

TENSAR[®] EROSION CONTROL

A GUIDE TO PRODUCTS AND SYSTEMS



➤ Tensar erosion products provide a high-performance and economical solution for the control of erosion.

Tensar Technology – Proven Practical Solutions and the Know-How to Build Them

Based on the characteristic properties of Tensar products, Tensar Technology is widely adopted for erosion control, ground stabilisation and soil reinforcement problems. Tensar Technology delivers real savings in cost and time to your projects. We can help you apply Tensar Technology to improve the bottom line on your project.



Unsurpassed Experience and Reliability

Tensar International Limited (Tensar) is a worldwide leader in the manufacture and provision of erosion control products and systems. Our Erosion Control Systems are sold exclusively through authorised Tensar distributors worldwide.

Whether your site needs short-term protection or permanent vegetation reinforcement, experienced specialists are available to provide design and on-site construction advice for your erosion project from concept to completion.

As with all Tensar specialty construction products and engineering services, we continually invest in erosion control innovation to ensure cost-effective solutions and exceptional results.

NEW NAME – SAME GREAT PERFORMANCE AND SERVICE

Tensar® acquired North American Green™ in 2004 to enhance our range of erosion control products. We are proud to be able to offer these high quality, high-performance erosion control products and systems under the name of Tensar.



Tensar's RollMax™ products can protect watercourses and channels by reinforcing vegetation roots and stems.



Erosion Control Matters

Very often, construction can mean removing vegetation, altering the landscape and/or covering previously vegetated areas with roads, driveways or buildings. These changes often cause soil erosion and sediment deposits, which can lead to a multitude of problems.

ENVIRONMENTAL AND ECONOMIC CONSIDERATIONS

- ▶ Disrupting the ecosystem can hinder the natural resources on which wildlife depend for survival
- ▶ Storm water runoff can increase stream bank erosion and disturb aquatic habitats and lifecycles
- ▶ Construction site soils and chemicals can wash into water supplies and compromise water quality for humans and animals
- ▶ High costs can be incurred as a result of rebuilding degraded slopes and shorelines and dredging sediment-filled waterways

Erosion control, sediment control and vegetation establishment are essential to almost every construction project. A well-planned solution tailored to your site can:

- ▶ Eliminate costly reconstruction of degraded slopes and shorelines
- ▶ Prevent damage to landscapes, water sources and wildlife
- ▶ Keep you in compliance with local regulations

With so much at stake, erosion control is a high priority. Tensar® Erosion Control Systems can help you comply with local regulations and protect our most valuable resources.



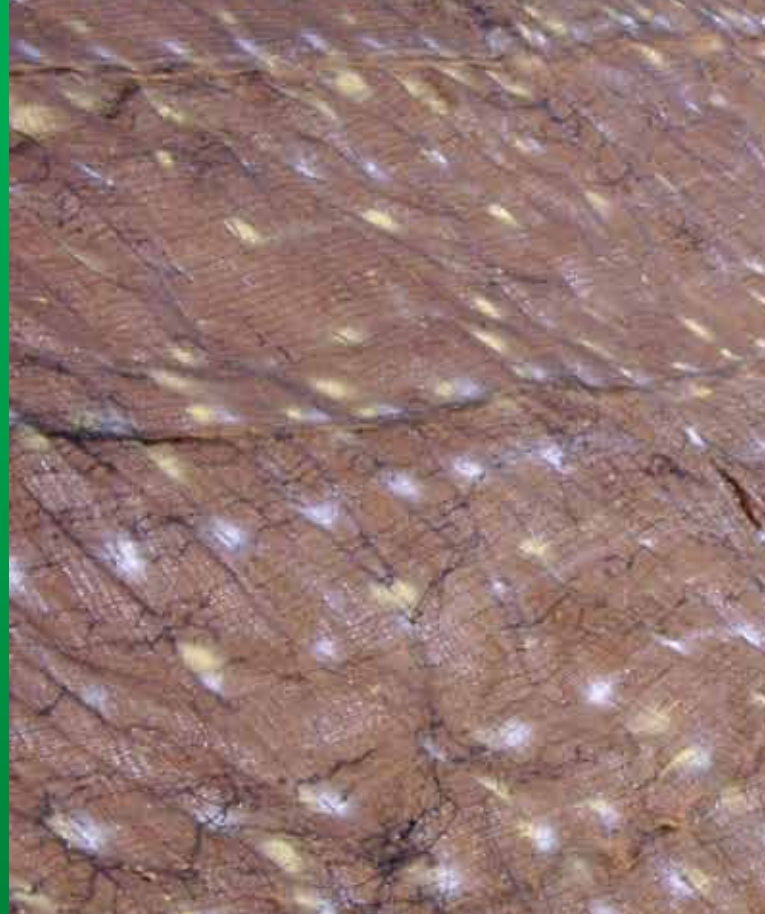
Erosion has undermined this cycle path and now threatens the safety of the adjacent road.

HOLD YOUR GROUND

Tensar has top quality solutions for almost every erosion control need. Our products are rigorously tested and are proven to be effective in a wide range of real-world applications including:

- ▶ Slopes and embankments
- ▶ Landfills
- ▶ Shorelines
- ▶ Ditches and culvert outfalls
- ▶ Levees and earthen dams
- ▶ Channels and spillways
- ▶ Bioengineering

Tensor® VMax® products will provide permanent vegetative reinforcement, allowing the area to look natural and green but with an engineered solution that will withstand bankfull flood events.



A greener and more cost-effective bioengineering solution can provide underlying engineering stability whilst improving the visual landscape.

RollMax™ Rolled Erosion Control

Every site has unique challenges created by soil characteristics, topography, climate and other environmental conditions. Tensor can cover them all, with our family of RollMax™ Rolled Erosion Control Products (RECPs). Whether you need temporary or permanent protection, short-term or long-term durability, biodegradable or photodegradable solutions, our RollMax products deliver a wide variety of advantages, features and benefits:

- ▶ High-performance protection of topsoil from wind and water erosion
- ▶ Support quick, healthy vegetation growth
- ▶ Protect dormant seeds during winter months
- ▶ Stabilise slope erosion to keep roads safe and clean
- ▶ Reinforce vegetation roots and stems
- ▶ Protect water quality in lakes, rivers and streams
- ▶ Conform to landscape features
- ▶ Provide easy handling and transport

PERMANENT TURF REINFORCEMENT MATS

Tensor's permanent Turf Reinforcement Mats (TRMs) are ideal for high-flow channels, stream banks, shorelines and other areas needing permanent vegetation reinforcement and protection from water and wind. More economical and aesthetically pleasing than rock riprap, articulated concrete blocks or poured concrete, our TRMs protect vulnerable areas with minimum maintenance and maximum durability.

- ▶ VMax® permanent composite TRMs combine three-dimensional matting and fibre matrix material for erosion protection, vegetation establishment and reinforcement. These products increase the permissible shear stress of many types of vegetation up to 0.67kN/m² – erosion protection equal to 900 mm rock riprap and concrete. VMax TRMs are available with various performance capabilities and support reinforced vegetative lining development from germination to maturity.



Stabilisation and Margin Landscape Improvement, Barcelona, Spain

Concrete walls were constructed as part of the channelling work that was required on the Riera de Santa Susanna, a stream channel that temporarily or seasonally fills and flows after heavy rain. The bank was made up of compacted back fill and tiered to obtain a profile of 1H:1V. Hydroseeding and the installation of Tensor's VMax® P550® permanent TRM will ensure protection against erosion and deliver a clear landscape improvement.



EROSION CONTROL BLANKETS

Erosion Control Blankets (ECBs) immediately prevent erosion and help vegetation get established. As vegetation root and stem systems stabilise the underlying soil, most ECBs gradually degrade. These products come in a range of weights and materials to accommodate low- to high-flow channels and moderate to severe slopes.

- ▶ EroNet™ Short-Term Photodegradable ECBs are designed for moderate slopes and low-flow channels. Made of 100% agricultural straw stitched to or between lightweight polypropylene netting with degradable thread, EroNet ECBs come in short-term varieties to protect and mulch soil surfaces from 45 days to 12 months.
- ▶ EroNet Extended-Term, Long-Term and permanent ECBs use heavy-duty double-netting and long-lasting coconut or permanent polypropylene fibre for protection and vegetation support for up to 36 months or longer. These products are available for extended and long-term stabilisation of steep slopes, medium- to high-flow channels and shorelines.
- ▶ BioNet® Short-Term Biodegradable ECBs are appropriate for bioengineering projects, environmentally sensitive sites, shaded areas, stream banks and shorelines. They're made of 100% agricultural straw stitched with biodegradable thread to 100% biodegradable jute fibre netting. Available in single- or double-net varieties, they protect for up to 12 months and leave no synthetic residues.
- ▶ BioNet Extended-Term and Long-Term Biodegradable ECBs incorporate coconut fibre stitched with biodegradable thread between biodegradable jute fibre top and bottom nets. Great for steep slopes, medium- to high-flow channels and shorelines, a choice of two products can provide erosion protection and vegetation establishment for 18 to 24 months.



Railway Bank Improvement, Yamal, Russia

The Bovanenkovskoye railway is located north of the Arctic Circle and has been built to provide a vital rail link for gas exploration. Tensar's EroNet™ SC150° temporary ECB was installed to provide erosion protection and enable vegetation to establish in an area that is subjected to severe permafrost.

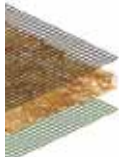
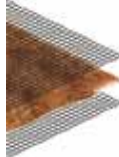

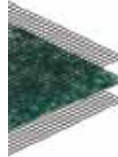
The complete line of RollMax products offers a variety of options for both short-term and permanent erosion control needs.

Reference the RollMax Products Chart below to find the right solution for your next project.



Riverbank protection works in mid Wales using VMax® P550, UK.

RollMax™ Product Selection Chart

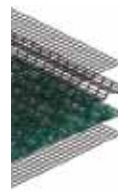
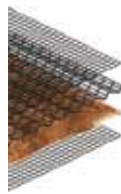
	TEMPORARY			ERONET
	ERONET	BIONET	ERONET	
				
	SC150	C125	C125BN	P300
Longevity	24 mo.	36 mo.	24 mo.	Permanent
Applications	Medium Flow Channels 2:1-1:1 Slopes	High-Flow Channels 1:1 and Greater Slopes	High-Flow Channels 1:1 and Greater Slopes	High-Flow Channels 1:1 Slopes
Design Permissible Shear Stress Pa	Unvegetated 96	Unvegetated 108	Unvegetated 112	Unvegetated 144 Vegetated 383
Design Permissible Velocity m/s	Unvegetated 2.44	Unvegetated 3.05	Unvegetated 3.05	Unvegetated 2.7 Vegetated 4.9
Top Net	Heavyweight UV-stabilised polypropylene 1.47 kg/100 m ² approx wt	Heavyweight UV-stabilised polypropylene 1.47 kg/100 m ² approx wt	Leno woven. 100% biodegradable jute fibre 4.53 kg/100 m ² approx wt	Heavyweight UV-stabilised polypropylene 2.44 kg/100 m ² approx wt
Center Net	N/A	N/A	N/A	N/A
Fibre Matrix	Straw/coconut matrix 70% Straw 0.19 kg/m ² 30% Coconut 0.08 kg/m ²	Coconut fibre 0.27 kg/m ²	Coconut fibre 0.27 kg/m ²	UV-stabilised polypropylene fibre 0.38 kg/m ²
Bottom Net	Lightweight photodegradable polypropylene 0.73 kg/100 m ² approx wt	Heavyweight UV-stabilised polypropylene 1.47 kg/100 m ² approx wt	Woven. 100% biodegradable jute fibre 3.76 kg/100 m ² approx wt	Heavyweight UV-stabilised polypropylene 1.47 kg/100 m ² approx wt
Thread	Degradable	UV-stabilised polypropylene	Biodegradable	UV-stabilised polypropylene



Vegetation establishment through VMax® P550® six months after installation, UK.

PERMANENT

VMAX



SC250	C350	P550
Permanent	Permanent	Permanent
High-Flow Channels 1:1 and Greater Slopes	High-Flow Channels 1:1 and Greater Slopes	Extreme High-Flow Channels 1:1 and Greater Slopes
Unvegetated 144	Unvegetated 153	Unvegetated 191
Vegetated 480	Vegetated 576	Vegetated 672
Unvegetated 2.9	Unvegetated 3.2	Unvegetated 3.8
Vegetated 4.6	Vegetated 6.0	Vegetated 7.6
Heavyweight polypropylene 2.44 kg/100 m ² approx wt	Extra heavyweight polypropylene 3.91 kg/100 m ² approx wt	Ultra heavyweight polypropylene 11.7 kg/100 m ² approx wt
Ultra heavyweight polypropylene - corrugated 11.7 kg/100 m ²	Ultra heavyweight polypropylene - corrugated 11.7 kg/100 m ²	Ultra heavyweight polypropylene - corrugated 11.7 kg/100 m ²
Straw/coconut matrix 70% Straw 0.19 kg/m ² 30% Coconut 0.08 kg/m ²	Coconut fibre 0.27 kg/m ²	UV-stabilised polypropylene fibre 0.27 kg/m ²
Heavyweight UV- stabilised polypropylene 2.44 kg/100 m ² approx wt	Extra heavyweight polypropylene 3.91 kg/100 m ² approx wt	Ultra heavyweight polypropylene 11.7 kg/100 m ² approx wt
UV-stabilised polypropylene	UV-stabilised polypropylene fibre	UV-stabilised polypropylene

INSTALLATION MADE EASY

- Tensor's exclusive Earth Anchors increase the veneer's mechanical strength by reaching deep into the soil strata for enhanced anchoring in the worst conditions. Earth Anchors can be used to permanently secure our VMax® Turf Reinforcement Mats or our RevetMax™ flexible revetment systems.
- Tensor fastener options include wire staples, PinPounder installation tool, rebar stakes, ShoreMax® high-impact plastic stakes, environmentally friendly BioStakes™ and wooden EcoStakes™.

Proper staple patterns must be used to achieve optimal results in RECP installation (staple patterns to be obtained from Tensor).



Slope erosion protection on the M25 Motorway, UK.

HydraMax™ Hydraulic Erosion Control

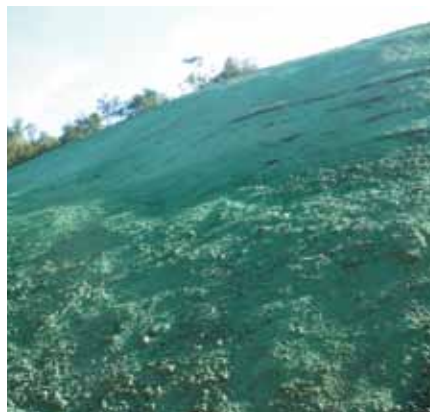
Hydraulic Erosion Control Products (HECPs) prevent erosion and aid vegetation establishment on slopes. Tensar's HydraMax™ Systems apply seed, soil amendments and hydraulic mulch in one step, offering a low-cost, low-labour solution. All HydraMax Systems' products are made with our patented proprietary blend of straw, reclaimed cotton plant material and tackifiers to ease application, enhance adhesion, retain moisture and stabilise soil. HydraMax HECPs also:

- ▶ Consist of a porous matrix with strong soil adhesion that forms an excellent vegetation establishment and erosion control medium
- ▶ Reduce expensive site preparation
- ▶ Can be installed up to three times faster than Erosion Control Blankets (ECBs) with 1/3 of the man power
- ▶ Come in easy to break bales for fast mixing
- ▶ Have low water to mulch ratios that increase productivity by requiring fewer tank loads per site
- ▶ Grow grass quickly with increased germination and biomass production over bare soil
- ▶ Contain only biodegradable, non-synthetic fibres
- ▶ Come in a pleasing natural green colour

HIGH-PERFORMANCE HECPs

Tensar's high-performance HECPs are effective on construction site slopes with gradients of 1:1 (H:V) or steeper. In many steep slope applications, they can cost-effectively replace temporary ECBs.

- ▶ HydraCX™ Extreme Slope Matrix is recommended for long-length, steep to severe slope gradients of 3:1 to 0.5:1. It is our highest performing hydraulic mulch and has demonstrated an unprecedented 100% soil protection in American Association of State Highway and Transportation Officials (AASHTO) – National Transportation Product Evaluation Program (NTPEP) testing.
- ▶ HydraCM™ Steep Slope Matrix scored 99.7% effective in reducing soil erosion when tested by AASHTO's NTPEP. Designed for medium length, moderate to steep slope gradients of 4:1 to 1:1.



Slope Restoration and Landscape Improvement, High-Speed Rail Line, Spain

Installed up to three times faster than ECBs with 1/3 of the man power, Tensar's HydraCX extreme slope matrix ensured vegetation cover of the entire slope just 45 days after application. The benefits of HydraCX include fast germination, rapid growth of vegetation, strong adhesion to the ground and resistance to rain.



Spraying HydraCX™ through rock netting on a soil nailed embankment for a rail project, UK.

STANDARD PERFORMANCE HECPS

HydraMax™ standard HECPs for mild to moderate slopes are excellent alternatives to wood and/or paper mulch and blown straw, which may take two steps to apply.

- ▶ HydraGT™ Moderate Slope Mulch Blend with Tack is ideal for short slopes with up to 2:1 gradients
- ▶ HydraGS™ Mild Slope Mulch Blend works best on short slopes with up to 3:1 gradients

READY, AIM, INSTALL

Tensar provides a detailed instruction guide to applying HydraMax Systems. It includes substrate and seedbed preparation, installation, mixing, product application, equipment cleaning and protection recommendations. A comprehensive loading chart ensures the correct amount of material for application on your site.

Slope Conditions Application Rate

Slope Conditions		Application Rate
HydraCX™ Extreme Slope Matrix (metric only)		
=1H:1V		5,100 kg/ha
=2H:1V and <1H:1V		4,500 kg/ha
=3H:1V and <2H:1V		3,900 kg/ha
<3H:1V		3,400 kg/ha
HydraCM™ Steep Slope Matrix (metric only)		
=2H:1V		4,500 kg/ha
=3H:1V and <2H:1V		3,900 kg/ha
=4H:1V and <3H:1V		3,400 kg/ha
<4H:1V		2,800 kg/ha
HydraGT™ Moderate Slope Mulch Blend with Tack (metric only)		
>3:1 and <2.5:1		2,800 kg/ha
>4:1=3:1		2,250 kg/ha
=4:1		1,700 kg/ha
HydraGS™ Mild Slope Mulch Blend (metric only)		
>4:1=3:1		2,250 kg/ha
=4:1		1,700 kg/ha



The application of our HydraMax hydraulic mulches will work with a wide range of mechanically agitated hydroseeding equipment, and the decreased water to mulch mixing ratio will get your job done faster.



Tensar's HydraMax System enables grass to grow quickly with increased germination and biomass production over bare soil.



RevetMax™ Flexible Revetment

Flexible revetment mats provide cost-effective erosion protection from turbulent water flow and moderate wave attack. Tensar's patent-pending RevetMax™ Systems can be ideal for applications where riprap, articulated concrete blocks or other rigid materials are normally used. When combined with a Tensar® Turf Reinforcement Mat (TRM) or other underlayment, this unique armouring solution dramatically elevates permissible shear stress and velocity protection. Satisfied customers have also found that RevetMax Systems:

- ▶ Are highly flexible and install easily over difficult topography
- ▶ Are non-buoyant to prevent floating or uplifting in submerged conditions
- ▶ Feature grip lugs that bite into underlying surfaces to prevent shifting
- ▶ Facilitate vegetation growth through voids in the mat
- ▶ Require no heavy equipment for installation
- ▶ Are easy to maintain
- ▶ Are safer for pedestrian and vehicle traffic than hard armour materials



ShoreMax transition mats facilitate vegetation growth through voids in the mat and are a smart option to replace rock in high scour areas such as pipe outlets.

SHOREMAX® TRANSITION MATS

Flexible, UV-stabilised ShoreMax® transition mats protect highly erosive areas such as shoreline transition zones, channel bottoms and pipe outlets and outfalls. The ShoreMax Mat can also be utilised for slope drains like those associated with car parks, roadways, mines and landfills. As a flexible revetment system, ShoreMax Mats can provide soft armouring on shorelines and spillway applications where wave attack can reach critical stages.

SIMPLE TO INSTALL

ShoreMax transition mats can be installed over prepared and seeded soil and fastened in place with ShoreMax high-impact plastic stakes, wire staples, rebar staples or percussion Earth Anchors, depending on soil and expected flow conditions. ShoreMax mats self-conform to the underlying terrain, so fasteners are to hold the panels in place, not force conformance to the underlayment material.



Recreational Lake, Florida, USA

The wind and waves from boats and other marine vehicles took a toll on the shorelines of a recreational lake. To combat further erosion, ShoreMax transition mats were installed over high-tensile strength TRMs. Together, they protected the shore and offered low maintenance, easy entry for pedestrians and safe small boat launches.



SediMax™ Sediment Retention

Unprotected topsoil, particularly on slopes and construction sites, is vulnerable to erosion and runoff problems. Significant damage can occur until these areas are ready for permanent erosion control. Tensar's SediMax™ Systems can prevent much of the damage and save millions spent on restoring slopes, rebuilding drainage channels and dredging ponds and streams.

SEDIMAX-FR™ FILTRATION ROLLS

SediMax-FR™ (Filtration Rolls) create a temporary, three-dimensional sediment filtration structure perfect for forest fire rehabilitation, bioengineering projects, construction sites, ski slopes, wetland mitigation and other applications where storm water runoff is a concern. This 100% biodegradable product is made with a 70% straw and 30% coconut fibre matrix reinforced with biodegradable netting rolled edge to edge. Other important benefits include:

- ▶ Up to 98% effective at reducing sediment migration
- ▶ 100% biodegradable
- ▶ Assists with environmental regulation compliance
- ▶ Can be incorporated with live planting, live staking and seeding
- ▶ Encasement net flexibility minimises accidental wildlife entrapment



Steep Slope Protection and Sediment Control, Washington, USA

After a devastating forest fire in Wenatchee National Forest, Tensar recommended SediMax-FR as a biodegradable alternative for steep slope protection and sediment control. SediMax-FR trapped silty, ashy soil while allowing water to pass through, greatly reducing soil migration into waterways. Installed SediMax-FR rolls can last one to two years and provide sediment control until vegetation is established.

SEDIMAX-SW™ STRAW WATTLES

SediMax-SW™ Straw Wattles are economical alternatives to silt fence and straw bales for sediment control and storm water runoff. They can be staked along the contour of newly constructed or disturbed slopes, wrapped around storm drain inlets and used as check dams on slopes and in swales and grass waterways. Straw wattles are recycled, compressed, agricultural straw cylinders wrapped in photodegradable synthetic netting.

INSTALLATION: ON A ROLL

SediMax Systems' products are straightforward to install. SediMax-FR is positioned, rolled out, re-rolled from edge to edge, and secured with wooden stakes. SediMax-SW is laid out, staked and can be used individually or tied together to achieve any length.

TRITON® COASTAL AND WATERWAY SYSTEMS

For heavier-duty, non-vegetative scour protection applications our Triton® composite marine systems are perfect used in conjunction with or alternatively to RevetMax™ Systems. Durable, non-corrosive Triton mattresses, marine cells, gabions and gabion mats are less expensive than riprap, more conforming to land contours and more scour resistant than rigid systems. These tough but innovative solutions are proven effective for:

- ▶ Foundations or cores for breakwaters and groins
- ▶ High-strength fills built in submerged conditions
- ▶ Channel linings and bridge scour protection
- ▶ Causeways, levees, dikes and bridge approaches



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Contact Tensar® International or your local distributor to receive further literature covering Tensar products and applications.

Also available on request are product specifications, installation guides and specification notes.

The complete range of Tensar literature consists of:

- ▶ **Tensar Geosynthetics in Civil Engineering**
A guide to products, systems and services
- ▶ **Ground Stabilisation**
Stabilising unbound layers in roads and trafficked areas
- ▶ **TriAx®: A Revolution in Geogrid Technology**
The properties and performance advantages of Tensar® TriAx® geogrids
- ▶ **Asphalt Pavements**
Reinforcing asphalt layers in roads and trafficked areas
- ▶ **TensarTech® Earth Retaining Systems**
Bridge abutments, retaining walls and steep slopes
- ▶ **Railways**
Mechanical stabilisation of track ballast and sub-ballast
- ▶ **Foundations Over Piles**
Constructing over weak ground without settlement
- ▶ **Basal Reinforcement**
Using Basetex high-strength geotextiles
- ▶ **TensarTech® Stratum™**
Cellular Foundation Mattress System
- ▶ **Tensar Erosion Control**
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