Reuse of Very Hard Reclaimed Asphalt Field Results

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The challenge with RA*

• Over aging asphalt pavement ages
  – More brittle, loss of flexibility
  – Stiffer

• General trends when valuing RA
  – Increasing RA content into asphalt mixes
  – More harder RA found and sometimes out of spec

* Reclaimed Asphalt
Use of rejuvenator

• To maximise value of RA, solution needs to
  – Restore flexibility of aged binders
  – Maintain good rutting resistance
• “Rejuvenation” is not reversing the oxidation
  – A rejuvenator works on the effective particle size of the asphaltene structures
  – A plasticizer will lower the viscosity of the binder by dilution
The project

• Pavement rehabilitation of industrial area, Fce
  – Pavement suffered damages from heavy traffic and low speed
  – New pavement with 6 cm Asphalt Concrete containing 40 %

• Full evaluation

Dosage study  Mix design  Field production  Post evaluation  Blending study

Reuse of hard RA – Field results
SYLVAROAD™ RP1000 Performance Additive

- Bio-based additive from Pine chemistry
  - Easy to handle product, liquid with high flash point, no known hazardous components

- Technical features
  - Dosage of 5 % restores by 2 grades aged binder
  - Restores flexibility at low temperature without compromising the high temperature behaviour
• Very hard RA binder out of specifications
• Rejuvenator enables to restore properties
  – Optimum dosage between 5% and 10%
  – Good resistance to hardening
Lab Mix design

- Lab Mix design comparing
  - Reference mix 40% RA + 70/100
  - Mix with RP1000 40% RA + 50/70

<table>
<thead>
<tr>
<th></th>
<th>Spec</th>
<th>Reference Mix</th>
<th>Mix with RP1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gyratory compaction</td>
<td>5-10%</td>
<td>9.0%</td>
<td>8.9%</td>
</tr>
<tr>
<td>Water sensitivity</td>
<td>&gt; 70%</td>
<td>86%</td>
<td>87%</td>
</tr>
<tr>
<td>Rutting, WTT</td>
<td>&lt; 5%</td>
<td>2.3%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Modulus at 15 °C</td>
<td>≥ 7000 MPa (at 5-8 % voids)</td>
<td>9300 MPa (8 %)</td>
<td>9400 MPa (6.7 %)</td>
</tr>
</tbody>
</table>
• The additive was spread on the RA
• Transport for 1h
• Application on job site including hand work
• During mix production
  – Effective dosage was 5.5% per RA binder
  – Mixing temperature 165 °C
  – Workability gave optimum temperature of 125 °C

• Loose mix collected for further evaluation
Reuse of hard RA – Field results
Reuse of hard RA – Field results

Binder post evaluation

• Binder extracted and recovered
  – Variation from the RA binder
  – Results consistent with initial lab evaluation

<table>
<thead>
<tr>
<th>Binder from RA</th>
<th>Pen value</th>
<th>Softening point</th>
<th>Binder content</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA from production</td>
<td>6 x0.1mm</td>
<td>78 °C</td>
<td>6.01 %</td>
</tr>
<tr>
<td>Mix production</td>
<td>19 x0.1mm</td>
<td>62 °C</td>
<td>5.27 %</td>
</tr>
<tr>
<td>RA binder</td>
<td>4 x0.1mm</td>
<td>89 °C</td>
<td>5.75 %</td>
</tr>
<tr>
<td>40%RA + RP1000 + 50/70 (RTFOT)</td>
<td>21 x0.1mm</td>
<td>64°C</td>
<td>---</td>
</tr>
</tbody>
</table>
Mix post evaluation

- Core samples from job site
  - Variability from plant production
  - Meet the specifications
  - Slightly lower than lab mix design even with low dosage

<table>
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<tr>
<th>Binder from RA</th>
<th>specification</th>
<th>Plant produced mix</th>
<th>Lab produced mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulus at 15 °C</td>
<td>≥ 7000 MPa (at 5-8 % voids)</td>
<td>8200 MPa (5.6 %)</td>
<td>9400 MPa (6.7 %)</td>
</tr>
</tbody>
</table>
Sequential extraction

- Measure of mobilisation of RA binder

Infra-red analysis, with C=O index as oxidation indicator
Degree of mobilisation

- From extracted binder out of mix production
  - Constant ICO value along sequential extraction
Conclusion

• From lab to full scale job
  – Treatment of RA with rejuvenator
  – Mix with 40% very hard RA met specifications
  – Good degree of blending
• Use of rejuvenator can help with
  – Higher RA content at 50 % and above
  – Very hard RA
  – Good workability ensuring high quality mix
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