Development of Specifications and Technical Guidelines for Warm Mix Asphalt
Project Overview

• Western Australia Road Research and Innovation Program (WARRIP)

• Objective: generation/modification of specifications and technical guidance documentation to facilitate implementation of WMA by Main Roads

• Anticipated benefits:

  Environmental:
  – Lower fuel consumption
  – Lower greenhouse gas emissions
  – Reduced exposure of workers to fumes
Project Overview

Performance:

• Reduced binder aging
• More time for mixture compaction
• Improved workability and compaction

Other Anticipated Benefits:

• Longer paving season
• Reduced plant wear
Warm Mix Asphalt

• The aim of the Warm Mix Asphalt (WMA) process is to reduce the high temperatures at which traditional asphalt mixes are produced and placed without adversely affecting these properties.

• Typically, WMA is produced at temperatures that are 25-40 °C below that of Hotmix Asphalt (HMA).

• Categorized in 3 main processes
  – Using Organic additive
  – Using chemical additives
  – Direct foaming technique
Project Methodology

- Literature review
  - Related Austroads and WAPARC studies
  - National and international practices
  - Quantifiable sustainable benefits of the WMA technologies available in WA

- Review of standardised tools for comparing the sustainability of asphalt materials

- Consultation with industry (2 workshops)

- Preparation of MRWA documents (specifications and technical documents)

- Preparation of a Contract Report
Austroads Projects (TT1220, TT1454)

• Review of overseas and Australasian studies
  – emphasis on the environmental differences between WMA technology and conventional HMA technology
• Development of WMA evaluation protocol
  – provide guidance on the evaluation of specific WMA technologies and processes
• Field validation of WMA pavements
• Laboratory validation of WMA mixes
• Review of the environmental aspects of warm mix asphalt
• Review of carbon calculators
## Reduction (%) in Emissions and Energy cf. HMA

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<th>Method</th>
<th>CO</th>
<th>CO₂</th>
<th>SO₂</th>
<th>NOₓ</th>
<th>Energy</th>
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<td>D’Angelo (tour of Europe)</td>
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<td>15-40</td>
<td>18-35</td>
<td>18-70</td>
<td>20-35</td>
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<tr>
<td>Zeolite (foaming)</td>
<td>62</td>
<td>*</td>
<td>83</td>
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<td>18</td>
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<tr>
<td>Water injection</td>
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<td>11</td>
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<tr>
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<td>31-35</td>
<td>25-30</td>
<td>62</td>
<td>24-35</td>
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Austroads WMA protocol

- Purpose: provide a guide to the evaluation of specific WMA technologies and processes
- Conduct of appropriate laboratory tests and field validation projects in order that the performance of WMA and conventional HMA can be compared
- Evaluation tool only; not a specification
- Protocol written so that, as a type of WMA is evaluated, the results can be distributed and discussed through the Austroads framework
- Expectation was that the use of the protocol would encourage road agencies to accept WMA without the need for additional testing
Components of Austroads protocol

- testing of asphalt containing additives and surfactants, both in the laboratory and during production
- testing of asphalt containing foamed bitumen (during production only)
- desirable site conditions for a field validation site
- timeframe for the evaluation
- data and information exchange

Information exchange is vital if the protocol is to be successfully implemented
Austroads Field validation criteria

• WMA and ‘control’ sites should meet a number of criteria to ensure that the evaluation can be conducted as objectively as possible (length, geometry, uniformity, etc.)

• WMA and HMA sites subject to the same traffic

• Production and placement criteria as set out in protocol
  – field compaction in line with road authority requirements/specifications
Carbon Footprint

• Several carbon calculators reviewed:
  – Australia (Sustainable Aggregates SA; RTA NSW)
  – Asphalt Pavement Embodied Carbon Tool (asPECT) (UK)
  – Environmental Sustainability of Recycled and Secondary Aggregates (ESRSA, UK)
  – CO₂ Emissions Estimator Tool (UK)
  – Greenhouse Gas Calculator (NAPA, USA)

• In the absence of sufficient Australian-based emissions factors, it is premature to recommend a carbon calculation system for inclusion into the WMA evaluation protocol

• Further work needed which focuses on local data collection
Summary Austroads Projects

- Laboratory testing conducted in line with draft Protocol
  - Protocol too demanding in terms of what can be practically achieved
- Performance of WMA and HMA pavements at validation site in Melbourne excellent after 18 months
- Monitor overseas projects (e.g. NCHRP, NCAT, UCPRC) and examine outputs in terms of possible application to Australia
- Premature to recommend a carbon calculation system for inclusion in Protocol
  - need to develop data sets to allow local carbon dioxide emissions factors for the main components of road construction
WAPARC Project – Conclusions

- No perceived risks with the use of granite aggregates
- Moisture sensitivity in Sasobit®-WMA can be an issue if plant operators rush the drying of aggregates, especially in drum plants.
- Literature indicates that the performance of WMA pavements is at least equivalent to that of HMA – no immediate need for accelerated pavement test in Australia.
- Still concern regarding long-term performance: focus on moisture susceptibility, rut resistance and durability.
- Once available, outputs of NCHRP projects and relevance to Australian conditions to be reviewed.
- Risks associated with moisture require monitoring as part of QA procedures as well as moisture sensitivity testing and possibly the use of adhesion agents or hydrated lime.
WAPARC Project – Conclusions

- Potential deficiencies in rutting resistance partly addressed by choice of binder grade.
- PMBs are well suited to production using foam technology
Recent NCHRP Studies

- Project 09-47: Engineering Properties, Emissions, and Field Performance of Warm Mix Asphalt Technologies
- Project 09-47A: Properties and Performance of WMA Technologies
- Project 09-49: Performance of WMA Technologies: Stage I – Moisture Susceptibility
- Project 09-49A: Performance of WMA Technologies: Stage II – Long-Term Field Performance
- Project 09-53: Properties of Foamed Asphalt for Warm Mix Asphalt Applications
Successful Implementation in WA

- Literature review
- Review of national and international practices
- Stakeholders to understand the motivation for the use of WMA
- Technical input from asphalt producers in the preparation of specifications and technical guidelines
- Investment in changes as required by the proposed technology
- Stakeholders to commit to proposed implementation plan and innovation
- Staged approach
Suggested Workshop Discussion Topics

• Specification of WMA
  – Separate mix registration?
  – Limits on additives and water content

• WMA Technologies
  – In Australia/elsewhere and likely to be brought to WA
  – Have these technologies been extensively used and proven?

• Aim and implementation
  – Best ways to introduce it
  – Minimum reduction temperature and maximum temperature
  – Benefits for the asphalt industry
  – Logistic considerations (distance, project size, weather, etc.)
Suggested Workshop Discussion Topics

• Risks of moving to WMA
  – Moisture susceptibility/stripping, rutting durability, other?
  – Main risks for the contractor/MRWA
  – Risks of implementation with RAP
  – WMA with PMB
  – Perceived risks with the use of granite aggregates

• Management of risks
  – Additional testing to assess moisture susceptibility
  – Additional testing to assess rutting
  – Implementation of higher quantities of RAP and WMA technologies
  – Implementation of WMA in PMB mixes
  – Lower layers
  – Initially in large construction contracts in Perth and not resurfacing maintenance or small contracts