2012 Study Tour Key Topics

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

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

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

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
What did we want to learn?

What is the current status of binder specifications in Europe?

What strategic direction is being adopted for binder specifications?

What test protocols are under consideration for binder testing?

What are the learnings and actions for Australia?
Brief History

Circa 1995 member states of the European Union agreed that harmonisation of specifications was required to facilitate cross border trade.

The first task was to set up a CEN committee charged with producing a pan-European bitumen specification. This group, TC336 worked on collating the existing country specifications and amalgamating them into Europe-wide specifications.
Data Collection
new tests
data on binders

CEN TC336
Bituminous binders

Task Groups
TG1 High service temps
TG2 Low service temps
TG3 Ageing-conditioning

Paving grade bitumen
EN 12591
Special paving grade bitumen
Hard paving grade
EN 13924-1
Multigrade
EN 13924-2

Polymer modified bituminous binders
EN 14023
Cationic bituminous emulsions
EN 13808
Cut-back & fluxed bituminous binders
EN 15322

Oxidized bitumens
(industrial applications)
EN 13304
Hard grade industrial bitumens
(industrial applications)
EN 13305
First generation – paving grade bitumen

**EN 12591 (1999)**

based on conventional test methods

---

**Penetration**

**Softening Point**
First generation - PMB specification

EN 14023 (2005)

Penetration
Softening point
Cohesion (optional methods permitted)
RTFOT
Flash point

Optional tests: Fraass, Elastic recovery, storage stability,
Progress towards Performance Related Specifications (PRS)

The European Construction Products Directive (CPD) requires that harmonised standards should be expressed as far possible in terms which are “performance based”

Step 1 Identify binder properties linked to asphalt pavement performance
Step 2 Select and standardise appropriate test methods to measure these properties
Step 3 Collect data and ensure field validation
Step 4 Review the grading system according to the new specifications
Progress towards Performance Related Specifications (PRS)

Interestingly, binder adhesion is not yet a candidate property for inclusion in a PRS.

CEN’s current position following an extensive amount of work is that an easy to use test to characterise bitumen adhesion doesn't exist nor is it likely that one will emerge in the near future.
Bitumen industry position report (2012)

Position Paper: Performance Related Specifications for Bituminous Binders

Acknowledgements

Eurobitume is grateful to the members of the Task Force PRS for producing this document

Frank Beer – Shell
Jeroen Besamusca – Kuwait
Didier Carré – GPB
Frédérique Cointe – ExxonMobil
Gilles Gauthier – Total
Sophie Limborg – Total
Alberto Madella – Api
Antonio Paez-Dueñas – Repsol
Ignacio Perez – Cepsa
Carl Robertus – BP - Chairman
Markus Spiegl – OMV
Anja Sörensen – Aris
Chris Southwell – RBA
Mike Southern – Eurobitume
Ron Taylor – Petroplus
Wim Teugels – Nynas
Future binder specifications

Eurobitume supports further studies and validation of new test methods in a move towards a limited or stepwise introduction of PRS.

It is considered that there is a need to differentiate between binders used in standard asphalt materials and those used in more intense traffic and special applications such as porous asphalt or EME.

Existing specifications do not adequately describe characteristics of PMBs
Future Binder Specifications

Simple and Complex Binders will have separate specifications

Simple binders (standard pen grades) can be satisfactorily specified by EN 12591

Complex binders are PMBs, hard grades and multigrades (Hard grades could be considered ‘simple’ but as they are used in special applications like EME they require a more precise description of the performance properties.)

A grading system for complex binders needs to be based on a correlation of binder properties and asphalt properties
Future Binder Specifications - Complex Binders

Task Group 1 (TG1) is working on finding a PMB property related to asphalt mechanical resistance and stability (rutting)

Zero Shear Viscosity ($ZSV$) using DSR

Easier to obtain Low Shear Viscosity ($LSV$)

SHRP used (DSR) parameter: $G^*/\sin \delta$ - but poor correlation with field experience

the Multiple Stress Creep Recovery ($MSCR$) test is under review: measures the non recoverable creep compliance ($J_{nr}$)
Dynamic Shear Rheometry

Typical PMB viscosity behaviour in high service temperature (e.g. 60°C)

Typical bitumen viscosity behaviour in high service temperature (e.g. 60°C)

Low shear viscosity

Apparent viscosity

Zero shear viscosity

Low shear rate (e.g. 0.0001 s⁻¹)

'Imaginary zero' shear rate

Log viscosity

Log shear rate
**MSCR test**

- load applied for 1 s, recover for 9 s
- further 10 creep/recovery cycles
- repeated for 4 stress levels (30, 100, 300, 1,000 Pa)
- \( J_{nr} \) (non-recoverable creep compliance) is the amount of residual strain left in the specimen after repeated creep and recovery

![Graphs showing comparison between neat bitumen and modified binders](image-url)
23 papers
Rheological testing
Rheological characterisation
Ageing of bitumen
Permanent deformation
Fatigue and fracture

All work demonstrated the importance of stringent operating conditions for modified binders before they can be considered suitable for use as DSR binder performance indicators.

A key conclusion from the papers dealing with permanent deformation was the successful use of the MSCRT and the correlation of $J_{nr}$ with asphalt deformation for both conventional binders and PMBs.
Summary

European has been working on EU Standards since 1995 (not dissimilar to Australia)

Binders are to be categorised according to rheological complexity for specification purposes:

- conventional binders: pen and softening point
- PMBs: sophisticated rheological tests

(Australia has a similar approach c.f. AS2008 with AGPT/T190)
Summary

TG1 “High Temperature Properties” working on a European Standard for MSCRT. Final draft in Q2 2013

TG2 “Low Temperature Properties” further validation against road performance for candidate tests Fraass, BBR and Fracture Toughness

TG3 “Binder Ageing and Conditioning” recommends RTFOT for short term ageing and PAV for long term ageing

TG5 “Specification Framework” PRS will be introduced into next version of EN 14023
Summary

Overall a similar approach to Australia
Proposed utilisation of internationally supported test equipment (DSR)
MSCRT proposed for high temperature characterisation
Low temperature characterisation unclear
It is important for Australia to continue to observe European developments and exchange information and experiences
Thank you for your attention
Merci pour votre attention
Vielen danke fur ihre zeit
Gracias por su atencion
Bedankt voor jullie aandacht
İlginiz için teşekkür ederim