Roads Of the Future

October 23th to 26th

Hotel Westin Grand Munich

AR2012 Conference
RPF Feedback
CSIR - 6 November 2012

Herman Marais

Much Asphalt

Content

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Background


AR2000

AR2003

AR2006

AR2009


Western Province won the Currie Cup!!

Background

This Conference, like previous AR Conferences, mainly focused on:

- All aspects of the design of Bitumen Rubber and Asphalt
- Life cycle cost analysis
- Construction
- Research
- Energy and environmental benefits
- Maintenance
- Recycling
- Tire/pavement noise reduction
- Production of Bitumen Rubber as a binder or use in a hot mix.

  Particular emphasis and priority given to papers about asphalt-rubber as defined by ASTM, i.e. at least 15 percent crumb rubber from recycled waste tires in the asphalt-rubber binder.

Delegates

- More than 250 delegates from 29 Countries
- 8 Delegates from South Africa
  - Prof Alex Visser
  - Ronnie Renshaw
  - Dr Terence Milne
  - Johan Müller
  - Georges Mturi
  - Wynand Nortje
  - Herman Marais
  - Riaan Odendaal

Authors

- USA (Total 22 of which 4 is status reports)
  - California (9)
  - Arizona (6)
  - Nevada (2)
  - Wisconsin (1)
- Italy (6)
- South Africa (5)
- Poland (4)
- Spain, Czech Republic & Sweden (3)
- Brazil (2)
- China, Hungary, Israel, Norway, Portugal, Puerto Rico, Spain, Sudan & UK (1)

Papers - Binder Properties

Comparing Effects of Crumb Rubber and Synthetic Polymers on Hot Mix Asphalt Performance – Bahia et al

- *"The results are encouraging and confirm the potential of successful use of GTR to deliver good performance at reasonable cost with less risk of supply shortages experienced with other additives."*

Papers - Binder Properties

- **Evaluation of an Alternative Gradation of Crumb Rubber on Binders and Asphalt Hot Mixes – Martinez et al**
- **Relationship between Crumb Rubber Morphology and Asphalt Rubber Viscosity – Santagata et al**
- **Influence of processing conditions on rheology of tyre rubber modified bitumens – Presti et al**
  - "TR-MBs are a very effective alternative to commercially used SBS-MB. Although the rheology of TR-MBs is very sensitive to the varying of processing conditions"
- **How the rubber meets more rubber – Pampulim et al**

Papers - Binder Properties

Effect of crumb rubber modification on binder-aggregate coating – Thodesen et al

- **Anti-stripping Agents and lime improved adhesion**
- **Increased rubber content did not improve adhesion**

Papers - Binder Properties

- **Development of a Crumb Rubber Modified (CRM) PG binder Specification – Baumgardner et al**

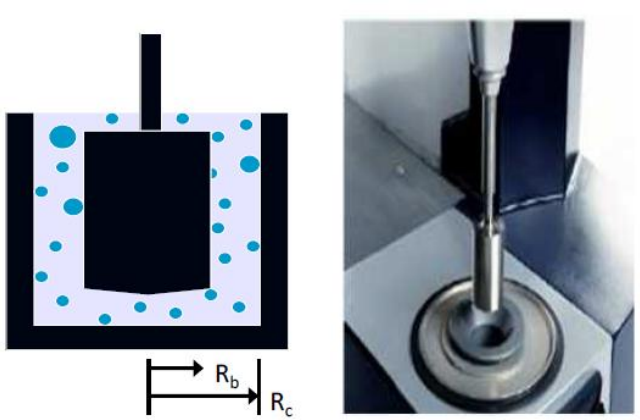


Figure 1. *a) graphic showing the bob submerged into the cup with CRM binder. b) Photograph of a cup and bob geometry with the bob extended above the cup.*

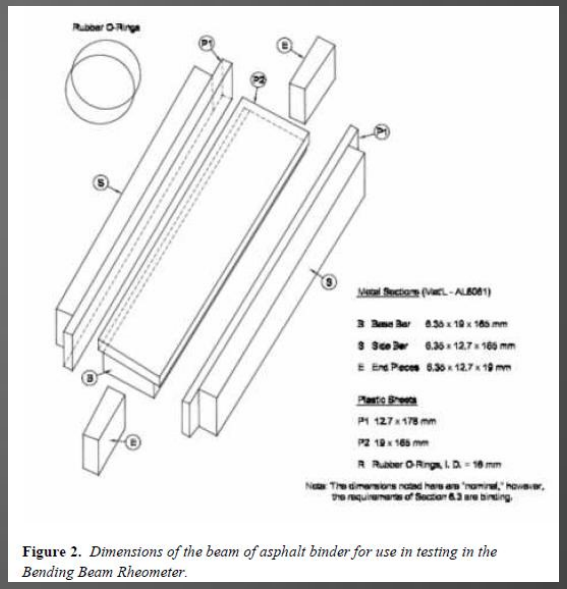
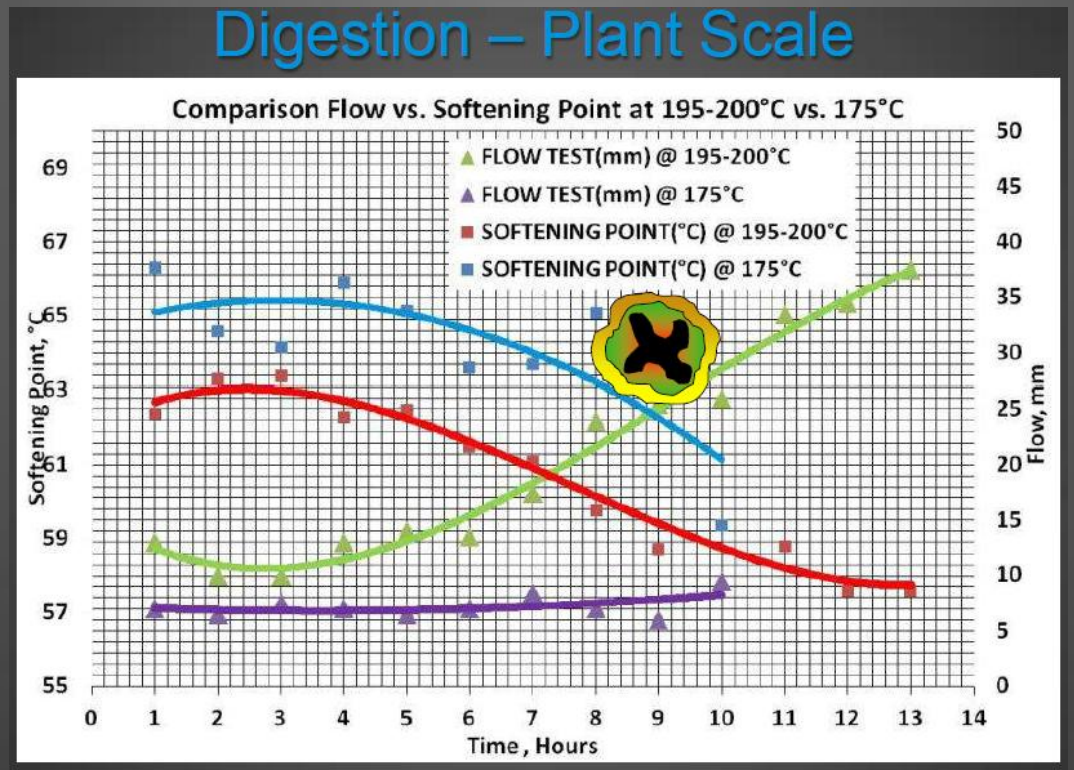


Figure 2. *Dimensions of the beam of asphalt binder for use in testing in the Bending Beam Rheometer.*

  - **Cup and Bob geometry successfully used for determination of** Superpave binder parameter G*/sin□ & Standard BBR can also be done

Papers - Binder Properties

- **THE PERCEIVED VERSUS ACTUAL SHELF-LIFE AND PERFORMANCE PROPERTIES OF BITUMEN RUBBER –** Müller et al



Papers - Binder Properties

- **Investigating the *in situ Properties of* Crumb Rubber Modified (CRM) Bitumen – Mturi et al**
  - A method for determining the rheology of CRM bitumen using a DSR has been demonstrated
  - The results were used successfully for the prediction of resilience response of a BRASO asphalt mix.
  - Rheological analysis also showed that a rheological property of CRM bitumen can be correlated to that of its soluble binder.
  - Second investigation (Seal application) showed the importance of characterising CRM bitumen properties with digestion time

Papers - Binder Properties

- **Internal structure characteristics of crumb rubber modified asphalt binders: An analysis using 3D X-ray Microtomography Imaging – Kutay et al**

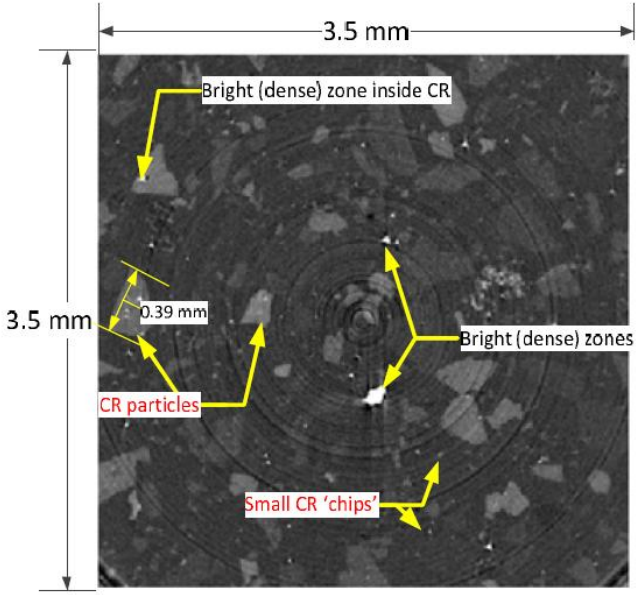


Figure 2. X-ray MT - based 2D slice image of the CR particles in the asphalt binder prepared using the Wet Process.

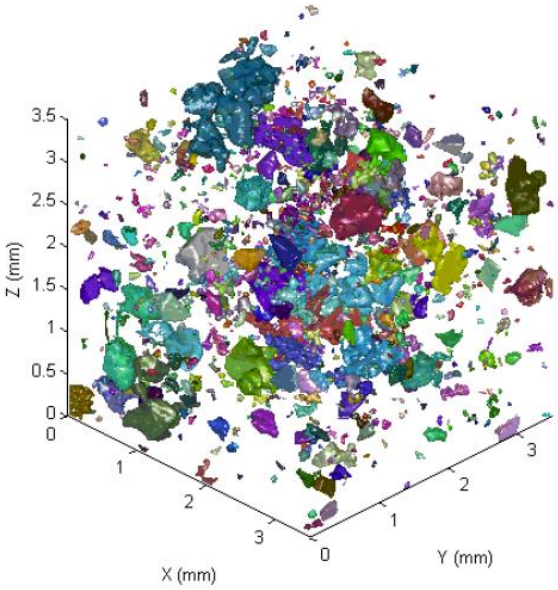


Figure 3. 3D visualization of the CR particles in the asphalt binder prepared using the Wet Process.

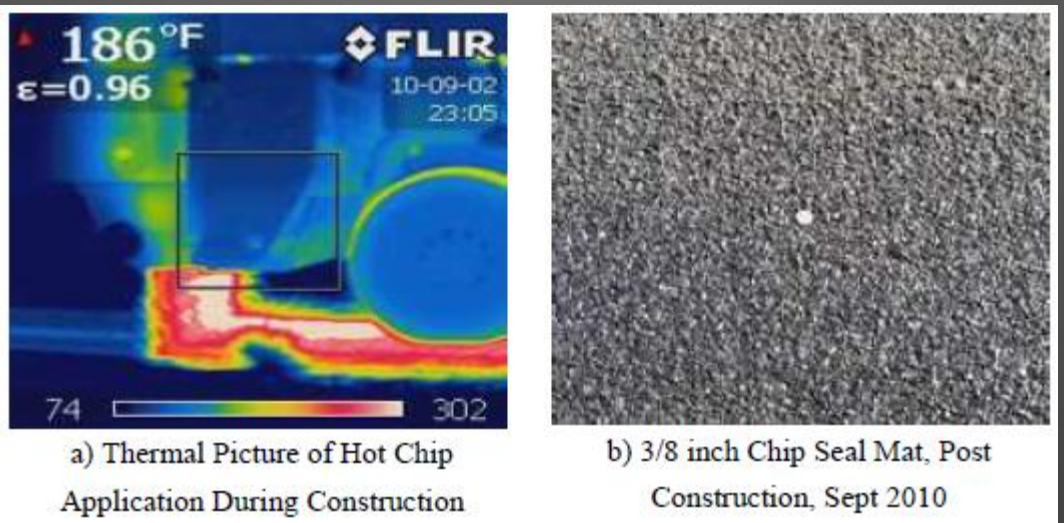
Papers - Binder Properties

Internal structure characteristics of crumb rubber modified asphalt binders: An analysis using 3D X-ray Microtomography Imaging – Kutay et al

- "It was observed that the mixing process causes the crumb rubber particles to partially melt and separate to create small CR 'chips'
- These small CR 'chips' homogeneously mix with the asphalt binder creating a polymer-like structure, which improves their engineering (e.g., fatigue) performance"

Bitumen Rubber WMA

- **Utilizing Warm Mix Technologies in Rubberized Asphalt Pavements – Cheng et al**
  - More than one million tons of RHMA warm mix placed in the northern California alone!
  - Also used in Chip Seals successfully.



a) Thermal Picture of Hot Chip Application During Construction

b) 3/8 inch Chip Seal Mat, Post Construction, Sept 2010

Bitumen Rubber WMA

- **Research findings on the use of Rubberized Warm-Mix Asphalt in California – Jones et al**
  - *"An absence of smoke and odour and significantly better workability compared to the hot-mix controls*
  - *Similar compaction levels were recorded on hot-mix control and warm-mix sections and on experiments in remote locations*
  - *Rubberized mixes could be hauled for up to four hours, placed with ease whilst still achieving the required compaction*
  - *Equal or better performance has been observed over four years"*

Bitumen Rubber WMA

- **Performance of Recycled Rubber Modified Binders in Warm Mix Asphalt Mixtures – Sebaaly et al**
  - **Evaluation of Sasobit and Advera**
  - “The use of terminal blend tire rubber-modified binder with WMA mixtures significantly improves their resistance to moisture damage”

Chipseals

- **Development and Application of the Asphalt Rubber Three Layer Cape Seal Pavement Preservation System -** Van Kirk et al
  - Slurry pre-treatment followed by BR Cape Seal

Figure 7. *Placement of the microsurfacing leveling course over wide cracks, Turlock, CA, 2010*

Figure 16. *Asphalt rubber 3-layer system, Ford Street, Watsonville, CA, 2009 (4 ½ years later resisting cracking)*

Chipseals

- **RESEARCH: BITUMEN RUBBER SEAL BEHAVIOUR ASSESSMENT AND PERFORMANCE PREDICTION – Milne et al**
  - ***The status of modelling the modified seals is presented, particularly modified bitumen binders (with postulates to that of bitumen rubber)***
- **EFFECTIVENESS OF BITUMENRUBBER DOUBLE SEAL FOR HEAVY MAINTENANCE – Jooste et al**

BR Compared

- **COMPARISONS OF RUBBERIZED ASPHALT BINDERS: Asphalt-Rubber and Terminal Blend – Shatnawi et al**
  - *"concludes that asphalt rubber and terminal blend binders are distinct from each other and possess completely different characteristics."*
  - *Each of these binders has its own properties and unique applications.*

BR Compared

- **Comparison of Conventional, Polymer, and Rubber Asphalt Mixtures Using Viscoelastic Continuum Damage Model – Zeiada et al**
  - *"The fatigue behaviour for the three mixtures was ranked based on the C-S curve results and the rubber-modified mixture showed the best fatigue damage resistance followed by the polymer-modified mixture and the reference mixture"*

BR Compared

- **Asphalt rubber versus other modified bitumens – Biro et al**
  - *"It was found that an appropriately designed and manufactured asphalt rubber binder can replace SBS, SBS-PPA or EVA, Elvaloy modified bitumen"*
- **Asphalt rubber as an alternative of polymer modified bitumen – Radziszewski et al**
  - *"Results of studies indicated that asphalt rubber display either comparable or better properties than polymer modified bitumen"*

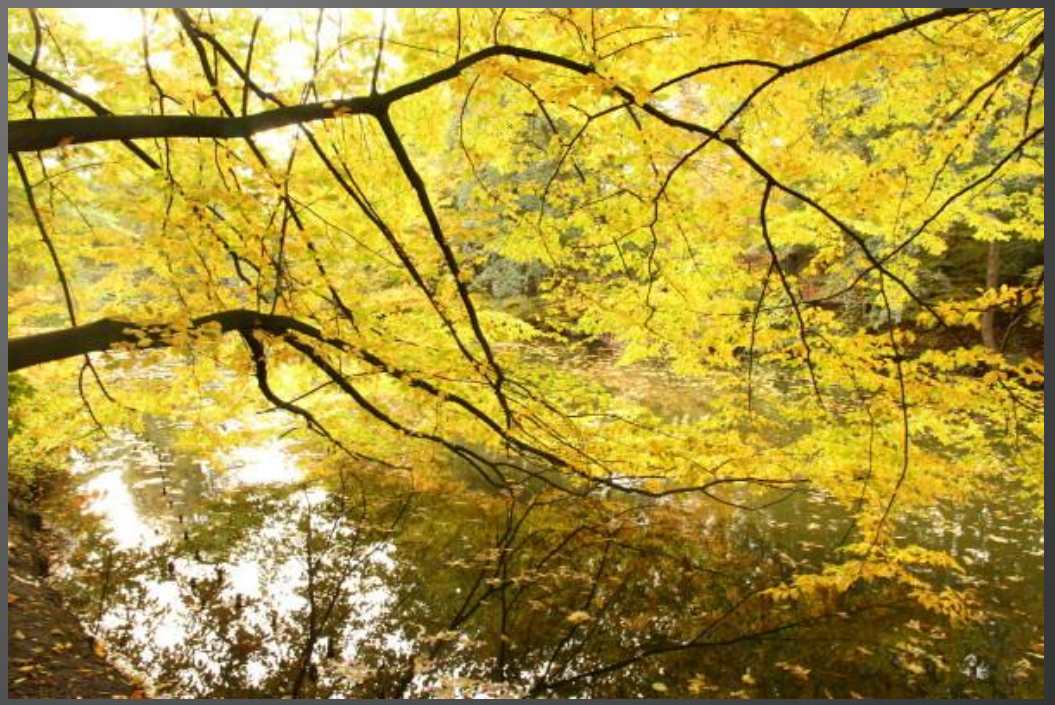
Aggregate crushing

- **Influence of asphalt rubber on the crushing of recycled aggregates used in dense HMA - de Farias et al**
  - *"particle crushing is reduced with increasing amount of crumb rubber."*

Figure 1 - a) Secondary crusher. b) Fractions of recycled aggregates.

Life Cycle Cost & Environment

- 3 papers indicating BR to be beneficial to both financial cost and environmental cost



Mix Design Validation

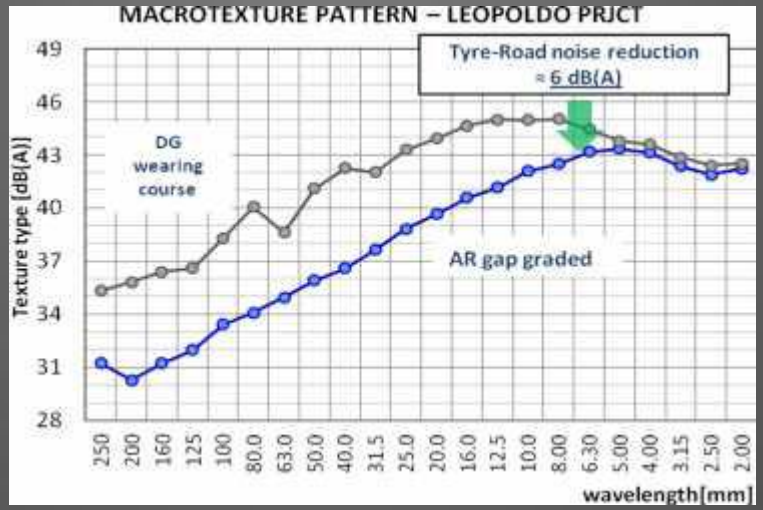
- Poland – Mastic Asphalt and SMA
- Sweden – Dense Graded and Gap Graded
- Puerto Rico – Gap Graded

Papers on Status of BR in Countries

- Czech Republic – Introduced 2008 now used
- Poland – Introduced 2006 now used
- Sudan – Introduced in 2006 and performing well
- China – Wet blend used extensively and looking at Terminal blend technology
- USA – California, Arizona, Texas, Florida used extensively – Other states limited or no use

Tyre Noise

- 4 papers indicating dampening of noise due to BR use (2 papers from Italy and 2 papers from Arizona)



New Technologies

- **Elastomeric Asphalt Extender – A New Frontier on Asphalt Rubber Mixes – Sousa et al**
  - *"The Reacted and Activated Rubber (RAR), as an Asphalt Rubber Binder, is composed of plain soft bitumen, fine crumb rubber, and an Activated Mineral Binder Stabilizer (AMBS) at optimized proportions"*
  - *Can be used as Dry blend*

New Technologies

- **New Bitumen Rubber Technology Improves Storage, Handling and Stability of Bitumen Rubber -** Müller et al
  - *"The combination of a Fischer-Tropsch wax additive and a swelling agent decreases the viscosity of the reacted binder significantly and improves the handling and compaction behaviour of the asphalt mixes.*
  - *It further allows lowering the production and paving temperatures from ~200°C to ~160°C."*
  - *Improved storage stability – 7 hours vs 7 days*

New Technologies

- **Crumb rubber modified bituminous emulsions. CRE-emulsions – Sola et al**
- **Development of Polymerized Asphalt Rubber Pelleted Binder for HMA Mixtures – Amirkhanian et al**

Railways and Runways (Spain)

- **“Subballast project” design of a new recycled crumb rubber bituminous layer in the railway track subgrade – Berenguer et al**

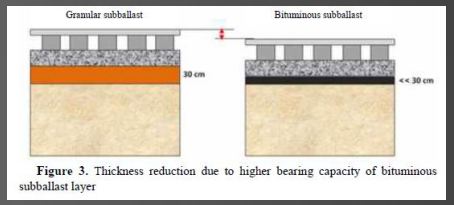


Figure 3. Thickness reduction due to higher bearing capacity of bituminous subballast layer

- **DESIGN OF ASPHALT RUBBER OVERLAYS FOR PCC PAVEMENTS IN AIRPORT RUNWAYS. THE CASE OF THE AIRPORT OF VITORIA, SPAIN – Gallego et al**
  - **100mm BR Gap Graded asphalt overlay**


Asphalt Rubber
2012
• ROADS OF THE FUTURE
- MORE CLEAR EVIDENCE OF ASPHALT RUBBER BENEFITS
- Improvements in Asphalt Rubber
- NEW PRODUCTS WITH CRUMB RUBBER