Geocomposites placed beneath ballast bed to improve railway track stability

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Due to complex geological conditions and gradual track degradation, railway tracks in the Czech Republic with high traffic volumes suffer from the migration of fine-grained soil particles from subgrade layers into the ballast bed and from the appearance of muddy spots. The accompanying phenomenon of the above process is local reduction of the vertical track stiffness, malfunctioning ballast drainage as well as total deterioration of track geometry parameters, and often also reduced load-bearing capacity of the track formation. This situation successively requires either frequent operative repairs (ballast cleaning and tamping) or a single, costly and extensive intervention into the whole roadway. The standard procedure consisting in repairing mud spots by cleaning the ballast bed, adding missing aggregates into the ballast bed and rail tamping, however, usually does not lead to the solution of this problem, but, on the contrary, to its periodic repetition.

An alternative, longer-term solution to the above issue without the necessity of an extensive and costly intervention into the track bed is the application of suitable geogrids or geocomposites placed underneath the ballast bed or in its bottom part, based on the knowledge of the interaction of geosynthetics with granular material. Efficient interlocking of the geocomposite with ballast aggregates leads to the limitation of the horizontal movement of aggregate grains around the geogrid and reduction of permanent vertical deformations of the ballast, which is favourably manifested by increased stability of track geometry parameters, less frequent maintenance cycles and extended service life of aggregates, or reduced degradation of aggregate grains due to frequent tamping [2]. Separation or filtration geotextiles, which are part of the geocomposite, prevent the migration of fine-grained soil particles into the ballast allowing, simultaneously, water passage in both directions to enable functioning ballast drainage in the long-term. In the case of a properly taken measure, economies in material, maintenance costs and costs of traffic limitations can be reached [3].

An efficient interconnection of the geogrid and granular aggregate material via interlocking leads to mechanical stabilization of aggregates within the reinforced zone, which results in the reduction of lateral movements of aggregates and increased stiffness of the layer. In practical terms, it is necessary to place the geosynthetic in a proper depth to secure it from damage during machinery-based maintenance, even though its placement closer to the sleeper would be more efficient [4]. The effective combination of the geogrid aperture size and the aggregate grading is also very important [5].

The lecture will focus on the effective stabilization of the rail bed and mitagation of pumping effect using geosynthetic products (geogrids and geocomposites). The results of case studies in the laboratory environment as well as experience with real verification in 4 test sections of railway lines in the Czech Republic will be presented [6]. The monitoring techniques used and the results of long-term monitoring of the test sections will be mentioned.

References:

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