EXPERIENCE WITH GEOSYNTHETICS IN CZECH RAILWAYS

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Introduction (I)
Introduction (II)
Introduction (III)
Problem description (I)

Many railway tracks in Czech Republic has been constructed without sub-ballast layer between ballast and subgrade composed of fine-grained soils.
Problem description (II)

Typical symptoms of such tracks:

- prone to the pushing of fine-grained soil particles from the subsoil into the ballast
- gradual ballast contamination is manifested by its reduced resistance to the vertical and transversal displacement of ballast grains and its impaired ballast drainage
- process is accelerated by increasing operating loads and presence of the so-called pumping effect

Result: visible muddy spots on the track and poor stability of track geometry
Muddy spots (I)
Muddy spots (II)
Problems with geometry
Solution

- Local failures in the track geometry and track bearing capacity are usually repaired by traditional methods – frequent ballast cleaning and tamping of sleepers.
- Traditional methods do not solve the causal factor of the problem and require additional costs for repair works.
- Effective solution can be placing proper geocomposites beneath ballast bed
  - prevents ballast from fine particles
  - enhances stability of railway track in the long-term perspective
Objectives

- stabilize the ballast by interlocking aggregate grains with the geogrid, which limits the pushing out of ballast bed grains in the transverse direction and reduces the vertical deformation of the ballast
- prevent the penetration of fine-grained soil particles from the subgrade into the ballast bed with the geotextile
- allow double-sided water passage to ensure long-lasting drainage of the rail bed with both components
- extend maintenance cycles, extend ballast bed lifetime and reduce the gravel degradation due to frequent tamping
Verification - test sections

Test section 1
Blovice (2008)

Test section 2
Holysov (2009)

Test section 3
Stara Hut (2012)

Test section 4
Domazlice (2015)
Installation
Monitoring programme

- periodic checking of track geometry parameters by a track geometry car
- measurement of the load-bearing capacity by means of static and impact plate load tests
- laboratory testing of geocomposite specimens sampled from trial holes
- visual checks of the environment at the placed geocomposite level
- measurement of rail deflection during the passage of trains

Measurement campaigns at least 2/year (spring/autumn).
Track geometric parameters

![Graph showing track geometric parameters](image)

Level crossing

GEOCOMPOSITE

height - right rail

Track alignment

- Subsection 1
- Subsection 2 (GCO)
- Subsection 3

GCO installation

Quality grade
Load-bearing capacity of track bed (plate load test)

<table>
<thead>
<tr>
<th>Stationing [km]</th>
<th>Subsection</th>
<th>$E_2$ [MPa]</th>
<th>Change [MPa]</th>
<th>Change [%]</th>
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<tbody>
<tr>
<td>169.830</td>
<td>1</td>
<td>25.0</td>
<td>29.7</td>
<td>4.8</td>
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<td>169.860</td>
<td>2</td>
<td>51.9</td>
<td>76.1</td>
<td>24.1</td>
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<tr>
<td>169.910</td>
<td>2</td>
<td>58.3</td>
<td>77.8</td>
<td>19.5</td>
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<tr>
<td>169.960</td>
<td>3</td>
<td>38.7</td>
<td>39.2</td>
<td>0.6</td>
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</table>
Load-bearing capacity of track bed (LWFD)
Measurement of rail deflection during train passage

➤ measured in characteristic profiles
## Measurement of rail deflection during train passage

- average values taken from time interval >4 hours in both directions

<table>
<thead>
<tr>
<th>Measurement campaign</th>
<th>Average speed [km/h]</th>
<th>Rail deflection [mm]</th>
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<tr>
<td></td>
<td></td>
<td>km 169.846 Subsection 1</td>
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<tr>
<td>6/2015*</td>
<td>59.0</td>
<td>4.65</td>
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<tr>
<td>9/2015</td>
<td>46.3</td>
<td>1.65</td>
</tr>
<tr>
<td>4/2016</td>
<td>66.7</td>
<td>3.37</td>
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<tr>
<td>11/2016</td>
<td>63.8</td>
<td>5.92</td>
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<tr>
<td>11/2017</td>
<td>71.1</td>
<td>6.02</td>
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</table>

* measured before geocomposite placement

Subsection 2 = with geocomposite
Conclusion

- Since 2008 four test railway sections are monitored in the Czech Republic, different installation procedures (with/without track grid dismantling) were examined.
- No muddy place in test sections until now.
- Intervals for maintenance/corrective works were significantly extended.
- Installation of geocomposite during ballast renewal is advantageous.
- Transversally inclined track formation allows efficient ballast drainage.
- Geocomposite must be prevent from damage by proper ballast thickness (min. 30 cm).
- In case of pumping effect, proper geotextile must be chosen (low characteristic opening size).
Published results


Czech Government approved the concept of high-speed railway construction in the Czech Republic in May 2017.
Thank you for your attention!

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