Introduction & Tour objectives
Itinerary

- 2\textsuperscript{nd} to 21\textsuperscript{st} June 2012
- Tour group 9 Australian roads people
- Six countries & 5\textsuperscript{th} E&E
  - France / Belgium / Netherlands / UK / Turkey / Germany
- Five key topics
  1. Long life pavements
  2. High performance asphalt & binders
  3. Sustainability
  4. Health & Safety
  5. Procurement Systems
Travel route

- Australia
- Paris, France
- London, UK
- Amsterdam, Netherlands
- Brussels, Belgium
- Cologne, Germany
- Istanbul, Turkey
**Warren Carter**  
Nation Technical Manager  
Downer Australia  
Level 2, Building T3, 39 Delhi Road NORTH RYDE,  
New South Wales 2113  
P: +61 2 9813 8353  M: +61 419 106 866  
M: warren.carter@downerdiworks.com.au  

*Why on tour:* To learn what is happening in Europe on Perpetual Pavements, WMA and RAP; to understand the future direction of binders regarding sustainability; testing regimes to assess quality; networking and establishing international contacts.  

*Background:* 25th year in the industry and had exposure to bitumen emulsions, polymer modified binders, sprayed sealing, asphalt and slurry/microsurfacing. Originally commenced in a laboratory role. The majority of my career has been in a technical role but have also held project management roles.  

*Qualifications:* B.Sc.(Industrial Chemistry), MBA

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**Khar Yean Khoo (Dr)**  
Research Scientist  
Pavements & Surfacings, Sustainable Infrastructure Science  
ARRG Group Pty Ltd  
500 Burwood Highway VERMOUNT SOUTH, Victoria 3133  
P: +61 3 9881 1602 M: +61 423 800 811  
E: khar.khoo@arrg.com.au  

*Why on tour:* To broaden my knowledge, skill base, establish contacts and to learn about new developments in bituminous materials of importance to Australia, principally bitumen properties, polymer modified binders and sprayed sealing.  

*Background:* Last four years with ARRG binders & sprayed sealing research team. Focussed on the chemical and physical properties of bitumen and the performance of polymer modified binders.  

*Qualifications:* B. Eng (Chem), PhD (BioChem Eng)

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**Graham Wilson (Dr)**  
Technical Manager  
BP Bitumen, BP Australia (Pty) Ltd  
GPO Box 5222 MELBOURNE Victoria 3001  
P: +61 3 8368 8740 M: +61 419 200 238  
E: graham.wilson2@bp.com  

*Why on tour:* Personal and professional development opportunity. Also, what is happening outside of Australia in the area of sustainability?  

*Background:* Varied: 2 years Post Doctoral Research Fellow, Physics Department Monash Uni; 5 years with South Pacific Tyres (DunlopOlympic & Goodyear) working on real time data acquisition systems; 11 years at Kodak Research Lab as Research Scientist and then Research Group Leader; 6 years (and counting) with BP Bitumen, first as Bitumen Technical Projects Manager then as Technical Manager.  

*Qualifications:* BSc.(Hons), PhD In Chemistry

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**Rob Vos**  
Queensland Executive  
Australian Asphalt Pavement Association  
903c Toowong Tower, 9 Sherwood Road, TOOWONG  
Queensland 4066  
P: +61 7 3870 2644 M: +61 414 533 481  
E: robert.vos@aapa.asn.au  

*Why on tour:* Learn about the status of the key issues in Europe. Meet the lead practitioners and share knowledge and contact. Seek details on Procurement systems.  

*Background:* 13 years at Cape Provincial Roads (South Africa) 10 years Technical Director Sabita, last 12 years in AAPA in Queensland as State Executive.  

*Qualifications:* BSc.Eng.Civil, Pr.Eng, C.Eng, MSAICE,MICE

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**Australian Asphalt Pavement Association**  
2012 Study Tour to Europe and 5th Eurasphalt & Eurobitume  
2 to 21 June 2012  
www.aapa.asn.au
John Lambert
Chief Executive Officer
Australian Asphalt Pavement Association (AAPA)
Level 2, 5 Wellington Street, KEW, Victoria 3101
P: +61 3 9853 3595 M: +61 419 822 114
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Why on tour: At E&E Congress to meet & further develop relationships and exchange key information with industry association colleagues. In Germany to capture their developments in HSE and recent fumes reports.

Nigel Preston (Dr)
Bitumen Technical Manager
The Shell Company of Australia Limited
GPO Box 872K, MELBOURNE, Victoria 3001
P: +61 3 8823 4451 M: +61 419 564 596
E: nigel.preston@shell.com
Why on tour: To understand the European approach to long life pavement design and utilisation of high modulus asphalt. Interested in the use and trends in EME binders and PMBs.

Greg Stephenson (Dr)
Senior Engineer – Civil Infrastructure
Asset Management Branch, Brisbane Infrastructure
Brisbane City Council
GPO Box 1434, BRISBANE Queensland 4001
P: +61 7 3403 9043 M: +61 423 417 326
E: greg.stephenson@brisbane.qld.gov.au
Why on tour: To understand trends in long life pavements, long term performance, sustainability, reuse and recycling to optimise the whole of life performance of our road network into the future.

Greg Stephenson
(continued)

Background: 32 years experience working for local government authorities, federal government and consulting engineers mostly in the road and airport construction and maintenance areas. Before joining BCC, I spent 5 years at Queensland University of Technology in a range of pavement and asphalt research related activities

Qualifications: B.Eng-Civil, M.Sc, Ph.D in Civil Engineering

Hugo van Loon
Senior Asphalt Engineer
Spatial Intelligence & Road Assets Section,
Transport Services Division: Department of Planning, Transport & Infrastructure, South Australian Government
PO Box 1533 ADELAIDE South Australia 5001
P: +61 8 8343 2524 M: +61 417 853 394
E: hugo.vanloon@sa.gov.au
Why on tour: Investigate the ‘rules’ for addition of RAP, understand high modulus asphalt, SMA mix design and fatigue of asphalt.

Background: Hugo has been asphalt engineer for the state road authority in South Australia for 17 years.

Qualifications: B Eng, Civil from Uni SA

Ian van Wijk (Dr)
Technical Director, Competency Leader: Roads
Aurecon
Locked Bag 331, BRISBANE Queensland 4001
P: +61 7 3173 8963 M: +61 402 399 948
E: ian.vanwijk@aurecongroup.com
Why on tour: To gain a better understanding of European and UK structural pavement design systems and performance inputs such as material properties and fatigue. Also to get additional info on new technologies, new binders and their inclusion in structural design procedures.

Background: Pavement design for 30+ years, practiced in Africa, Middle East, India, Malaysia and Australia. Previously 4 years in a South African Provincial Roads Authority and 5 years at Purdue University, USA (from which MSCE and PhD were obtained). Worked in academia, and for consulting engineers Van Wyk & Louw, Africon and now Aurecon.

Qualifications: BEng, MSCE, PhD, Pr Eng, MIAUST CPEng, RPEQ
Australia & its roads

BIG, FLAT, DRY/FLOODS, MINERAL RICH, FOOD BASKET, LUCKY COUNTRY

“Icon” & loads

Seals vs. heavy pavements

Poor materials
<table>
<thead>
<tr>
<th></th>
<th>Europe/EEC</th>
<th>Australia</th>
<th>ratio</th>
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<tbody>
<tr>
<td>Land area (km²)</td>
<td>4 324 782</td>
<td>7 741 220</td>
<td>X 0.6</td>
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<tr>
<td>Population (June 2010 est)</td>
<td>502 486 499</td>
<td>21 766 711</td>
<td>X 23</td>
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<tr>
<td>Unemployment</td>
<td>10%</td>
<td>5.0%</td>
<td>X 2</td>
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<tr>
<td>GDP US$ purchasing power (b)</td>
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<td>$911</td>
<td>X 17</td>
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<tr>
<td>GDP / person</td>
<td>$35 116</td>
<td>$40 800</td>
<td>X 0.9</td>
</tr>
<tr>
<td>GDP growth rate (2011)</td>
<td>+0.7%?</td>
<td>+1.8%</td>
<td>X 0.4</td>
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<tr>
<td>Roads total length (km)</td>
<td></td>
<td>818 356</td>
<td>X</td>
</tr>
<tr>
<td>Roads paved (km)</td>
<td></td>
<td>341 448</td>
<td>X</td>
</tr>
<tr>
<td>Asphalt (million tonnes/annum)</td>
<td>309.2 (Europe)</td>
<td>7.5</td>
<td>X 42</td>
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<tr>
<td></td>
<td>0.6 t/pop</td>
<td>0.4 t/pop</td>
<td></td>
</tr>
<tr>
<td>Bitumen (tonnes/annum)</td>
<td>14 492 000</td>
<td>750 000</td>
<td>X 19</td>
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</table>
2012 Study Tour

Key Topics

& Questions
Key topics 2010, 2011, 2012

1. Perpetual Pavements / Long life pavements
2. Warm Mix Asphalt
3. Recycled Asphalt Pavements
4. Accelerated Pavement Testing

1. Surface Treatments
2. Binders
3. Improving Pavement Performance
4. Sustainability

1. Long life pavements
2. High performance asphalt & binders
3. Sustainability
4. Health & Safety
5. Procurement Systems
2012 Study Tour Key Topics

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

2. High performance asphalt & binders
   o High modulus asphalt (EME, HiMA), modifiers

3. Sustainability
   o RAP/WMA, bitumen substitutes, carbon calculators & energy analysis
     climate change impacts, societal concerns

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

5. Procurement Systems
   o Proprietary products (Avis Technique, HAPAS, etc.), “green” procurement,
     REACH, responsible sourcing, PPP and contract models
Overview of reasons

• A revision to the Austroads pavement design guide is required to keep flexible pavements competitive against rigid pavements

• The proposed revision will take into account the ‘perpetual pavement concept’ underpinned by the asphalt fatigue endurance limit and healing which is widely accepted in the literature (mainly NCAT test track findings)

• A number of issues hinder implementation in Australia, e.g.
  o evidence of successful implementation by Road Authorities
  o proven structural and material design procedures
  o appropriate laboratory testing and criteria (moduli and fatigue properties)
  o specification, construction and quality control requirements.

• European performance data will facilitate the validation and calibration of the limiting cumulative distribution of asphalt strain for long life pavements.
Topic 1: Long life pavements

Questions

• Usage and performance records
  o Examples and case studies
  o Composition, traffic, deflection history
  o Typical maintenance

• Design aspects
  o Design procedures
  o Most appropriate approach - mechanistic or catalogue
  o Prioritisation of focus – design models or construction

• Material properties
  o Types of materials typically used
  o Relevant material properties
  o Measurement of material properties
  o Laboratory curing and testing
  o Incorporation of “non standard” materials, e.g. PMB, EME, RAP
Topic 1: Long life pavements

Questions

• Fatigue & healing
  o Definition of fatigue/failure
  o Fatigue testing and the determination of endurance limit
  o Correlation between laboratory test results and field performance
  o Effect of binder type on fatigue/endurance
  o Healing of asphalt mixes – testing, effect of traffic loading frequencies

• Contract and construction
  o Initial construction cost – flexible vs. rigid
  o Specification requirements in D&C contract
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 adapted and adopted in Australia. Seeking details on:
  o new developments and test methods in high performance asphalt and bituminous materials (e.g. HiMA /EME, PMB, Emulsion)
  o actions taken by European and others (e.g. binder manufacturers, asphalt producers and researchers) to overcome field problems (e.g. climate change)
  o correlation between laboratory test results and field trials
Topic 2: High performance asphalt & binders

Questions

• Asphalt
  o EME/ HiMA - specification, testing, field links, pavement & subgrade requirement, binder selection & processing
  o Performance & Construction
  o Reinforced, Modified Binders & SMA – design & composition, service life, pros & cons
  o Moisture Susceptibility: measures, tests & approaches
  o PGA/PA: maintenance & performance

• Specifications and Test Methods
  o Approaches to proprietary mix design, types of modifiers used, low temperature test methods, control of segregation & degradation, etc
Topic 2: High performance asphalt & binders

Questions

• Binders
  o concerns: climate change, quality & characteristic of imported material
  o testing level, lab-field correlation, stabilisation of unbound material

• Emulsions
  o test methods
  o types used in sprayed chip sealing
  o performance based specifications

• Surfacings
  o cost benefit of thin surfacings, reasons of application & modelling
Topic 3: Sustainability

Overview of reasons - Challenges

- Climate Change – Green House Gases
- Future Carbon Tax
- Increasing Demand - Limited Resources
- Ageing Infrastructure - Rehabilitation
- Waste Reduction - Focus on Recycling
- Reduced Construction Periods – Minimise Delays
- Society’s Perceptions & Funding Constraints
Topic 3: Sustainability

Questions

• Recycled Asphalt Pavement (RAP)
  o How Extensively Used / Percentage Added
  o RAP Materials – QA, Binder Types, Ownership
  o Mix Design Changes – Binder Type & Quantity
  o Production Issues – Blending, Mixing, “wet” RAP
  o Placing Issues

• Warm Mix Asphalt (WMA)
  o How Extensively Used
  o What Technologies – Most common
  o Design & Testing Changes
  o Problems / Performance Issues

• RAP in WMA

• Other Low Temperature Technologies
Topic 3: Sustainability

Questions

• Bitumen Alternatives
  o Long Term Binder Availability
  o Reliance on Oil

• Carbon & Energy Calculators
  o What, When, Where & Why are they used?

• Climate Change
  o Is it being considered?
  o What Material / Specification changes?

• Societal Concerns
  o Perceptions of Asphalt Industry
  o Other Recycling Opportunities
Overview of reasons

• Australia has high expectations & legal requirements for a healthy & safe operating environment – key operating focus
• Europe is considered to aware and sensitive to this requirement
• Recent changes to the European operating environment (REACH, IARC, austerity) may have impacted and lessons learnt could be shared

• Specific issues and implications for Australia
  o Improving road work site safety
    – full closure / contraflow / automatic aids / speed
  o Increased environmental awareness & society friendly treatments
    – new developments | emerging concerns
    – impact of REACH on products and operations
    – IARC classification of bitumen
Topic 4: Health & Safety

Questions

• Health
  o Impacts of IARC classification of bitumen on industry?
  o Has REACH impacted on the supply and use of products?
  o Drive for healthier products? What products?
  o Noise – measured, surfacing options, maintenance?

• Safety
  o Statistics – injuries & fatalities? How measured & collected?
  o What are the greatest road worker risks?
  o What training is available?
  o What techniques / methods for safer maintenance?
  o Communicating road worker safety needs to the public – how?
  o Urban & multi accessed sites – any special safety approaches?
  o Are higher safety road surfacing products preferred?
Overview of reasons

• Australia has tried to set up systems like Avis Technique & HAPAS but have been unsuccessful

• The benefits of innovation and declining skills in the road authorities point to its greater use.

• Lessons learnt, benefits of the systems used, changes to purchasing to accommodate and implications for road authority expertise is sought.

• Use of the systems to promote innovation and product development in new areas such as CO₂ reduction, energy efficiency, nose reduction etc.

• The use of procurement systems from PPP, Alliancing, DBOM, ECI including normal contracts, long & short term contract maintenance systems.
  ○ What key performance characteristics over time?
  ○ How to retain the culture of stewardship in the contracting agency?
  ○ How to retain expertise on the road authority to manage / ensure value-for-money?
Topic 5: Procurement Systems

Questions

• Systems
  o Avis-Technique systems – are they working / cost effective?
  o Lessons learnt, still promoting innovation?
  o How are underperforming products addressed?

• Functional and performance requirements
  o Are performance based specifications used?
  o What test methods used to measure performance / proprietary?
  o Functional specifications and fitness-for-purpose assessed over time – how is this done?
  o How are environmental / traffic loading changes included in the assessment?
  o Define what a “warrantee” means, for how long, end state?
  o Can proprietary product systems replace performance-based specs?
  o Can “green procurement requirements fit into the system (C02, energy)
Topic 5: Procurement Systems

Questions

• Product sourcing and life cycle assessment
  o Has REACH impacted on the product selection and use in Europe, are their benefits?
  o Are there any “responsible sourcing” influences on product selection?
  o What methodologies and inputs are used to assess WOLC for pavements?

• Contract & procurement models
  o Are PPP widely used to fund and deliver European road projects?
  o Do PPP affect the products chosen and warranties required?
  o What are the dominant contract models for services, construction & proprietary products? Are there case studies showing cost differences?
  o Are non-price criteria used in assessing tender submissions –and how?
  o On contracted maintenance:
    • How is culture of ownership or stewardship for the network retained?
    • How do road authorities retain skills to be an informed client?
Now for the discussion & finding the answers
Current Australian Research & Development in Pavements
Asphalt & Binders
Australian Research & Developments

- Binders & Seals
- PMB Trials
- WMA Trials & introduction
- Long Life Pavements
- Innovation – BTB using foam technology
- Innovation – In-situ foamed Innovation
- Anything else?? – ARRB Conference in Perth
R&D – Austroads Projects

TT 1353 : Asphalt Properties and Mix Design
SMA issues and performance. EME (HiMa) studies

TT 1454 : Performance of WMA
Trials and introduction of State based WMA specifications

TT 1608 : Aggregate Polishing Test
Possible adoption of UK PSV test

TT 1659 : Revision of Austroads Guide pt 4B
General advice document
R&D – Austroads Projects

TT 1352 : Scarce and Quality Resources
  Characterisation of bitumen from supply points in Australia

TT 1354 : Optimising PMB performance
  Segregation studies, PAV vs Durability

TT 1357 : Maintaining the rural road network
  Sprayed seal performance, adhesion etc

TT 1665 : Current generation PMB sprayed seal trials

TT 1612 : Future availability of bitumen
  Extended bitumen (tall oil) sprayed seal trial

www.aapa.asn.au
R&D – Binders

• Australia is aware of the potential for sustainability issues with bituminous surfacings
  ➢ conserve existing
    – seals: extra life available
    – asphalt: strict compaction control, etc.
  ➢ recycle – asphalt in particular
  ➢ extend – add suitable extenders to bitumen
  ➢ replace – difficult to manufacture any renewable binder in sufficient quantities to meet current usage
R&D – Binders

• Conventional bitumen specified by viscosity at 60°C
  - Class 600 (500 – 700 Pa.s; Pen at 25°C > 20 dmm)
  - Class 320 (260 – 380 Pa.s. Pen at 25°C > 40 dmm)
  - Class 170 (140 – 200 Pa.s. Pen at 25°C > 62 dmm)

• PMBs specified by softening point, torsional recovery, viscosity and ‘consistency’. Related to asphalt applications and sealing applications
  - A10E – highly elastomerically modified asphalt grade
  - A15E – highly elastomerically modified asphalt grade
  - A20E – mid elastomerically modified asphalt grade
  - A35P – highly plastomerically modified asphalt grade
R&D Binders

- S10E – low level elastomerically modified sealing grade
- S15E – mid level elastomerically modified sealing grade
- S20E – mid level elastomerically modified sealing grade
- S25E – highly elastomerically modified sealing grade
- S35E – low level elastomerically modified sealing grade
- S40R – crumb rubber modified sealing grade (15% rubber crumb)

- Research is being carried out in Australia looking at the performance and characterisation of bitumen and PMBs to provide asset owners and Industry a framework that can deliver consistent high performance through a cost effective means
R&D Binders

TT 1352: Scarce and Quality Resources

• Key activities – characterisation of bitumen from supply points in Australia (including imported bitumen)
• Viscosity (25°C – 135°C), durability, softening point, penetration, chemical fractionation (SARA, Gaestel Index)
• Comparing the above data with historical results going as far back as 1950s
• Enabling to see whether any trends in bitumen properties are occurring.
R&D Binders

TT 1354: Optimising PMB Performance

• Key activities:
  ➢ Development of a long term ageing test method (PAV vs. Durability)
  ➢ PMB segregation study
R&D Binders

TT1357: Maintaining the rural road network

• Key activities:
  - Sprayed seal performance: adhesion mechanisms - aggregate wetting, cutting practice, precoat effectiveness
  - Double/Double seal design
  - Primerseal design
  - Guide to the selection and use of PMBs
  - Sprayer Calibration
  - Improving seal design for heavy vehicle
R&D Binders

AT 1612: Future availability and increasing cost of bitumen

• Key activities: extended binder trial was established near Ballarat (Victoria) in March 2012.
• To date the extended bitumen is behaving identically to the C170 control, although both are showing some slight stripping.

TT 1665: Current generation PMB sprayed seal trials

• Performance of current generation sprayed seal PMBs through full scale road trials
**R&D – PMB Trials**

**TT 1665** - Road trials of strain alleviating membrane seals (SAMs) sprayed at 2 sites in Australia in 2011/12. A hot, dry climate site (Coober Pedy) and a cold, wet climate site (Cooma)

![Australia Map](https://via.placeholder.com/150)

- Coober Pedy (Desert Climate)
- Cooma (Cool high elevation climate)
### Coober Pedy (hot, dry climate) layout

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<tr>
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<td></td>
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| Section Length (m) | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 180 | 320 | 250 | 250 | 250 | 250 |

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- C170 Control
- S10E
- S20E
- S35E
- Shell S5E
- BP S15E
- SAMI S20E SS
- SAMI S45R SS
Cooma (cold, wet climate) layout

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<td>600</td>
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<td>C</td>
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Binder:

- S10E
- S35E
- S15E
- S15RF
- S20E

Binder:

- SAM
- Polyseal emulsion

HSS
Some measurements...
R&D – WMA Trials & Implementation

• AAPA members have dabbled with WMA since 2000
• Field validation trial – initiative of AAPA and Austroads
• Dissemination and acceptance of data
• Aim: Does WMA perform equal, better or worse than HMA? – not an evaluation of individual WMA technologies
• Development of a laboratory evaluation protocol for WMA technologies
Field Validation Project

- Comparison of field performance of HMA and WMA
- Includes 2 additives and 2 foamed WMA mixes
- 3 HMA, 4 WMA (0% RAP), 3 WMA (with RAP of 10% to 50%)
- 3 major asphalt suppliers providing mix
- HMA is VicRoads standard mix, Dense Graded Asphalt Type H
- Field trial constructed April 2010
Pavement Before WMA Resheet
<table>
<thead>
<tr>
<th>Generic Definition</th>
<th>WMA FHWA Definition</th>
<th>Process Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Additives</td>
<td>Wax Additives</td>
<td>Sasobit</td>
</tr>
<tr>
<td>Chemical Additives</td>
<td>Surfactants Amides &amp; Other Chemicals</td>
<td>Cecabase RT945</td>
</tr>
<tr>
<td>Hydro Technologies</td>
<td>Water-bearing Additives</td>
<td>Zeolite</td>
</tr>
<tr>
<td></td>
<td>Water-based Processes</td>
<td>Foam Technologies</td>
</tr>
<tr>
<td></td>
<td>Emulsion Technologies</td>
<td>Astec Double Barrel Green</td>
</tr>
</tbody>
</table>
Field Validation Project

Laboratory testing

• 28 tests for WMA, 28 tests for HMA

• Each asphalt company completed testing

• Preparation of samples and testing by asphalt companies and ARRB – established protocol

• Laboratory observers (from VicRoads, RMS NSW, QTMR and SA DPTI) during asphalt placement, preparation of samples and testing
Field Validation Project

Field Testing:

- roughness,
- rutting,
- texture
- strength/deflection (FWD and Deflectograph)
- cracking (multi-laser NSV and visual)
- traffic volumes
- initial compaction

Austroads reporting at 0, 12 and 24 months
### North

<table>
<thead>
<tr>
<th>Chainage (m)</th>
<th>Distance (m)</th>
<th>Lane 3 (fast)</th>
<th>Lane 2</th>
<th>Lane 1 (slow)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 160</td>
<td>160</td>
<td>A WMA 0% RAP</td>
<td>B HMA</td>
<td>C HMA</td>
</tr>
<tr>
<td>160 - 335</td>
<td>175</td>
<td>A WMA 10% RAP</td>
<td>B WMA 10% RAP</td>
<td>C WMA(1) 0% RAP</td>
</tr>
<tr>
<td>335 - 485</td>
<td>150</td>
<td>C Type V WMA</td>
<td>C Type V WMA</td>
<td>C Type V HMA</td>
</tr>
<tr>
<td>485 - 700</td>
<td>215</td>
<td>C HMA</td>
<td>A HMA</td>
<td>B HMA</td>
</tr>
<tr>
<td>700 - 910</td>
<td>210</td>
<td>C WMA(2) 0% RAP</td>
<td>A WMA 10% RAP</td>
<td>B WMA 0% RAP</td>
</tr>
<tr>
<td>910 - 1120</td>
<td>210</td>
<td>B HMA</td>
<td>C HMA</td>
<td>A HMA</td>
</tr>
<tr>
<td>1120 - 1335</td>
<td>215</td>
<td>B WMA 0% RAP</td>
<td>C WMA(1) 50% RAP</td>
<td>A WMA 0% RAP</td>
</tr>
</tbody>
</table>

### South / Melbourne
# Field Trial (Foamed)

<table>
<thead>
<tr>
<th>Property</th>
<th>WMA</th>
<th>HMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulus (G.Pa)</td>
<td>4.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Rec Visc 25ºC (Pa.s)</td>
<td>1,520</td>
<td>4,340</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>0.07</td>
<td>0.04</td>
</tr>
<tr>
<td>Moisture Sensitivity (%)</td>
<td>78</td>
<td>97</td>
</tr>
<tr>
<td>Wet Tensile Strength (kPa)</td>
<td>691</td>
<td>950</td>
</tr>
<tr>
<td>W/Tracking (mm)</td>
<td>5.5</td>
<td>4.5</td>
</tr>
</tbody>
</table>
WMA Project Conclusions

• Performance after two years of trafficking was excellent and also independent of asphalt mix type, type of warm mix asphalt, and the percentage of RAP (0-50%) incorporated into the mix.

• Extent of cracking after almost two years of trafficking, compared to the extent of cracking prior to patching and overlay, was small and also that almost all of the cracking that was observed appeared to be reflection cracking.
Slow Lane Rutting OWP

- RUT OWP 2010 Apr Before overlay
- RUT OWP 2010 May After overlay
- RUT OWP Dec 2010
- RUT OWP 2011 July
- RUT OWP 2012 March

Chainage (m)

Rutting (mm)
R&D – Long Life Pavements

• Adopting best international practice is a key requirement for Australia.

• A revision to the Austroads pavement design guide is required to keep flexible pavements competitive against rigid pavements.

• AAPA is conducting an R&D project to prove the perpetual pavement concept through material characterisation and field performance. Asphalt Pavement Solutions – For Life (APS-FL)
APS-fL Project : Cracking Top Down
APS-fL : LLAP thickness design envelope? AUSSIES?

![Fig 3.2 Asphalt thickness design for 100 MSA$_{80}$ design traffic](FEHRL Report 2004/01)
APS-fL : Cumulative Distribution of Strain

CORRELATION OF STRAIN DISTRIBUTION AND PERFORMANCE

No Fatigue

Fatigue

Percentile

Microstrain

N1 2003
N2 2003
N3 2003
N4 2003
N5 2003
N6 2003
N7 2003
N8 2003
N9 2006
N10 2006
S11 2006
S13 2000

N1 2006
N2 2006
N3 2006
N4 2006
N5 2006
N6 2006
N7 2006
N8 2006
N9 2006
N10 2006
S11 2006
S13 2000
R&D – Long Life Pavements - Project

- Materials characterisation in APS-FL will generate dynamic modulus master curves (using AMPT).
- Complex shear modulus master curves for bitumen and bitumen mastic.
- Material properties to be used in CIRCLY layered elastic design analyses to determine the asphalt strain distribution over pavement temperature and loading spectrum.
- Material properties to be compared with US and European data to validate the approach adopted.
- Confirmation of test results will mean that data from US and European LTPP studies can be transferred to Australia for similar climate and loading regimes.
Resilient options for floods in Queensland

Damage across the whole state, 85% of roads with pavement damage, road users aware of the inconvenience and economic impact.

Opportunity for innovative more resilient pavement options: BTB & foam
R&D – Innovation – BTB & foam

• Industry supported project trial in Queensland (220 000 + 80 000 tonnes)
  o Remote regional centre, limited asphalt production, aggregates marginal
• Run of crusher aggregate < 20mm to base course standards
• Binder (foamed) at 4% with CL 170 (35/50 pen)
• Layer thickness of 300mm with waterproofing 7mm seal
• Properties:
  o Hamburg rutting < 8mm 20 000 passes, stripping > 16 000 pass
  o Coopers WT < 3mm, TSR > 85%
  o Density 93% CV on max theoretical density
  o Air voids target 4.5% (getting 4.5 to 6%)
R&D – In-situ foamed bitumen

• In-situ foamed bitumen
  o Has successfully been used in Australian and NZ for a number of years
  o Design
  o Different approaches by Road Agencies
    • Material/mix
    • Structural design
R&D – Any thing else??

25th ARRB Conference, 23 - 26 September 2012, Perth

- Theme: Shaping the Future: Linking research, policy and outcomes
- "International best practice workshop", Sprayed Sealing Alliance's – brainstorming ideas: aggregate rolling and aggregate precoating
- http://wired.ivvy.com/event/6NRYP8/
AAPA 2012 Study Tour to Europe – Introduction & Objectives