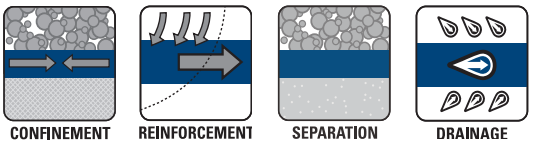
TENCATE Mirafi®



Case Study

application	Rail sub-ballast reinforcement	job owner	CN
location	Rosetown, SK	engineer	CN and TenCate Geosynthetics Americas
product	Mirafi® RS580*i*	contractor	H & S Backhoe Service Ltd
		date of installation	August 2013

TenCate develops and produces materials that function to increase performance, reduce costs and deliver measurable results by working with our customers to provide advanced solutions.

THE CHALLENGE

The CN Rosetown subdivision runs between Roskin Junction and Kindersley, Saskatchewan. The CN track located at mile 63.65 on the Rosetown Sub in Saskatchewan had to be lifted and realigned over 20 times between 2009 & 2013 because of track settlement caused by extremely soft subgrade conditions and inadequate sub-surface drainage. This portion of the track is situated on a low embankment, approximately 1.6m above the natural ground elevation.

Initial attempts at remedial work included the installation of drains at three locations; however there was no improvement and the track continued to settle. Over this five year period, there was evidence that the track foundation had failed and pumping of fines in the ballast was also evident. There was no separation between the ballast and the subgrade. Additionally, trains in this area had to operate on a permanent slow order to ensure no derailment occurred.

The clay/silt foundation soil has a bearing capacity of 60 kPa (~9 psi) and an undrained shear strength of 15 kPa (~2 psi), corresponding to a CBR of less than 1%.

The objective of the project was to rebuild this section of track while incorporating a geosynthetic reinforcement in order to provide an overall maximum ballast and sub-ballast thickness of approximately 600mm.

THE DESIGN

In 1920, Arthur Newell Talbot (Professor of Municipal & Sanitary Engineering – University of Illinois), developed a methodology allowing designers to design rail track bed thicknesses based on the pressure developed at the base of a railway tie and the allowable stress at the sub-ballast/subgrade interface. By using this approach, CN design engineers determined that 1,200mm (47") of track bed was going to be required, which was far in excess of what was practical to build on this site. This would have required extensive excavation of the foundation soils which was not acceptable. This section would have consisted of 450mm ballast and 750mm sub-ballast. CN engineering personnel approached TenCate for assistance in developing a geosynthetic reinforced cross-section that would allow for a reduced sub-ballast thickness.

TenCate design engineers were able to incorporate Mirafi® RS580*i*, a high-modulus woven polypropylene reinforcement geotextile, into the Talbot Equation. By doing so, we were able to show a 550mm reduction in sub-ballast, down to 200mm. The overall thickness of the ballast and sub-ballast as designed was 650mm with two layers of Mirafi® RS580*i*: the first located at the subgrade/pit-run interface, and the second layer in between the compacted pit run material and the sub-ballast. CN decided to adopt the proposed TenCate solution and proceeded to reconstruct this section of the Rosetown Sub.

Bulldozer spreading pit-run material on top of Mirafi® RS580*i*.

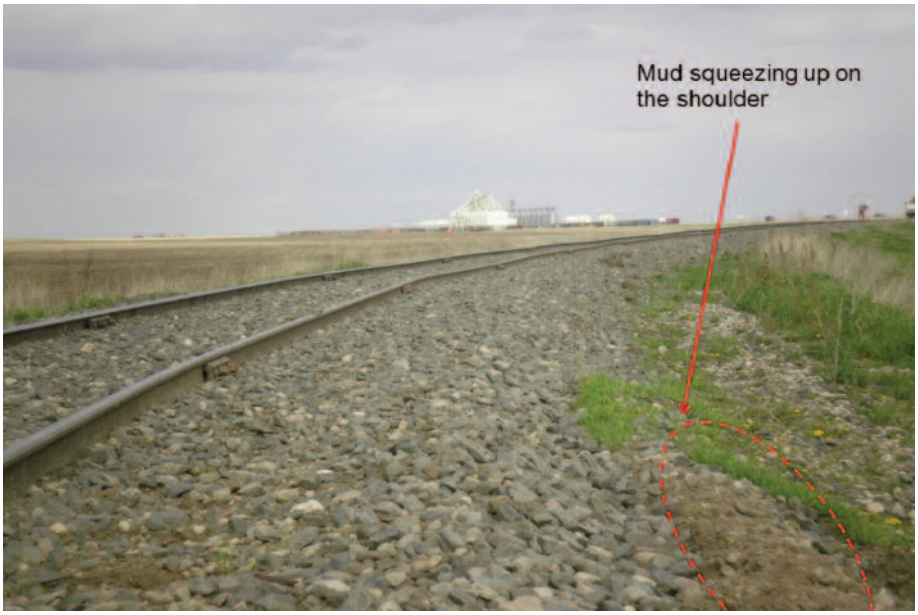
*Patented

THE CONSTRUCTION

In late July, 2013, the contractor removed the rail track and ties over the affected areas. Afterwards, the contractor installed the first layer of Mirafi® RS580*i* (4.6m wide) directly on top of the soft clay subgrade, followed by between 375 mm and 675 mm of pit run material. A second layer of Mirafi® RS580*i* was subsequently installed on top of the pit run material and 200 mm of sub-ballast followed on top of the reinforcement geosynthetic. 450 mm of ballast material was placed on top of the sub-ballast, at which point the contractor re-installed the rail ties and track.

THE PERFORMANCE

By incorporating Mirafi® RS580*i* geosynthetics as part of the Rosetown rehabilitation , CN was able to successfully repair a track section that had been rehabilitated 20 times in the previous 5 years. This operation was done without having to change the grade of the track or over-excavate the entire work area, and also saved the cost of 550mm of sub-ballast stone. The slow order has since been lifted along this section and CN's resources can now be focused along other areas of their vast network.



Mud squeezing up on the shoulder.

Evidence of track settlement.

Installation of pit-run material on Mirafi® RS580*i*.

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