Strategic Alliance Reference Group

Field Performance of PMB’s

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Current Situation

- Modifying bitumen with polymers enhances the binders properties which leads to improved field performance vis-à-vis unmodified bitumen.
- The increased cost of PMB is offset by the improved benefit achieved through longer service life of the surfacing.
- Key is to ensure that the product we pay for is the product we get on the road!
- How do we ensure that we achieve the latter?
  - monitor the binder properties at point of application & check compliance
  - does PMB degradation = poor in-service performance?
Variables effecting PMB properties during supply chain

Crude source
Refining process

Localised overheating
Prolonged heating
Contamination

Raw materials - %, type & grade of polymer & base bitumen chemical composition
Blending process – temperature, mixing time & blender type
Effects on ‘S’ curve of SBS

Styrene content of SBS

Asphaltene content of bitumen
What do we know?

- We can expect a change in binder properties during normal handling due to uncontrolable variables.
- What effect will these changes have on the performance properties of the surfacing?
- PMB properties degrade with heating over time.
- Phase separation of polymer & bitumen takes place during prolonged heating & storage.
- PMB properties revert to those of base bitumen.
- Papers from recent AAPA conference on the topic:
  - Iulian Mann: The effect of prolonged hot storage of the elastomeric PMBs on the rutting and fatigue properties of HMA.
Numerous heat ageing studies have been executed on bitumen/SBS systems and there are two intriguing findings:

1. There is **no consistency** in the outcome of the various (empirical) tests that should quantify the effect of ageing

2. **No correlation** has been found between the overall performance changes and the chemical analysis that have taken place

By altering the mid-block of a standard SBS molecule, the polymer can be made to be more durable and smaller and therefore more compatible, whilst retaining the normal SBS benefits
Iulian Mann et al

**Softening Point**

- Number of days of storage at 185 deg.C
- Softening Point (deg.C)
  - 88
  - 90
  - 92
  - 94
  - 96
  - 98
  - 100
  - 102
  - 104
  - 106
  - 108

**Torsional Recovery**

- Number of days of storage at 185 deg.C
- Torsional Recovery at 25 deg.C (%)
  - 20
  - 30
  - 40
  - 50
  - 60
  - 70
  - 80
Correlation between Softening Point and Wheel Tracking rut depth

\[ y = 0.343x - 0.3882 \]
\[ R^2 = 0.1446 \]

Correlation between Torsional Recovery and Wheel Tracking rut depth

\[ y = 0.2181x - 0.0919 \]
\[ R^2 = 0.2324 \]
Conclusions: I. Mann

- All mixes exceeded 1 million cycles in Fatigue testing. This behaviour demonstrates that a 34 days hot storage of the A10E binder doesn’t have a detrimental effect on the fatigue life of the asphalt mixes;

- Wheel Tracking rut depth values ranged between 1.8 and 2.1mm indicating no significant changes in the rutting properties;

- Correlation between the rheological properties considered in the study and wheel tracking rut depth at various stages of hot storage is very poor;

- The results obtained in the present study clearly indicate lack of correlation between the change in the rheological properties of an A10E binder and the performance of the hot mix in the laboratory.
Where to from here?

- Ensure adequate engineering controls in tanks i.e. stirrers, use thermal oil for heating large tanks, temperature controls with cut off, circulate during heating
- Develop method statements for handling PMBs in collaboration with supplier. Update PMB code of practice
- Poor correlation between PMB properties & lab performance tests therefore:
  - uncertainty over the impact change in PMB properties will have on in-service performance of surfacing
  - need to monitor in-service performance over time to establish impact of change in PMB properties
- Continue to monitor changes in PMB properties during handling & validate with in field performance
- Implement performance based specifications for surfacings?