TRACKTEX

Rail Anti-Mud Pumping Geocomposite

TRACKTEX™

A unique patented, engineering solution delivered through a calculated product development programme, in partnership with rail operators and track bed engineering specialists.

Tracktex™ has been created to address the extensive and expensive track and ballast deterioration problem caused by 'Erosion Pumping Failure' or mud pumping which results in mud holes.

Susceptible mud-pumping formation.

THE 'PUMPING PROBLEM'

'Erosion Pumping Failure' is a long-term and global problematic phenomenon that affects the longevity of track geometry through contamination of the ballast. This is a mechanism where fine grained particles in the formation layer beneath the ballast are mobilised upward into the ballast layer above. This is further augmented by the presence of either rainfall or ground water, which allows the washing of the particles through the interconnected void spaces between the ballast. This process of fines movement also softens and degrades the basal layer through erosional processes, so that depression of the ballast into the subgrade also occurs.

These factors lead to rail deflection with uneven settlement of the rail-line and also promotes lateral movement of the same nature. The consequence of erosion pumping is the loss of rail 'line and level', specifically its lateral and vertical position and regularity.

This is likely to directly cause the reduction of the line's safe traffic speed for safety reasons, resulting in the removal of the line from service so that the line and level can be restored to prevent derailment.

This process is costly both as a maintenance function and on service provision impacting the time tables of the service providers (the privatised train companies) as it increases the time taken to travel between locations and can reduce the amount of traffic the track can support.

The movement of these fines and muddying of the separate layers in the rail bed leads to the uneven settlement of the track initiating further movement of the track away from it's original 'perfect position'. This whole phenomenon applies across all countries around the world with similar ground conditions and is well documented where the term 'Erosion Pumping Failure' has been applied.

Several studies have taken place to address the 'Pumping Failure' issue including previous research from the then nationalised UK railways that examined the use of varying membrane liners to prevent this problem. The conclusion was then, and since enforced, that the use of any form of impermeable membrane was neither a practical nor economic solution. Whilst ballast remained uncontaminated the subsidiary impact of such barriers was saturation of the overlying sub base construction and build up of a hydrostatic head beneath by interrupting natural hydraulic flow patterns.

Other issues to further aggravate and amplify the movement of 'fines' from the subgrade and base layers into the ballast layer are:

- The ingress of water and train effluent (spoil and diesel / oil / grease)
- Water ingress from below, due to a rising water table or water table already above that of the subgrade
- Water ingress from either side of the track from the embankments that would form part of a railway cutting

In addition to the 'wet contaminants', stone damage also occurs due to the physical attrition and abrasion of the aggregate thereby generating ballast flour.

THE DEVELOPMENT PROCESS

More recently significant progress has been made in both ground investigation techniques and the development of more complex and high-performance geocomposites. Work to identify the solution to this pumping phenomenon has been readdressed successfully. A program supported by mainstream rail clients produced a design for a performance based test rig that was tailor engineered and installed at laboratories located in Leeds, UK. The equipment was developed to accommodate any realistic track bed construction in order to gain further data on both track and geosynthetic performance, in situ, so that improvements could be made to create bespoke materials that can extend track performance and maintenance intervals.

Real time rail loading is simultaneously and cyclically applied to the replicated track construction through three hydraulic powered ram actuators. The rams can be programmed to load the installed track dynamically to simulate anything from an empty passenger train to a fully loaded freight train, or an ultra-high-speed train of the future. Trafficking frequencies can be modelled to replicate customers' specific requirements.

Once set up the test equipment can then be utilised effectively to evaluate the actual performances of any nominated track construction.

Large scale test rig.

- 4.5m x 1.8m x 0.4m subgrade
- Seven half-width sleepers
- Three PC-driven ram actuators
- Up to 120kN axle loads
- Up to 12Hz application of rams 1 million cycles (6 day test duration) = 5 real-time years

SECTOR SUITABILITY

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In addition to track evaluation, the rig incorporates the opportunity to utilise both existing and innovative geosynthetic materials within the construction. The development team closely monitor performance to create successful geosynthetic solutions to long-term and expensive ground engineering problems.

It is important to note that the test rig equipment also has the ability to support a water table and passively controls any further flows using spray head nozzles. The rail bed created for 'Erosion Pumping Failure' research simulates a live track scenario using 300 mm of fine London clay covered with 800 mm of rail ballast using a standard geotextile separator in each case, between the stone ballast and clay layers. All of which was tamped down to create slurry prior to each test programme.

Failed pumping test using standard geotextile separator.


Successful pumping test using Tracktex.

A fully examined performance comparison of a significant number of alternative geosynthetic materials were carried out during the process, including:

- Various nonwoven geotextiles
- Membrane liners sandwiched between nonwoven geotextiles
- Nonwoven geotextiles with membrane composite and the inclusion of a geonet

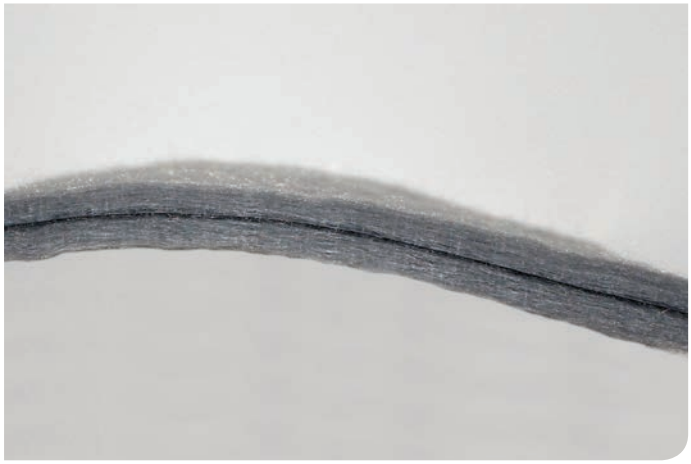
Each individual test in this program was carried out using a million cycles with mixtures of high-speed, local train and freight train loading profiles, which were established from research in the USA. In a full-sized testing rig the conditions for subgrade erosion were established – 1M cycles. The same conditions were used to evaluate potential solutions. The most successful product, Tracktex™ sustained 10M cycles (the equivalent of approximately 140 MGT (Million Gross Tonnes) without damage or ballast contamination. Water was added to the equivalent of 5 years average rainfall during the test program and the depression and track integrity were monitored over the full test period.

Tracktex has been proven to increase trackbed maintenance intervals on sections affected by pumping failure by more than 25 times, providing significant savings over any available alternative.

TRACKTEX™

THE ANTI-EROSION PUMPING SOLUTION

Tracktex™ was specifically manufactured to address 'Erosion Pumping Failure' and is a composite material consisting of a unique micro-porous filter, sandwiched between two high strength protection geotextiles. The product was developed following continual testing using the aforementioned equipment and was tested intensively to over 10 million cycles (140 million gross tonnes), successfully retaining functionality and performance.



Tracktex™ is approved for use by Australian and New Zealand Rail Authorities and has since developed a substantial well proven reference list having been extensively installed on sites across Australia and New Zealand, effectively solving the problem of 'mud-pumping'

Tracktex™ allows subgrade pore-water pressure to dissipate whilst still preventing fine soil particles migrating upwards to contaminate the ballast. In addition, the composite conforms to the formation profile and thus minimises the potential for pockets where slurry could accumulate.

TRACKTEX FEATURES & BENEFITS:

- Pore water is relieved upwards through the composite under the cyclic loading.
- Rainfall cannot penetrate the micro-porous filter and is drained laterally to the sides of the track.
- Any residual slurry becomes dried as any pore water is dissipated.
- Conforms to surface depressions in the formation layer preventing the creation of slurry pockets.
- Compact 25 m rolls for easy management.
- Fast installation rates reducing the construction costs and increasing the coverage for a given possession time.
- No requirement for specialist plant.
- Geogrids can be placed immediately on top of the composite.
- UKAS accredited laboratory testing.
- Predicted durability of greater than 100 years in soils with pH in the range 3 - 11.

ENVIRONMENTAL BENEFITS

The use of Tracktex™ can reduce or totally remove the depth of excavation and the sub-ballast materials that would be required to construct a traditional 'Erosion Pumping Barrier'. Tracktex™ promotes significant reduction in the number of vehicles delivering materials to site and the volume of spoil being taken away for disposal thus improving carbon footprint performance.

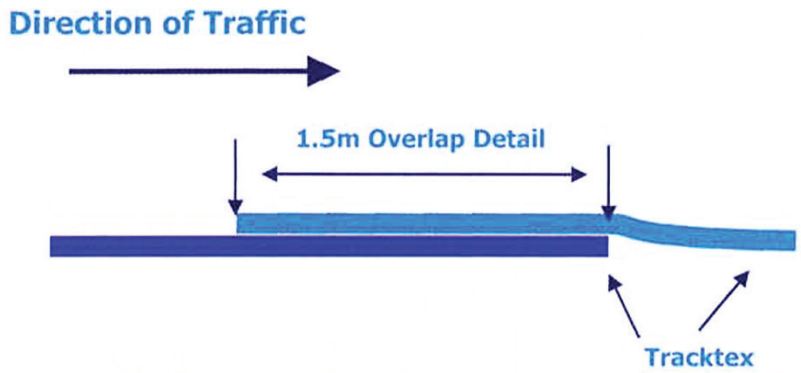
TRACKTEX™

Installation Details

The standard specified and installed width of Tracktex™ is 3.9 m laid directly onto a prepared formation avoiding any lapping up the sides of the excavation. This should be achieved wherever possible.

Where the above is not achievable typically because of width restrictions, a standard 3.9 m roll can be lapped up one side of an excavation. This should only be conducted where work has been carried out to provide an adequate fall or suitable gradient that creates a clear drainage path to a suitable track drainage system installed on the opposite edge for runoff e.g. slotted or perforated pipe or a granular based drainage channel. Tracktex™ is the installed up to the edge of this drain. This procedure would also apply in tunnels and other structures where there is a restricted width on track.

Any further reduction in the specified width of Tracktex™ should be approved by the relevant Railway Design Engineer.



The roll end to end overlapping detail must be installed at 1.5 m and in the direction, as illustrated, in the diagrom above.

Tracktex™ shall be protected with a minimum of 150 mm of ballast before any construction traffic is allowed to run over it.

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