



NATURE IMPROVED

David Holland highlights the benefits of combating high flow erosion with 3-D turf mats

Vegetation has been used for centuries to control erosion on rivers, but during high flow events, nature can benefit from bioengineering. Typically grasses fail during flow events when velocity hits a flow of three to

four m/sec for over five hours. In such events turf reinforcement mats (TRM) can improve the performance of vegetation greatly.

Salix has installed TRMs at hundreds of sites across the country, successfully mitigating against erosion during

extreme flow events where grasses alone would fail. But small differences in the physical specifications of a product can present a vast difference in performance.

Independent research and thousands of applications across the world have

shown Tensar's VMax³ P550 and VMax³ C350 products are able to withstand extremely high flow velocities (7.6m/s – P550 and 6m/s C350) when vegetated. Even prior to the establishment of vegetation, the 'composite' fibre layer provides exceptional erosion control performance (3.8m/sec – P550 and 3.2m/sec – C350).

Tensar V-Max C350 and P550 have been tested independently at four research institutions and results are published openly from one to 50-hour flow durations. Failure criteria is based on vegetation damage and soil loss, as these are the key factors that lead to surface erosion and eventual bank failures.

FLAWED TESTING

While many other manufacturers of TRMs publish performance data, few state the exact testing criteria and parameters. Often, a product will undergo one flume test for an hour and then these results are used as general average performance values over all possible flow events. Critical aspects of performance can be hidden or misrepresented; for example, the duration of a flow event and the

resultant reduction in performance as time increases.

FLAT EROSION CONTROL MATS

Flat and open TRM's have been shown to have high performance for only one hour. Longer, ten-hour flume tests, show that this performance is reduced greatly, by anything up to 70 per cent. After this time the vegetation starts to be stripped out and soil erosion and resultant bank failure occurs rapidly. As such, duration is a critical factor in TRM performance. Tensar's C350 and P550 use test data from these longer duration events, as this is a more accurate reflection of a flood or dam overtopping event.

COMPOSITE TURF REINFORCEMENT MATS

Composite Turf Reinforcement Mats (C-TRM's) have high performance levels that can sustain extreme high flow events for very long durations, as they provide a 3-D structure that slows flow velocities at the soil interface and physically supports the base of the grass stems. Research tells us that the optimum depth for a TRM is 15-22 millimetres. A composite fibre layer helps slow flow

velocities and critically holds seeds in place, stabilising the soil surface as the vegetation develops.

A fibre layer that is optimum to protect the underlying soil and allow good vegetation development provides a cover factor of approximately 85 per cent. Open mats, without a composite fibre layer, only provide a ten to 15 per cent ground cover and therefore have very poor un-vegetated performance levels. As flow velocities increase, so does the oscillation speed and force of a grass stem. Typically flows over five hours in duration cause grass stems to become fatigued by this oscillation, resulting in the grass stem snapping.

A 3-D STRUCTURE IS CENTRAL TO HIGHER PERFORMANCE

Spillways and flood embankments are often designed to withstand long duration flows (ten hours or more), and changes in reinforced vegetation performance can vary greatly over time depending upon the base-reinforcing product.

The C350 is 16 millimetres thick with a corrugated central grid, which greatly reduces velocity and shear stress within the structure, as well as erosive force

CASE STUDY ONE

Protecting homes in the Conwy Valley



Salix supplied 9,000 square metres of VMax³ shear Stress Turf as part of the Conwy Flood Alleviation Scheme. The grass remained undamaged after a subsequent major flood event with an estimated flow velocity up to seven m/s flow.

FOLLOWING SIGNIFICANT flood events in the Conway Valley in North Wales in 2004 and 2005, where the spillway over topped six m/s for over ten hours, affecting many properties in Llanrwst and Trefriw, Team Van Oord developed the £7million Conwy Flood Alleviation project.

The scheme allows water coming down from mountains in eastern Snowdonia to flow over man-made flood banks onto the natural flood plain of the valley floor, where it is then stored and drains away over a number of days. To achieve this, the flood bank immediately upstream was lowered and a new flood bank built.

Salix was contracted to supply and install 9,000 square metres of VMax³ Shear Stress Turf for the project, grown using P550 with a specified grass mixture to provide instant vegetative erosion protection on the lowered flood defences. P550 within the turf offers permanent reinforcement, increasing the power of vegetation to withstand high velocity flow regimes of up to 7.6m/sec.

The turf on the spillway was put the test when the area was hit by heavy rain just two months later in November 2009 and experienced the worst flooding in 25

years of recording, with floods exceeding the 1:30 year events of 2004/2005.

All parties concerned were impressed with the performance of the product, with Team Van Oord project manager, Matt Phillips, stating: 'The pre-grown P550 performed very well during a significant flood event. There was no flood damage to repair on the banks protected by the P550.'



V-Max P550 after a five-hour over topping event with flow velocities modeled at seven m/s flow. There was no recorded damage to the vegetation layer and no soil loss.

around the soil surface and base of the mat where the stem/root interface is located.

Flat mats provide no 3-D structure and the root/stem interface is exposed to the full flow velocity and maximum bed shear stress. Performance drops dramatically with time as vegetation is stripped out of the matting - almost down to plain grass performance after a five-hour flow duration. Some flat mats have been shown to suffer a 90 per cent loss of vegetation after a one-hour flow

event, which is catastrophic as it exposes the underlying soils to significant erosion and rapid embankment slope failure.

The manufacturers of V-Max P550 and C350 publish both short and long duration flow performance and use vegetation loss and soil loss as clear failure thresholds. Critically, these V-Max products have been validated in hundreds of applications in the UK and thousands around the world, including actual overtopping events at UK spillways, storm

surges and 1:100 year flood events.

Observing and recording such events can be a rare occurrence and gives us the opportunity to validate their published performance values from US flume tests in real life applications. ●

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For more information visit www.salixrw.com

CASE STUDY TWO

Fighting erosion on the River Ebbw



River Ebbw during installation of V-Max P550 and Rock Roll/Fascine Toe

ON THE RIVER EBBW at Risca in South Wales, Salix worked with Merrimans Ltd to stabilise over 1.2 kilometres of steep 1-in-1.5 riverbank, composed of highly erodible colliery shale.

Initial proposals looked at the extensive use of over 10,000 tonnes of large blockstone to stabilise the bank, but we wanted to explore the possibility of using greener and more cost-effective bioengineering methods.

To provide underlying stability, as well as an ecological resource, the toe of the bank was protected using a combination of rock rolls and living willow fascines. The upper bank was

protected using two high performance erosion control mats, VMax³ P550 and VMax³ C350.

The project has withstood well against the test of time and delivered excellent ecological benefits. The riverbanks now look completely natural and although there's now no sign of the rock rolls or TRM, these materials are working hard, reinforcing and stabilising the vegetation layers above.

Some blockstone was installed on one reach and it is fascinating to see that ten years on it is the three-tonne blockstone that is failing and not the reinforced vegetation.



Top: Establishment after one year. Note the blockstone actually failed here
Above: The TRM reinforced vegetation after ten years.



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