colbond-geosynthetics.com

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