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Improving of performance characteristics during mechanical stabilization of quarry haul roads with stiff polymeric Tensar Triax hexagonal geogrid

G.V. Solovyev^a, K.I. Vatchnadze^b

^aEmperor Alexander I St. Petersburg State Transport University, Moskovskiy pr., 9, St. Petersburg, 190031, Russia

^bANCO «NII STT», Nizhnyaya Krasnoselskaya str., 13, Moscow, 105066, Russia

Abstract

During the construction and operation of quarry haul roads by large dump trucks the employees of mining companies face a number of problems caused by inhomogeneity and low deformation characteristics of foundation soils. This results in high rutting of the road topping, inability to operate during the spring and autumn period, increased consumption of fuel and expensive elements of the running gear of the dump trucks because of the poor state of quarry roads. To solve these problems, experimental laying of the Tensar TriAx stabilizing hexagonal geogrid was performed during the construction of a quarry road. This article describes the course of the experiment, including the production technology of the work, modeling of operation by quarry dump trucks during the unfavorable period, assessment of the increase of deformation characteristics of the construction and the reduce of rutting of the road topping after applying the hexagonal geogrid. In the course of the experiment it was concluded that the positive effect of the hexagonal geogrid use in the construction and operation of quarry haul roads is significant.

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The Zheleznogorsk Bauxite Mine Group located in Kazakhstan is the major producer of bauxite in the whole of CIS. Together with the Aqtobe aluminum plant, the Turgai Bauxite Mine Group and the limestone mine "Arkharly", they form the main platform for aluminum production in Kazakhstan. Bauxite quarrying in Zheleznogorsk Bauxite Mine is open-cut. The rock mass is loosened by blasting; stripping and loading are then carried out by excavators and transportation is carried out by heavy trucks.

* Corresponding author. Tel: 7 921 341 58 98;.
E-mail address: gsolovyev@tensar.ru

During construction and trafficking of the haul roads by heavy dump trucks, the mine operators were faced with a number of challenges as listed below:

- Heterogeneity of the foundation soils leading to uneven surface rutting/settlement;
- Low deformation characteristics of foundation soils;
- Inability to operate the haul roads in spring-autumn due to excessively wet nature of the soils due to the thawing cycle of the foundation soils;
- Lack of specialized road construction equipment (compactors);
- High rutting of the unbound haul road surface;
- Excessively high consumption of fuel and general wear and tear of expensive dump trucks parts, especially the tyres, due to the poor state of haul roads

In order to try to overcome the above challenges, it was proposed to perform experimental laying of a stiff, monolithic, polymeric geogrid, the Tensar TriAx stabilizing hexagonal geogrid. The geogrid was laid directly on top of the existing foundation soils thereby mechanically stabilizing the blasted rock aggregate layer that was placed directly on top of the geogrid to construct the haul road.

Geogrid mechanical stabilization of a granular layer is the result of a mechanism whereby the stone particles of the granular layer effectively penetrate and interlock within the rigid apertures of the monolithic geogrid under vertical loads thereby restricting vertical and horizontal movement of the granular particles. A stiff, monolithic, hexagonal polymeric geogrid, when placed at the bottom of the granular layer, is known to evenly distribute any applied vertical load over the underlying subgrade, reduce the development of irregular surface deformations and rutting, protect the granular material from migrating and being lost into the underlying weak subgrades and improve the overall performance of an unbound haul road.

The aims of the experiment geogrid laying were as below:

- Simulation of adverse ground conditions during spring-autumn period when soils experience excess humidity and partial decompression and determination of deformation characteristics of the foundation during these adverse conditions;
- Creation of two experimental mine haul road sections (Figure 1): a) a control section that was constructed according to the traditional technology (without geogrid), and b) a geogrid stabilized section with Tensar TriAx 180 hexagonal geogrid. Deformation characteristics were determined for both the control and stabilized sections of the experimental haul road.

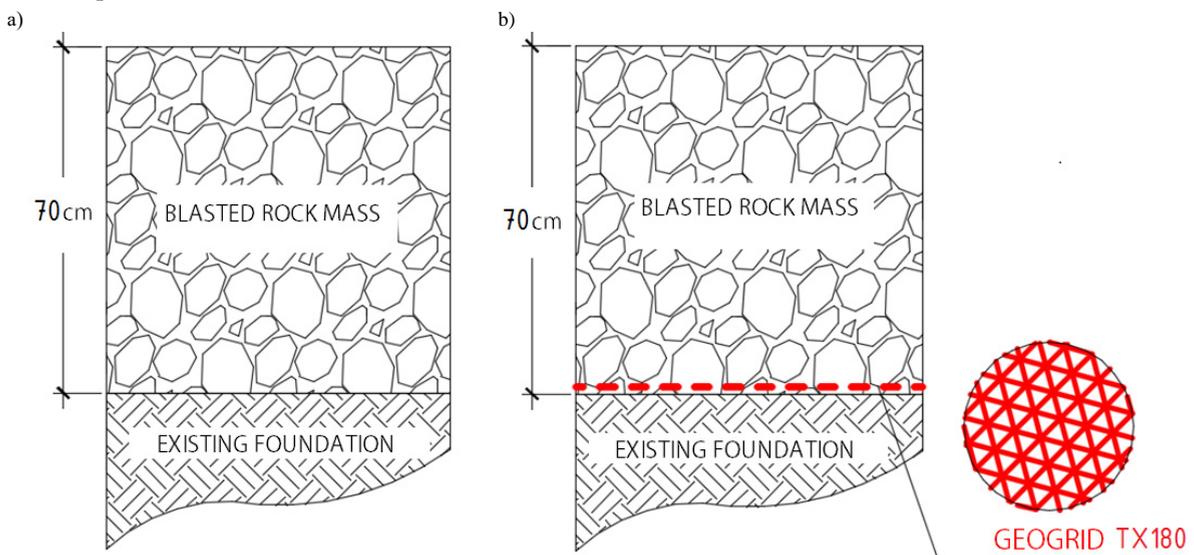


Fig.1. Structure of the experimental sections: a) control section, constructed according to the traditional technology; b) section stabilized with Tensar TriAx 180 geogrid.

- Creation of a model of the impact of trafficking on both experimental mine haul road sections

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