APPLICATION OF COLD REMIX TECHNOLOGY IN THE HUNGARIAN ROAD BUILDING

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Topics of presentation

- Data of Hungarian road network
- Cold recycling techniques in-place in Hungary
- Study cases
- Conclusions
Data of Hungarian road network

Length of the pavement-types on the road network in Hungary

- Main roads (km)
- Secondary roads (km)

Asphalt concrete
Macadam
Others
Data of Hungarian road network

Condition of the surface eveness on secondary network

- **Good**: 34%
- **Adequate**: 18%
- **Bearable**: 17%
- **Insufficient**: 14%
- **Bad**: 1%
- **Not measured**: 1%
Data of Hungarian road network

Cost of "big surface" rehabilitation (in year 2000)

- Strengthening of pavement
- Thin asphalt layer
- Construction of base course
- Profiling
- Surface dressing

Cost, %
Cold recycling techniques in-place in Hungary

- **recycling asphalt with binder spraying**: milled/demolished asphalt spreading, bitumenemulsion spraying, 2/5 mm chipping spreading, rolling the layer

- **remix technology with mixed recycling asphalt**: milled/demolished asphalt spreading, bitumenemulsion spraying, in place milling and mixing the existing layer with the spreaded asphalt, laying the new mixture, rolling the layer

- **deep remix technologies in situ**:
  - reparation adding water and bitumenemulsion
  - reparation with cement
  - reparation adding cement slurry
  - reparation adding cement slurry and bitumenemulsion
  - reparation with foamed bitumen
  - reparation adding foamed bitumen and cement
Application example
Remix technology with mixed recycling asphalt

Experimental section

- Year of construction ⇒ 1999
- Length of the section ⇒ 1, 6 km
- Traffic loading: AADT = 520 PCU/day, heavy traffic: 147 V/day.
- Width of the existing layer ⇒ 3,5 – 4, 0 m
- Before the cold remix procedure widening on both sides altogether to 6 m.
- The existing structure was 7-10 cm coated macadam and 15 cm crushed stone base.
- Widening ⇒ with 20 cm lime crushed stone.
- On the widened surface a finisher laid 6 cm thick 0/25 mm grain size old asphalt granulate and the recycler mixed it together with 6 cm thick milled layer of the existing pavement.
- After precompaction of the layer by rubber roller the cold remix layer was stabilized with special (patented) cationactiv bitumemulsion in 2x2 l/m² amount. The binder is suitable for the rejuvenation of the aged asphalt layer.
- 10 kg/m² UKZ 2/5 crushed stone was layed on top of the cold remix layer and it was compacted.
Application example
Remix technology with mixed recycling asphalt

**Bearing capacity of the section**

- Prescribed value of plate bearing capacity $E_2 > 80 \text{ MN/m}^2$
Application example
Remix technology with mixed recycling asphalt

Texture depth data of surface

<table>
<thead>
<tr>
<th>Year of measurement</th>
<th>Texture depth (mm)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>0,39</td>
<td></td>
<td>0,43</td>
</tr>
<tr>
<td>2001</td>
<td>0,45</td>
<td></td>
<td>0,38</td>
</tr>
<tr>
<td>2002</td>
<td>0,44</td>
<td></td>
<td>0,53</td>
</tr>
</tbody>
</table>

The texture depth is equal to the surface mean texture depth of an AB-20 type asphalt concrete where the required value is MTD = 0,50 mm.
Application example
Remix technology with mixed recycling asphalt

experimental section in 2002

texture of the surface
Application example
Deep remix technology with foamed bitumen and cement

Experimental section

- Year of construction  \(\Rightarrow\) 1999
- Length of the section  \(\Rightarrow\) 4, 9 km
- Traffic loading: AADT = 2842 PCU/day, heavy traffic: 427 V/day.
- The preliminary tests were carried out on core samples.
- Criteria of mixdesign (modified Proctor test):
  - Unconfined compressive strength (after 7 days on 5 °C) > 1,5 MN/m²
- Optimal mix composition: 85 % existing material, 15 % 0/20 mm crushed dolomite, 3 % cement (CEM 32,5 type), 3 % foamed bitumen, 6 % water content \((w_{\text{opt}})\)
- Production of foamed bitumen  \(\Rightarrow\) on 170-180 °C
- Applied bitumen type  \(\Rightarrow\) B 70/90 bitumen
- Needed water for foaming  \(\Rightarrow\) 2 % based on bitumen.
Application example
Deep remix technology with foamed bitumen and cement

Construction procedure

- Laying of cement and crushed dolomite on the existing surface.
- The 17 cm thick part of the existing pavement was milled by the recycler (Recycler 2500)
- After adding the water and foamed bitumen the materials were mixed
- The treated material was laid by the recycler
- Precompaction by rubber roller
- The required surface was shaped by grader and compacted by vibrating rollers
- In the top of deep remix course was layed 6 cm AB-16/F asphalt concrete type wearing course
### Application example

Deep remix technology with foamed bitumen and cement

#### Quality requirements and test results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Frequency</th>
<th>Specifications</th>
<th>Test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unconfined compressive strength (after 7 days)</td>
<td>every 2000 m²</td>
<td>1.5-3.5 MN/m²</td>
<td>1.52 - 2.37</td>
</tr>
<tr>
<td>Compaction rate</td>
<td>1000 m/cuts</td>
<td>97% (min. 95%)</td>
<td>97.1 - 101.0</td>
</tr>
<tr>
<td>Thickness</td>
<td>1000 m/cuts</td>
<td>prescribed value -15%</td>
<td>18.1 - 23.1</td>
</tr>
<tr>
<td>Bearing capacity (light falling weight deflectometer)</td>
<td>200 m/cuts</td>
<td>min. 120 MN/m²</td>
<td>102 - 187</td>
</tr>
</tbody>
</table>
Application example
Deep remix technology with foamed bitumen and cement

experimental section in 2002
Application example
Deep remix technology with foamed bitumen and cement

Dynamic creeping test of the wearing course type AB-16/F asphalt concrete

Wheel tracking test of the deep remix layer
### Application example

Deep remix technology with foamed bitumen and cement

#### Deflection data

<table>
<thead>
<tr>
<th>Place of measurement</th>
<th>Deflection (mm) measured by KUAB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outer wheel track</td>
</tr>
<tr>
<td>Correct site</td>
<td>0,34</td>
</tr>
<tr>
<td>Faulty site</td>
<td>0,67</td>
</tr>
</tbody>
</table>
Conclusions

- The behaviour of the experimental sections since the constructions time was generally favourable.

- It is very important:
  - the sufficient dewatering of the existing pavement structures
  - the equal bearing capacity of the existing pavement
  - the sites having weak bearing capacity should be repaired before constructions

- At the cement-bitumen deep remix techniques the keeping of the determined cement-bitumen rate is very important. Altering of the rate will result either a rigid, susceptible for cracking mixture or developing of site having weak bearing capacity.
Conclusions

- The utilization of milled/demolished asphalt materials for cold recycling techniques is favourable in Hungary because of the milled/demolished asphalt is qualified as „dangerous waste product” and therefore its deposition is strictly regulated.

- From costs aspects
  - the techniques using bitumenemulsion are appr. 30 % more expensive
  - the cement-foamed bitumen techniques are appr. 80 % more expensive

Because of the cost aspects the cold recycling techniques are still experimental state in Hungary.
THANK YOU FOR THE ATTENTION