South African Experience on in situ Recycling with Bitumen Emulsion and Foamed Bitumen

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- Issues related to design
- Issues related to construction
- Political and social issues
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Introduction

- South African road network
- Environmental legislature
- Arrival of high speed recyclers
- Foamed bitumen = emulsion?

Issues related to design

- Lack of lab. mixers simulating field conditions
Issues related to design

- Optimum bitumen and active filler ratio
- Appropriate performance tests

Pre-design pavement investigation
- Sampling of material

<table>
<thead>
<tr>
<th>Material Code</th>
<th>ITS (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100-300</td>
</tr>
<tr>
<td>UCS (kPa)</td>
<td></td>
</tr>
<tr>
<td>700-1400</td>
<td>FB4</td>
</tr>
<tr>
<td>1400-2000</td>
<td>FB2</td>
</tr>
</tbody>
</table>

Issues related to design

- Comparison between emulsion and foamed bitumen treated layers

Proffered conditions for use of foamed bitumen:
- Early opening to traffic
- High initial moisture content

Proffered conditions for use of emulsion:
- Inadequate foaming properties
- Material temperature < 15°C
- Inadequate fines in the material (< 5%)

Mechanistic-empirical design method

Distress mechanisms:
- Effective fatigue
- Permanent deformation

Development of transfer functions
Deep in situ recycling, design charts

![Graph showing support vs. thickness with example points and tolerance added.]

Issues related to construction

- Differences between conventional and high speed recycling
- Cross or forward blend of material
- Application of cement
- Limited time for corrections

Issues related to construction: compaction

![Diagram showing layer thickness vs. static mass of primary roller with material grading categories.]

Example:
70 MPa Support
ES0.3 (100 000 to 300 000 E80s)
190 mm, rounded 200 mm
Add construction tolerance
Issues related to construction

- Construction in temp. < 15°C
  - Influence of aggregate temp. on particle coating
  - Foam suitability

<table>
<thead>
<tr>
<th>Foam Index (sec)</th>
<th>Aggregate 15°C</th>
<th>Aggregate 25°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;75</td>
<td>Unsuitable</td>
<td>Unsuitable</td>
</tr>
<tr>
<td>75 – 100</td>
<td>Very poor</td>
<td>Poor</td>
</tr>
<tr>
<td>100 – 125</td>
<td>Poor</td>
<td>Moderate</td>
</tr>
<tr>
<td>125 – 175</td>
<td>Moderate</td>
<td>Good</td>
</tr>
<tr>
<td>75 – 200</td>
<td>Good</td>
<td>Very good</td>
</tr>
<tr>
<td>&gt;200</td>
<td>Very good</td>
<td>Very good</td>
</tr>
</tbody>
</table>

Political and social issues

- Labour intensive construction (LIC)
- Development of small, micro and medium entrepreneurs

Political and social issues

In-plant mixing
- New / upgrading projects
- Control of input materials
- Quality of mixing
- Stockpiling

Labour-intensive construction
Labour Intensive Construction

- Quality of road surface finish
- Compaction
- Quality control
- Construction duration

Recycling with Foamed Bitumen and Emulsion

Conclusions

- In place deep recycling and in plant recycling were successfully used in South Africa.
- This technology can also be used for labour intensive construction.
- Effective when carefully controlled.

Political and social issues

- LIC construction cost
- Social benefits of LIC

SA Experience on Recycling with Foamed Bitumen and Emulsion

- Interim Technical Guidelines: The Design and Use of Foamed Bitumen Treated Materials
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