Recycling Using Ex-Situ Foamed Bitumen Basecourse

Young Presenter - REAAA Roadshow
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Downer New Zealand Ltd.
Ex-Situ Foamed Bitumen

[Diagram showing the process of foamed bitumen with labels for hot bitumen, water, air, expansion chamber, and foamed bitumen.]
Ex-Situ Types

Active fillers:
- Cement
- Lime etc.

Bituminous Binders:
- 80/100 bitumen
- 180/200 bitumen etc.

Quick Visco-Elastic (QVE)

Granular Materials
Ex-Situ - Uses in Pavement Construction

<table>
<thead>
<tr>
<th>Test Pit 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>40mm: asphalt, max size 14mm</td>
</tr>
<tr>
<td>40 - 220mm: dark, grey basalt, very dense, dry, uncontaminated, max size 105mm, gap graded, subangular</td>
</tr>
<tr>
<td>220 - 300mm: Very dense, dry, uncontaminated, max size 85mm, gap graded, subangular</td>
</tr>
<tr>
<td>&gt;300mm: light, brownish grey, CLAY, stiff, dry, highly plastic</td>
</tr>
</tbody>
</table>

Test Pit 7

40mm: asphalt, max size 14mm

40 - 140mm: brownish clay, max size 14mm

140 - 280mm: brown, scoria, max size 280mm

>280mm: yellowish CLAY, size 390mm

>360mm: dark grey, max size 360mm

>460mm: yellowish brown, size 460mm

>480mm: greenish grey COAL, size 480mm

>610mm: reddish/yellow CLAY, size >610mm

>650mm: dark brown COAL, size >650mm

500 - 680mm: very dense, dry, highly plastic

610 - 200mm: dry, firm, cohesive, uncontaminated

>200mm: greenish grey, CLAY, size >200mm

Medium density, firm to soft, moist to dry

Test Pit 6

40mm: asphalt, max size 14mm

40 - 140mm: brownish clay, max size 14mm

140 - 280mm: brown, scoria, max size 280mm

>280mm: yellowish CLAY, size 390mm

>360mm: dark grey, max size 360mm

>460mm: yellowish brown, size 460mm

>480mm: greenish grey COAL, size 480mm

>610mm: reddish/yellow CLAY, size >610mm

>650mm: dark brown COAL, size >650mm

500 - 680mm: very dense, dry, highly plastic

610 - 200mm: dry, firm, cohesive, uncontaminated

>200mm: greenish grey, CLAY, size >200mm

Medium density, firm to soft, moist to dry
Ex-Situ - Uses in Pavement Construction
Ex-Situ Production

Paver laid
Grader laid
Placed via. excavator
Hand placement
Ex-Situ FB - Laboratory Testing

Indirect Tensile Strength (ITS)
Indirect Tensile Method (ITSM)
Unconfined compression strength (UCS)
Repeated Load Triaxial (RLT)

Wheel Tracker

Laboratory Testing:
• Resilient Modulus
• Rut Resistance
Ex-Situ FB - Field Testing

Nuclear Densometer

Clegg Hammer

Benkelman Beam Testing

Falling Weight Deflectometer

Field Testing:
- Compaction
- Layer Stiffness
- Curing Rate
Case Study 1: Bairds Road, Otara

Auckland Transport, Opus and Downer Team
Mid 2012 Howick Pakuranga Maintenance Contracts
Case Study 1: Bairds Road, Otara
Case Study 1: Bairds Road, Otara
Case Study 2: Denbigh Ave, Mt Roskill

- Collaboration with AT, Opus and Green Vision Recycling
- Residential setting (17,000 vpd urban collector)
- 30 year design life
- Conforming design – 250mm SAC
- Alternative design – 250mm FBS, 40mm AC14
Case Study 2: Denbigh Ave, Mt Roskill

- ~1700T of Ex-situ Foam produced at Green Vision and batched directly into tip trucks

95% Recycled Mix
Case Study 2: Denbigh Ave, Mt Roskill

- Paver laid in two 125mm lifts
- Comprehensive on site Quality Assurance testing
## Case Study 2: Denbigh Ave, Mt Roskill

### Summary of Mix Design and QA Samples

<table>
<thead>
<tr>
<th>Component</th>
<th>Analysis</th>
<th>Dry ITS (kPa)</th>
<th>Soaked ITS (kPa)</th>
<th>TSR</th>
<th>Dry Density (t/m³)</th>
<th>UCS (Mpa)</th>
<th>ITSM (Dry Mpa)</th>
<th>Phase 1 (Mpa)</th>
<th>Phase 2 (Mpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Average</td>
<td>340</td>
<td>331</td>
<td>0.97</td>
<td>2.25</td>
<td>1.6</td>
<td>2865</td>
<td>3200</td>
<td>2070</td>
</tr>
<tr>
<td>QA</td>
<td>Average</td>
<td>368</td>
<td>407</td>
<td>1.09</td>
<td>2.25</td>
<td>1.9</td>
<td>2470</td>
<td>3756</td>
<td>2466</td>
</tr>
<tr>
<td>No. QA Tests</td>
<td></td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>16</td>
<td>5</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Diff</td>
<td></td>
<td>7%</td>
<td>19%</td>
<td>11%</td>
<td>0%</td>
<td>17%</td>
<td>14%</td>
<td>15%</td>
<td>16%</td>
</tr>
</tbody>
</table>

### FWD Testing

<table>
<thead>
<tr>
<th>Year</th>
<th>D0 Deflection (mm)</th>
<th>Curvature (mm)</th>
<th>Deflection (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>Mean</td>
<td>0.35</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>90 %ile</td>
<td>0.47</td>
<td>0.1</td>
</tr>
<tr>
<td>2013</td>
<td>Mean</td>
<td>0.25</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>90 %ile</td>
<td>0.32</td>
<td>0.08</td>
</tr>
</tbody>
</table>
On Going R & D
**Ex-Situ FB - Benefits**

- Lower energy consumption vs. structural asphalt (low carbon footprint)
- Less demand on bitumen and virgin material
- Greater consistency – pre-qualify materials and controls on production
- Alternative solution to in-situ stabilisation – can manage small vol. jobs
- Allow better use of waste streams to generate premium materials
- Greenfields FB sites – Only lay the basecourse once
Thank you

Questions?