2012 Study Tour Key Topics

1. Long life pavements
   - Experience, design systems, use, durability & performance

2. High performance asphalt & binders
   - High modulus asphalt (EME, HMA), modifiers

3. Sustainability
   - RAP/WMA, bitumen substitutes, carbon calculators & energy analysis

4. Health & Safety
   - Construction of road works, health considerations for bitumen and asphalt products

5. Procurement Systems
   - Proprietary products (Avis Technique, HAPAS, etc.), "green" procurement, REACH, responsible sourcing, PPP and contract models

Topic 2: High performance asphalt & binders

Overview of reasons
- Bituminous binders – key component in the performance and service life of bituminous surfacings & asphalt pavements
- About 90% of the Australian all weather road network length is surfaced with sprayed seals – about 50% of binder usage
- Need to ensure optimum asphalt and seals performance in the field, and to promote best practices suitable to be adopted and adopted in Australia. Seeking details on:
  - New developments and test methods in high performance asphalt and bituminous materials (e.g. HIMA/EME, PMI, Emulsion)
  - Actions taken by European and other (e.g. binder manufacturers, asphalt producers and researchers) to overcome field problems (e.g. climate change)
  - Correlation between laboratory test results and field trials

What is High Performance Asphalt?
- What does it look like?
- How is this different to what we currently do?
- Isn’t what we do good enough?
- For Heavy Duty roads – what’s your pavement configuration?
Topic 2: High performance asphalt & binders

Three French Methods of achieving High Modulus Asphalt:
- EME (Enrobés Module Élevé)
- GB5
- GAB II

All methods move asphalt bases to Higher Modulus resulting in increase in load spreading and hence increased capacity.

EME: High Modulus Asphalt:
- Standard Dense mix gradings
- 10/14/20 mix sizes
- Special Hard Binder:
  - Stiffness
  - Rut Resistance
- Increased binder content:
  - Fatigue Resistance
  - Density:
    - Stiffness
    - Moisture Resistance

GB5: High Modulus Asphalt:
- Double Gap graded gradings (using packing theory):
  - Density:
    - Stiffness
    - Moisture Resistance
- Standard binder content (4.0%):
  - Stiffness
  - Rut Resistance
- Modified Binder:
  - Fatigue Resistance

GAB II: High Modulus Asphalt:
- 65% Sand (16/32 Aggregate acts as a filler):
  - Density:
    - Stiffness
    - Moisture Resistance
    - Rut Resistance
  - Special Hard Binder:
    - Fatigue Resistance

Hard Binders:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test method</th>
<th>Unit</th>
<th>Penetration grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before RTFOT</td>
<td>EN 1426</td>
<td>mm</td>
<td>10/20 15/25 20/30</td>
</tr>
<tr>
<td>Penetration at 50°C</td>
<td>EN 1427</td>
<td>°C</td>
<td>55-71 %5-9 13-25</td>
</tr>
<tr>
<td>Softening point</td>
<td>EN 1427</td>
<td>°C</td>
<td>55-71 %5-9 13-25</td>
</tr>
<tr>
<td>Viscosity at 60°C</td>
<td>EN 12596</td>
<td>Ppas</td>
<td>&gt;700 &gt;550 &gt;440</td>
</tr>
<tr>
<td>Increase in softening point</td>
<td>EN 1427 °C</td>
<td>- &lt; 8 &lt; 8 &lt; 8</td>
<td></td>
</tr>
</tbody>
</table>
Topic 2: High performance asphalt & binders

Hard Binders:

EME Binder Content:

<table>
<thead>
<tr>
<th></th>
<th>HiMA base course</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class 1</td>
</tr>
<tr>
<td></td>
<td>Class 2</td>
</tr>
<tr>
<td>D (mm)</td>
<td>10, 14, 20</td>
</tr>
<tr>
<td></td>
<td>10, 14, 20</td>
</tr>
<tr>
<td>$P_{\text{b min}}$ (g/cm³)</td>
<td>3.8 5.1 5.0</td>
</tr>
<tr>
<td>$P_{\text{b min}}$ (g/cm³)</td>
<td>3.8 4.9 4.9</td>
</tr>
<tr>
<td>Richness modulus K</td>
<td>2.5 3.4 3.4</td>
</tr>
</tbody>
</table>

Softening Point [°C]

Penetration [1/10 mm]

EN 12591 paving grade

EN 13924 hard paving grade

EME Binder

Content:

IFSTTAR

Main specifications of HMA (fundamental method, only one)

IFSTTAR

EME: main performances

IFSTTAR

New structure: national road (catalogue 1998)

IFSTTAR

Performances ranking of Asphalt mixes for base course

IFSTTAR

Limits of performances determined in laboratory, used in pavement design
Topic 2: High performance asphalt & binders

GB5 Packing:

- Additional void interactions due to the wall effect
- Loss of contact between coarse particles
- Solid D
- Solid C
- Voids

Topic 2: High performance asphalt & binders

GB5: www.aapa.asn.au

GB5 Packing:

- Mix with high fines content
- \( \rho < \rho_p \)
- \( \frac{c}{F(b)} + D_p \)
- Mix with medium fines content
- \( \rho = D_p \)
- \( \frac{c}{F(b)} + D_p \)
- Mix with low fines content
- \( \rho = \rho_p \)
- \( \frac{c}{F(b)} + D_p \)

Topic 2: High performance asphalt & binders

GB5: www.aapa.asn.au

Mix Design & Performance Testing:

- Compatibility (and geometry)
- Compaction
- Water sensitivity
- Rutting
- Stiffness
- Fatigue test
- Pavement design

AAPA 2012 Study Tour to Europe – Feedback Session
High performance asphalt and binders – Part 1

Page 4
Pull out of high performance asphalt and binders

**Topic 2: High performance asphalt & binders**

**Mix Design & Performance Testing:**

- **Workability:** Water resistance, Rutting resistance
- **Level 1:** Modulus, Fatigue resistance
- **Level 2:** General requirements
- **Level 3:** >14000 MPa, >130 p as (16°C, 2 Hz)
- **Level 4:** Fundamental approach in EN 13108-1

**High Modulus Asphalt**

- **Fatigue**
- **Rut**

**High Modulus Asphalt Production:**

<table>
<thead>
<tr>
<th>Country</th>
<th>HMA production (millions tonnes)</th>
<th>RAP in HMA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>39</td>
<td>3</td>
</tr>
<tr>
<td>France</td>
<td>39</td>
<td>7</td>
</tr>
<tr>
<td>Austria</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>USA</td>
<td>327</td>
<td>17</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>10</td>
<td>32</td>
</tr>
</tbody>
</table>

**Questions**

- **Asphalt**
  - EME/HiMA - specification, testing, field links, pavement & subgrade requirement, binder selection & processing
  - Performance & Construction
  - Reinforced, Modified Binders & SMA – design & composition, service life, pros & cons
  - Moisture Susceptibility: measures, tests & approaches
  - PGA/PA: maintenance & performance
- **Specifications and Test Methods**
  - Approaches to proprietary mix design, types of modifiers used, low temperature test methods, control of segregation & degradation, etc

- **Binders**
  - Concerns: climate change, quality & characteristic of imported material
  - Testing level, lab-field correlation, stabilisation of unbound material

- **Emulsions**
  - Test methods
  - Types used in sprayed chip sealing
  - Performance based specifications

- **Surfacings**
  - Cost benefit of thin surfacings, reasons of application & modelling