

Bio-based SMA FIELD TRIALS

Partial to full replacement of fossil bitumen

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Bio-based SMA: the road to 100% fossil-free binder

Dutch approach

Standard Asphalt mixtures

- Mixture design: Follow the standard “ RAW bepaling”
- functional approach (CE Marking, Type test)
 1. Binder and Base layers (RA content not limited)
 2. Surface layers (AC surf) upto 30% RA
 3. SMA and PA no RA content allowed

Innovatieve Mixtures (sustainability driven)

- High RA content, special noise reducing mixtures, Bio binder, etc... requires validation
- Validation based on TRL levels (TRL-1 to TRL 9),
- Intensive traject and usually requires 5 years or more

Transition Fossil to bio binder

Sector challenge requires sector wide approach : TCL and TRL need to match

Complementary forward looking exploration also help to identify potential solutions

Bio-based SMA: the road to 100% fossil-free binder

CIRCUROAD: Sector collaboration

A stepwise replacement of fossil bitumen: **BBM30** → **BBM50...** → **BBM100**

Step 1 - BBM30: 30% bio-component in the binder.

Laboratory validation to TRL 4 → 200-300 m trial sections to reach TRL 6 to TRL 9.

→ TRL ladder hand in hand with TCL (market)

Current status

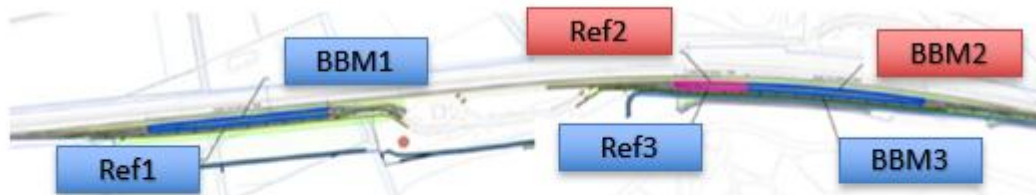
- BBM30 validation is ongoing for SMA/AC-surf (30%RA), PA(45%RA), & Bin/base binders(60-70%RA)
- Exploration: evaluating 100% bio-based replacement (BBM100)
 - 100%Bio replacement is not meant for validation at this stage, more for exploration



1st Test section: SMA 40%RA BBM30

Test section with in CIRCUIROAD scope

- One of the three BBM's in InnovA58 test sections
- Length: 300m
- Constructed: december 3, 2024



Figuur 1: Inrichting proefvakken



BIO SMA

SMA 8B 70/100 BBM30
40% reclaimed asphalt

REFERENCE

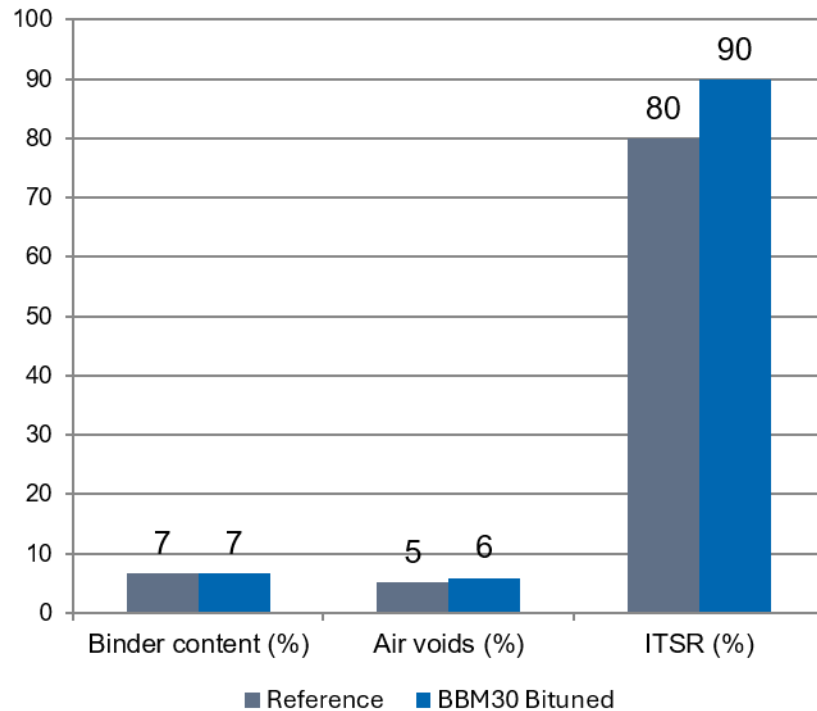
Standard SMA-NL 8B 70/100
0% reclaimed asphalt

Primary purpose: evaluate production, workability and realised field quality at TRL 6.

1st Test section: SMA 40%RA BBM30

Mixture design

- Functional approach, similar target properties
- Difference lies in RA content, and binder type



Key design differences

Bio SMA

40% reclaimed asphalt
6.7% target binder
BBM30 binder (grade 160/220)

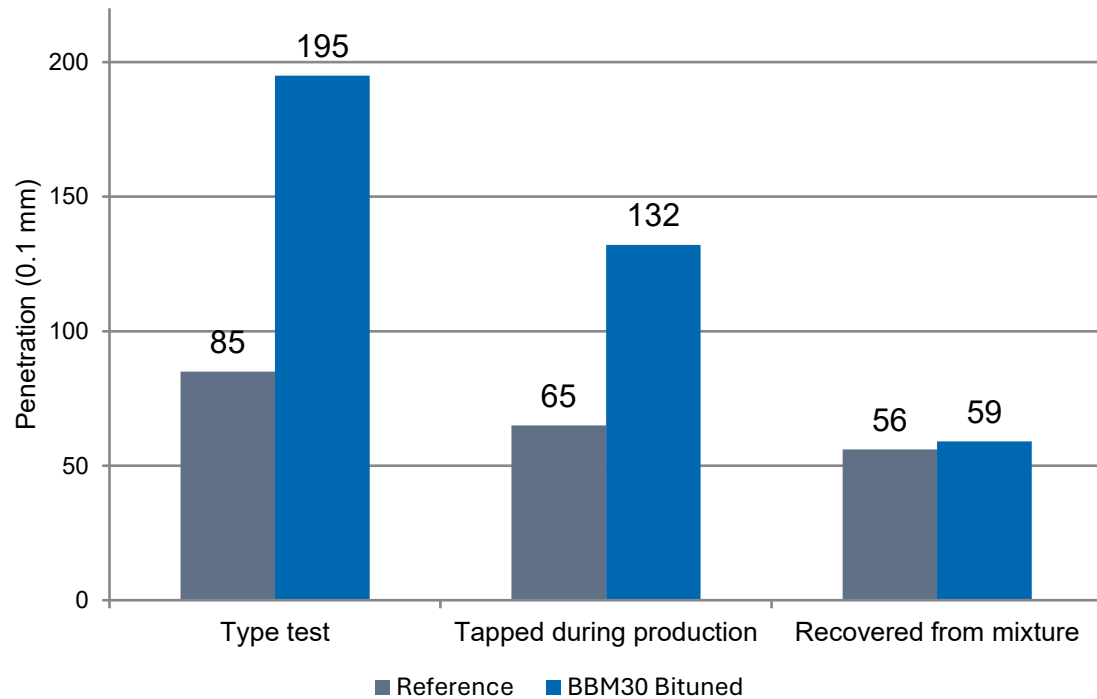
REFERENCE

0% reclaimed asphalt
6.6% target binder
70/100 bitumen

Type-test water sensitivity:
ITSR_80 catagory

1st Test section: SMA 40%RA BBM30

Binder properties



Recovered binder

59 dmm bio

vs.

56 dmm reference

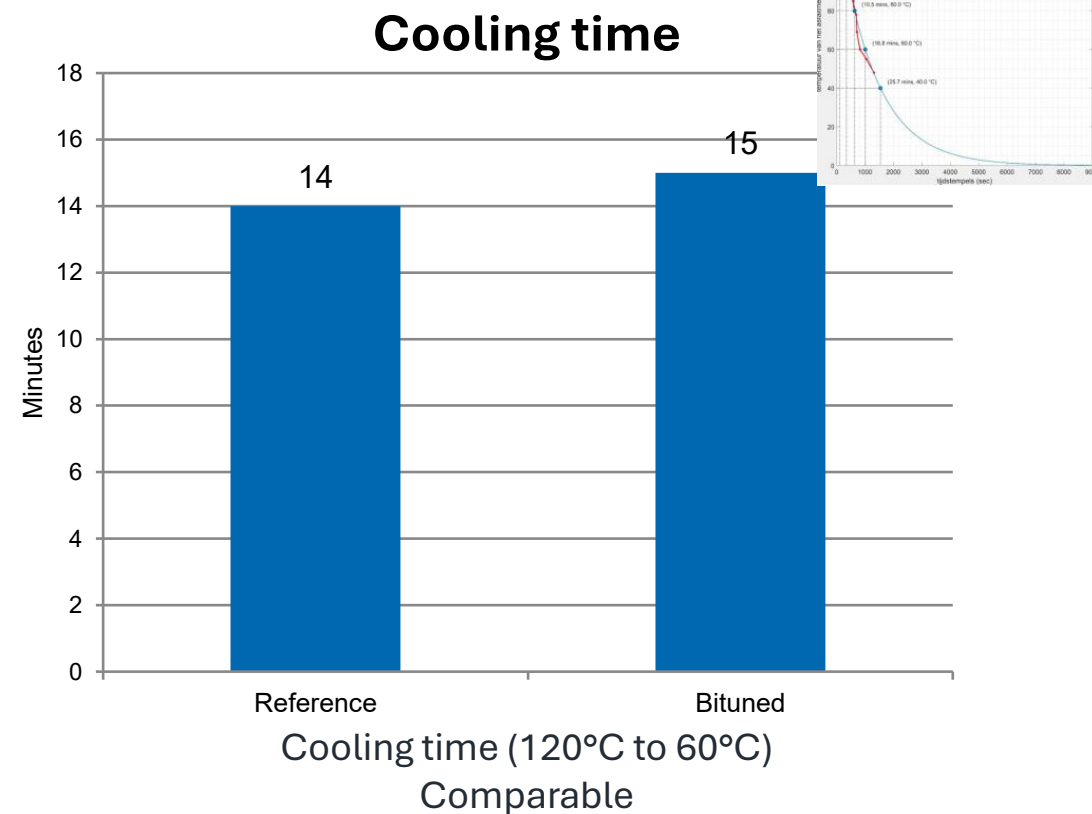
Comparable target properties

1st Test section: SMA 40%RA BBM30

Paving process:

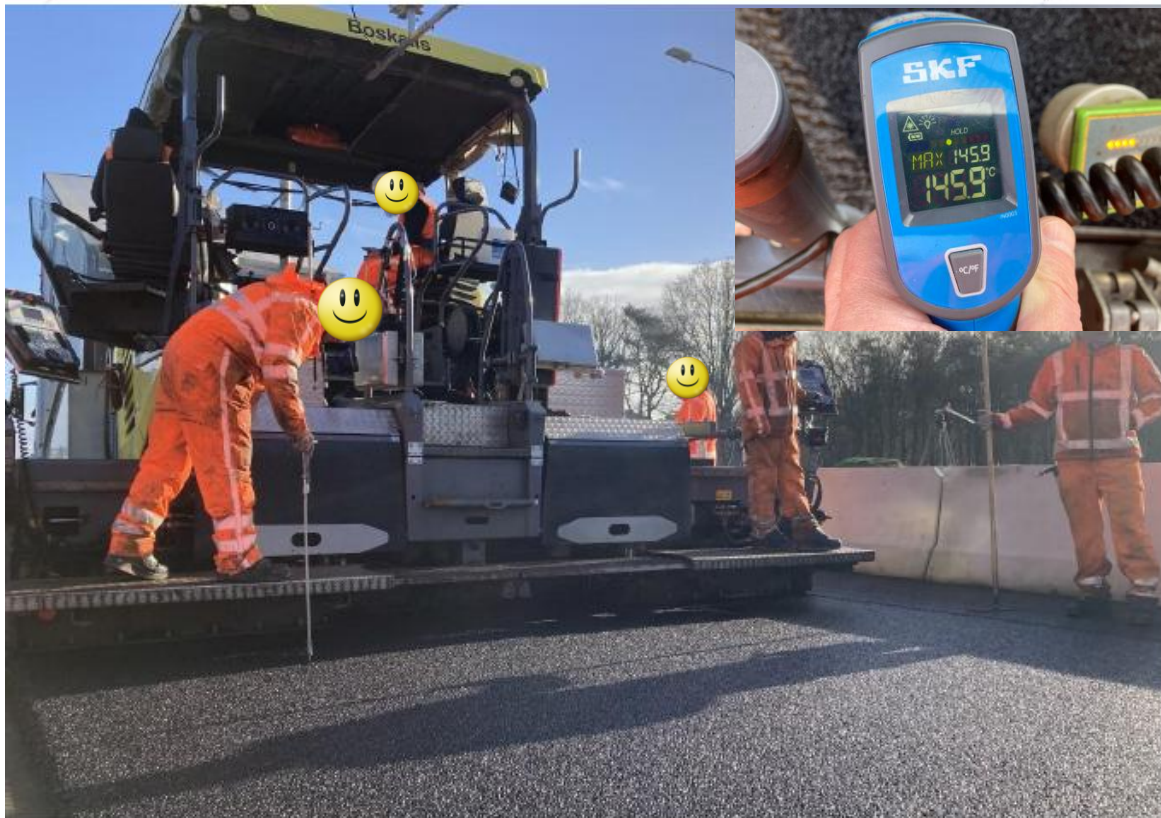


Fig : Temperature homogeneity Ref and BBM bituned(dec3-2004)



1st Test section: SMA 40%RA BBM30

Paving process:



Workability **Good and homogeneous**

Compaction **No unusual observations**

Crew feedback **Overall positive**

Temp Behind the screed **140-150 °C ~ 30C lower than the ref.section**

Bio SMA fitted the normal paving workflow.

1st Test section: SMA 40%RA BBM30

Delivered quality

Metric	Reference	BBM30 SMA
Layer thickness	36	36.5 mm
Binder content	6.7%	6.9%
Air voids	6.4%	8.3%
Compaction	98.5%	97.6%
Dry ITS	1.40 MPa	1.40 MPa
Wet ITS	1.05 MPa	1.26 MPa
ITSR*	75%	90%
Skid res.(req 0,63)	1.01	1,03

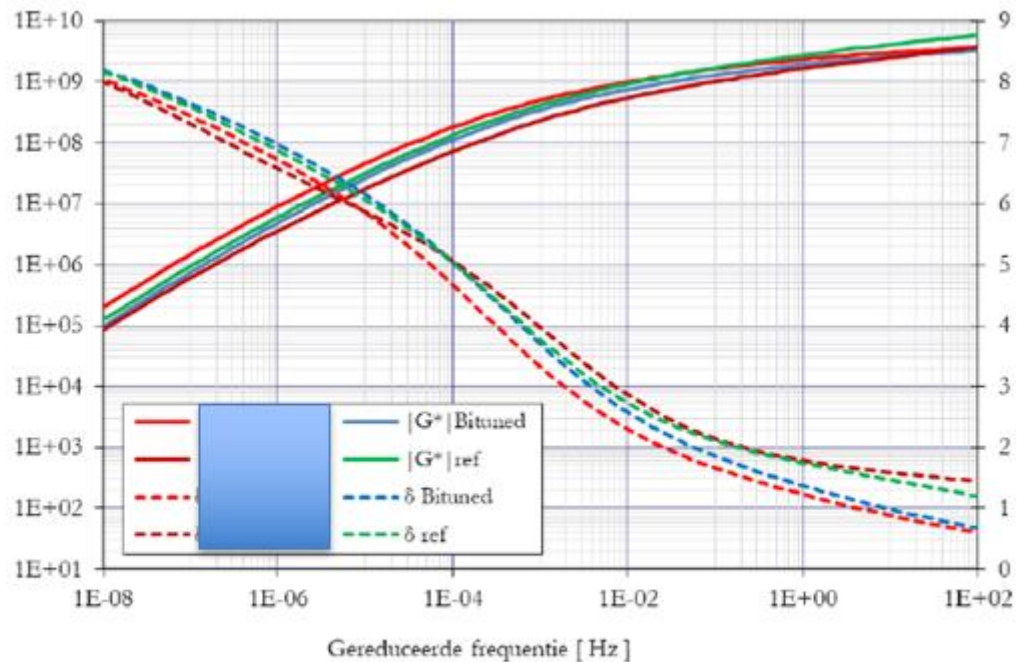


Slightly higher air voids but in general very comparable quality with the reference section

*Indicative only because ITSR on field cores is largely influenced by core thickness

1st Test section: SMA 40%RA BBM30

Delivered quality: Mortar properties Tref -10°C



*Master curve of mortars, Tref = -10°C



Very comparable Mortar properties

1st Test section: SMA 40%RA BBM30

Inspection 2025



Full replacement BBM100 : SMA 65%RA BBM100 trial section

Purpose: explore the potential

- Mixture, 65% RA with 100% Bio binder
- Length: 300m
- Constructed: May 11, 2026
- Location: InnovA58 Access road.



BIO SMA

SMA 8 BBM100 65%RA

REFERENCE

none

Primary purpose: evaluate production, workability and realised field quality: explorative

BBM100 - Fresh bio-binder: soft, workable, bitumen-like

Viscosity and mixing temperature

Rotational viscosity → Equiviscous temperature (173 mPa·s): **150 °C**

Binder compatible for use in current production facilities

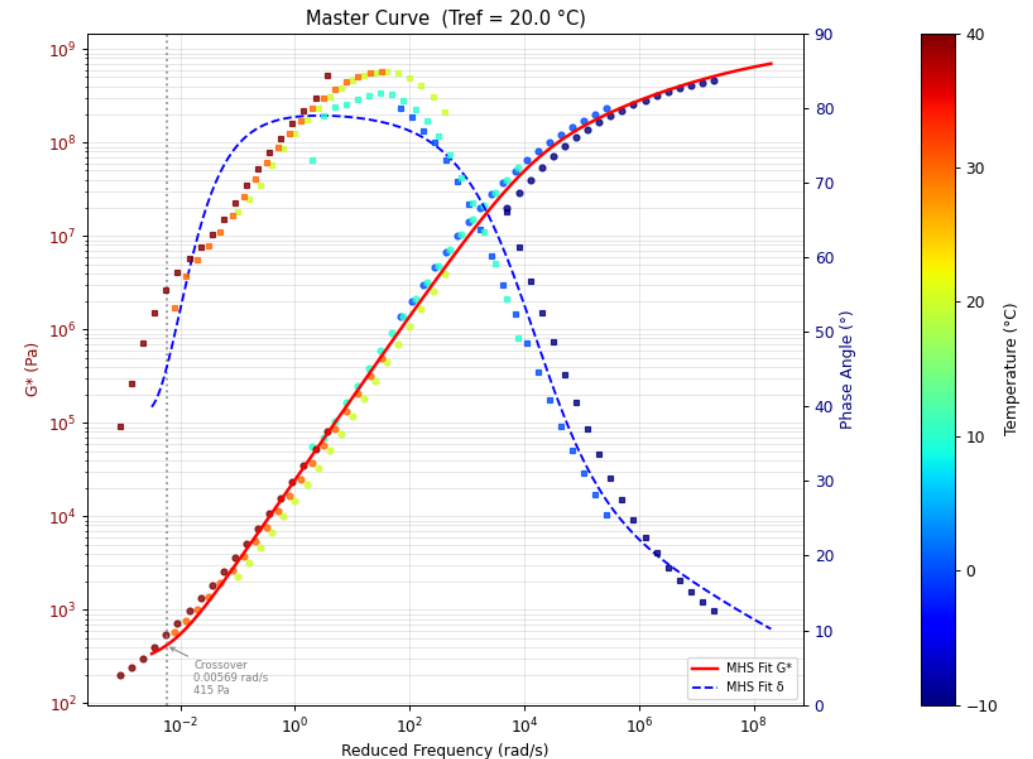
HMA production temperatures; no special handling.

Rheology (DSR, -10 to 40 °C, Tref 20 °C)

Thermo-rheologically simple material.

Very soft binder, consistent with a 160/220 grade - by design, to rejuvenate the RAP binder.

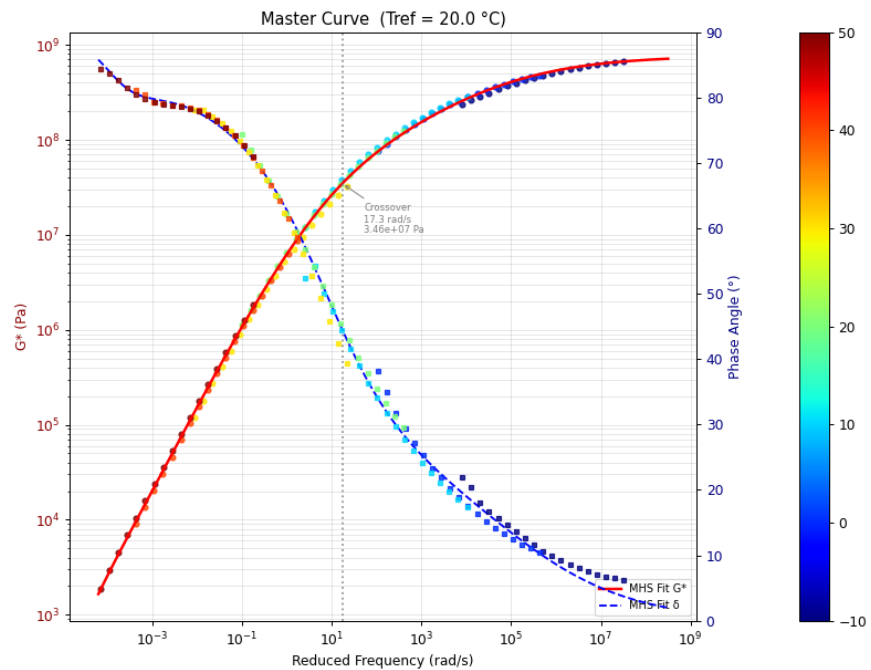
Phase angle → possible use of a PMB modifier.



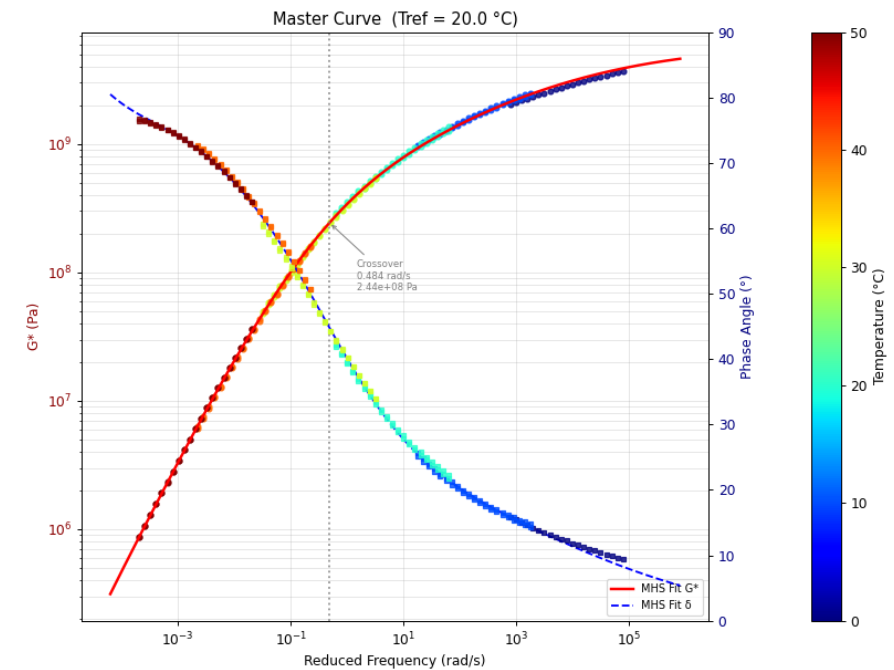
Master curve fresh bio-binder 160/220

BBM100 – Mortar and Recovered Binder

Bio binder blend well with fossil binder. No sign of a two-phase or incompatible blend
Time-temperature superposition remain valid (bitumen & Mortar level).



Recovered binder - SMA BIO 65% RA (Tref 20 °C)



Mortar - SMA BIO 65% RA (Tref 20 °C)

Field trial: feedback



Workability

Good and homogeneous

Compaction

No unusual observations

Crew feedback

**Overall positive:
Odour distinct and more fumes than BBM30**

**Temp Behind the
screed**

~165 °C

Conclusions

BBM30 (30% bio replacement)

- TRL 7/8 test sections with 30% RA are underway via Circuroad.
- Long-term performance of various sections being monitored.
- Alongside the **mechanical performance**, **recyclability**, **emissions** and **health** aspects are being studied.

BBM100 (100% bio replacement)

- production, laying and compaction went smooth.
- This proves the road map towards 100% bio is tangible.
- EVT of the BBM is ~150°C
- high RA content requires higher production temperature → explains the higher fumes relative to the BBM30

What this means for the sector

- Bio-binders are no longer a laboratory concept
- Compatible with current practices: same tests, same acceptance procedures and same paving and quality control procedures.
- Missing aspect: long term performance → the sections are being monitored.
- Every tonne of bio-binder is a tonne of fossil bitumen that stays in the ground.



Thank you for your attention

Questions?