AV '19 KONFERENCE ASFALTOVÉ VOZOVKY 2019

Binder and mix evaluation of highly modified bitumen

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Motto: Po asfaltových vozovkách k černým zítřkům

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Background

Pavement preservation systems can address key challenge for asset management of mature road network

European vision towards circular economy encourages whole life cycle approach including end of life

High performance asphalt mixes, such EME* type, provide long lasting, optimised pavement design

SBS modified bitumen has shown proven benefits in surface layers and can find value in structural layers

Full evaluation of asphalt with highly modified bitumen for modern and smart asphalt pavement

* Enrobés à Module Elevé

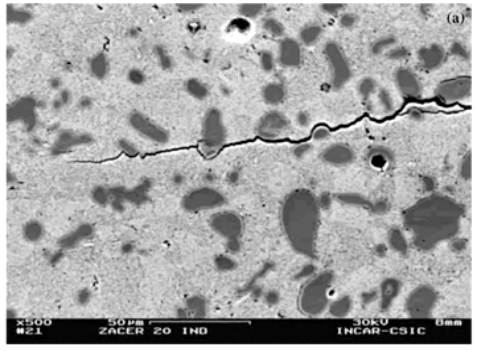
HiMA concept

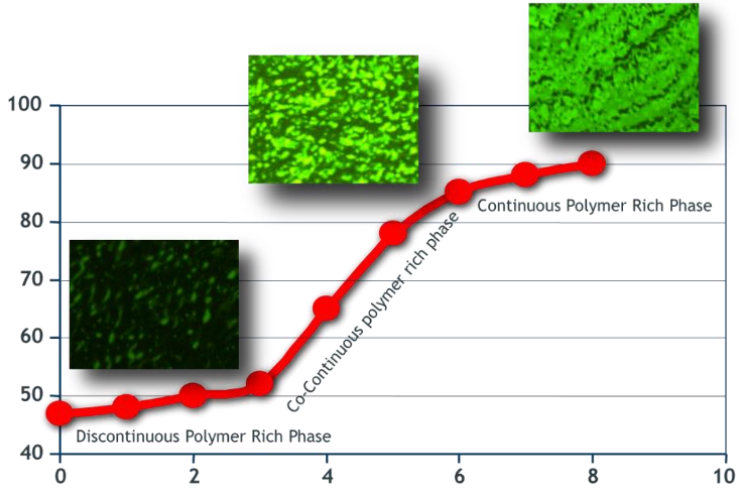
Highly Modified Asphaltic binder

Balance between asphaltenes and polymer phases

- SBS in bitumen expands by 7-10 times in volume
- HiMA achieved with 7-8 % SBS
- Denser polymer network for rutting and cracking resistance

Advantages for structural layer



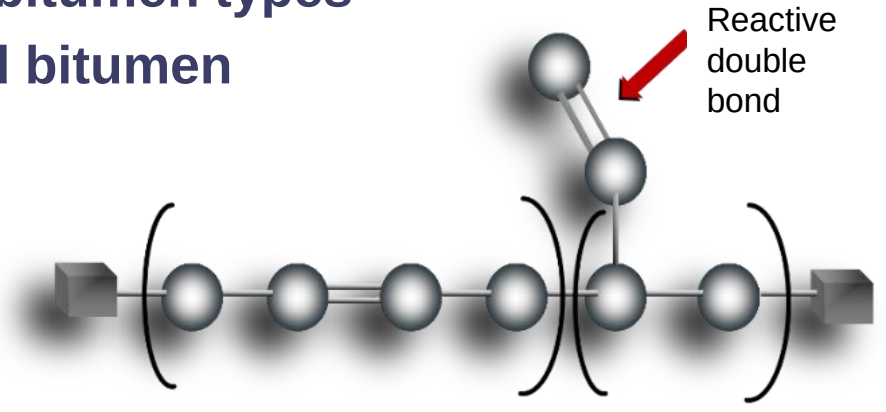


The path to HiMA

With standard SBS polymer, the higher the SBS content, the higher the viscosity is

Mitigate potential high viscosity with tailored high vinyl di-block SBS (D0243)

- **Easy dissolving, low shear often sufficient**
- **High compatibility with various bitumen types**
- **Suitable for modification of hard bitumen**
- **Improved aging resistance**



Experimental plan

Comparing BBME* type mix with HiMA mix

- BBME* with hard binder 20/30 and 25% RA**
- Asphalt Concrete, AC***16, with HiMA binder and 25% RA**

Binder evaluation

- Conventional properties including aging
- More fundamental rheology properties

Mix evaluation

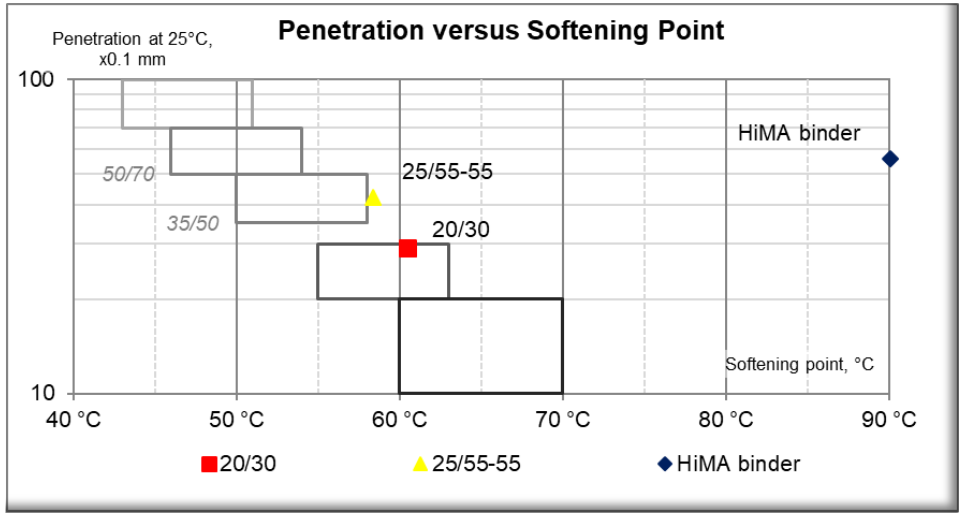
- Mechanical characteristics, rutting, modulus, cracking susceptibility
- Binder recovery and further evaluation

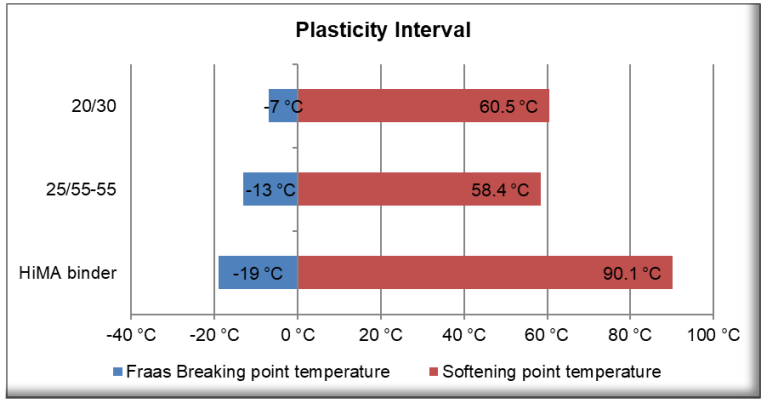
* Béton Bitumineux à Module Elevé, **Reclaimed Asphalt, ***Asphalt Concrete

Binder characterisation

Based on penetration value at 25°C and softening point temperature

- HiMA binder achieve high softening point > 80°C and still reasonable penetration value
- High temperature interval (delta in softening point vs Fraass)

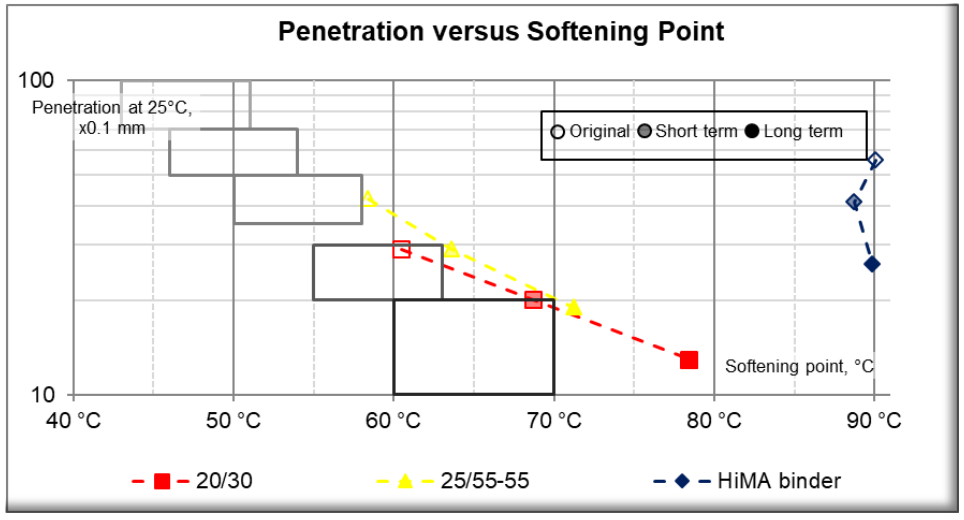




Binder aging

Binder lab aging

- Short-term aging with RTFOT
- Long-term aging with PAV



Less changes in properties for the HiMA binder

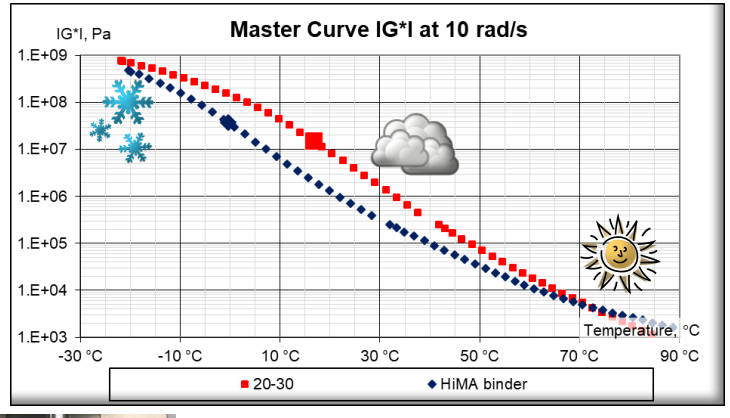
Rolling Thin Film Oven Test
75 min at 163 ℃

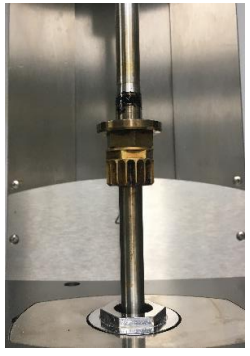
Pressure Aging Vessel
20 h at 100 ℃

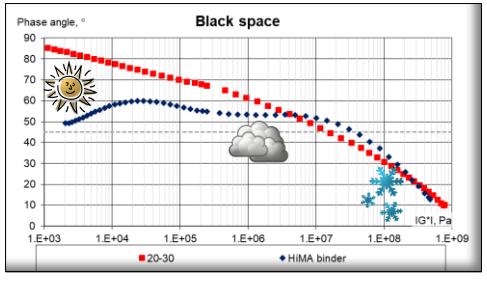
Binder rheology, fundamental properties

Dynamic Shear Rheometer

- Wide range of temperatures

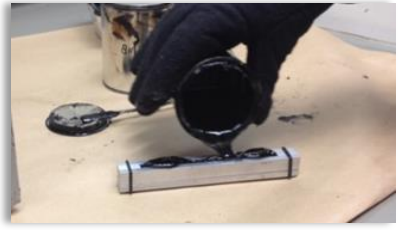


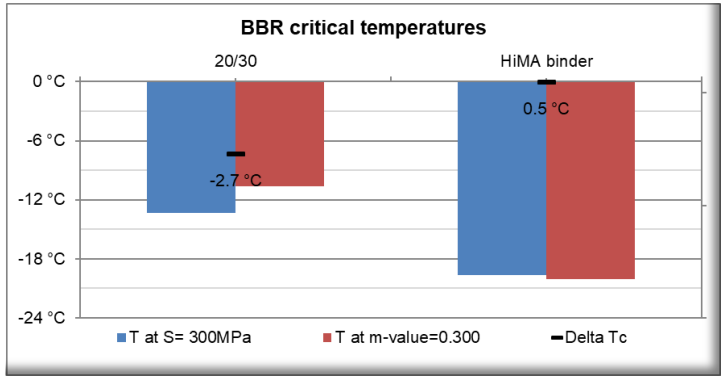




Bending Beam Rheometer

- At low temperature, creep stiffness and relaxation





Asphalt mix

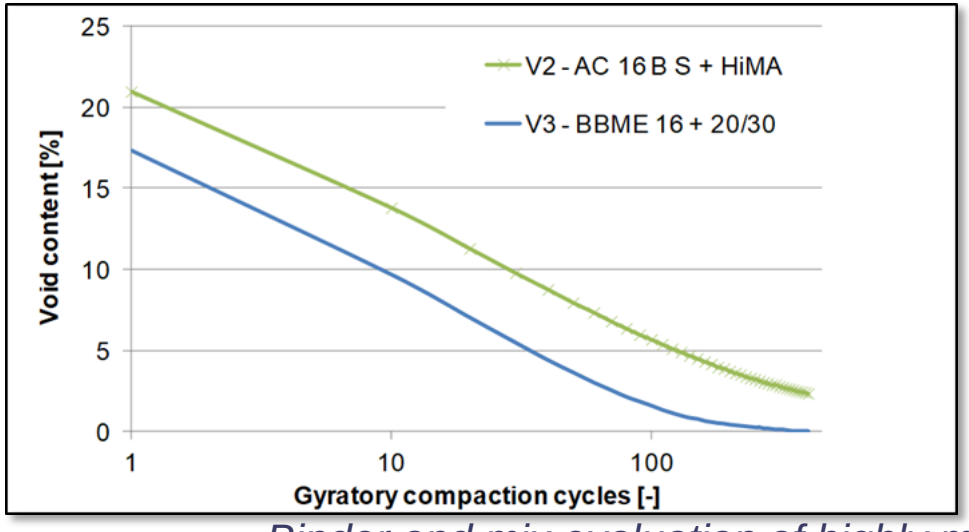
Asphalt mixes with 25% Reclaimed Asphalt, RA

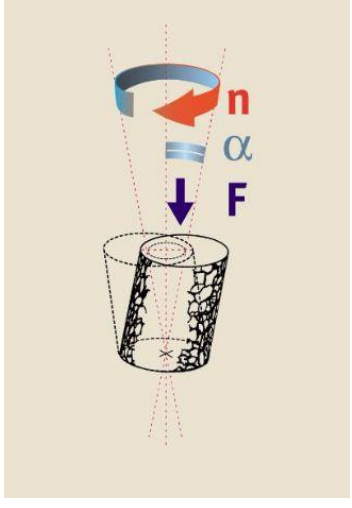
- BBME with higher binder content 5.4% and filler 8%

Mix	Binder	RA	Binder content	Void content
BBME	20/30	25%	5.4%	2 - 4 %
AC 16 HiMA	HiMA		4.8%	5 - 7 %

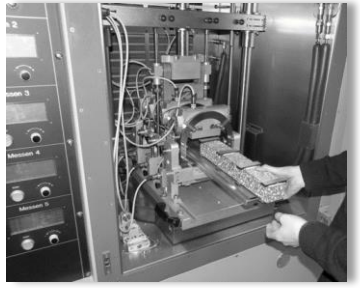
Compactability via gyratory compaction

- Much lower void content with BBME



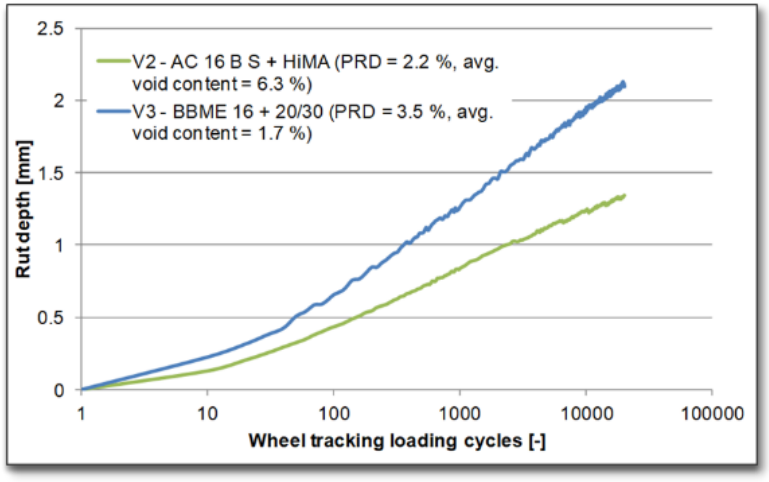


Asphalt mix mechanical characterisation



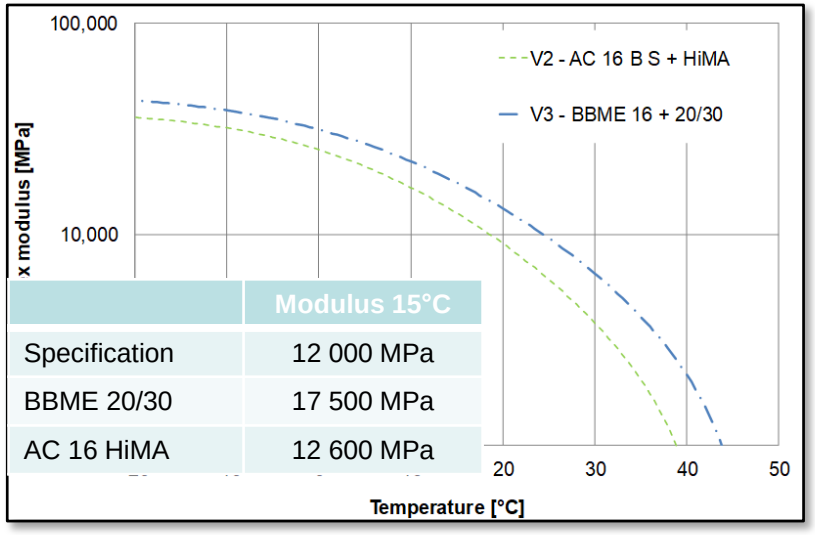
Rutting resistance (EN 12697-26)

- BBME slightly higher rutting depth



Modulus 4PT (EN 12697-26)

- BBME → very high modulus due to RA
- HiMA re-balanced modulus in specification

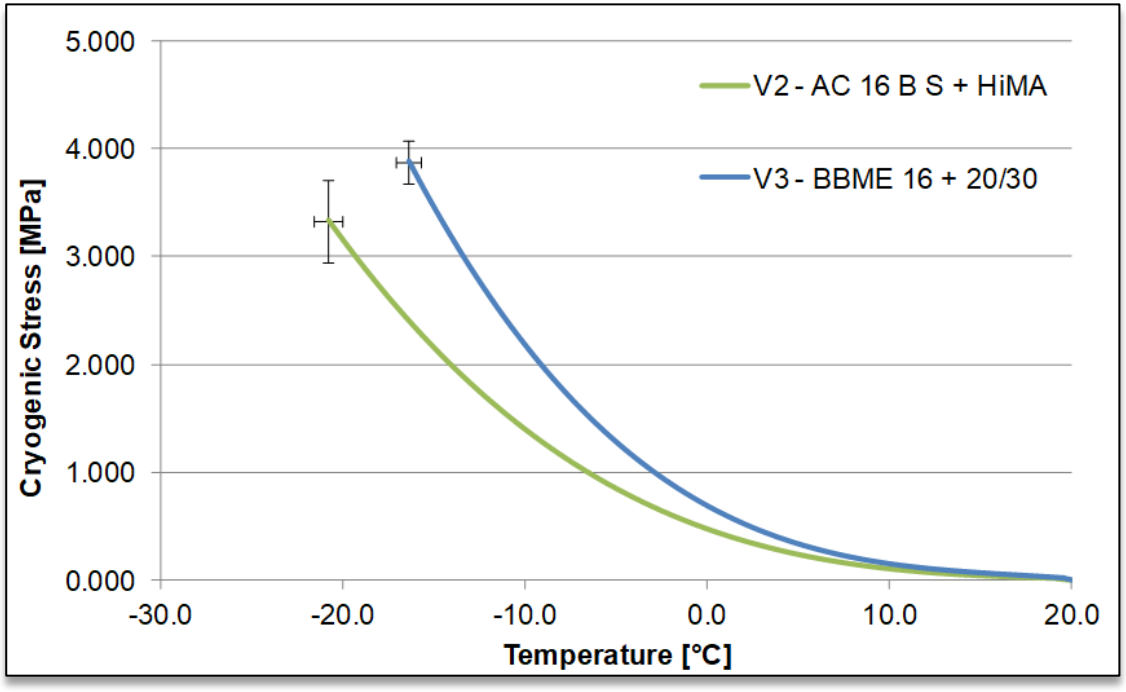


	Modulus 15°C
Specification	12 000 MPa
BBME 20/30	17 500 MPa
AC 16 HiMA	12 600 MPa

Additional mix testing

Cracking susceptibility through restrained cooling test

- Ability to withstand thermal shrinkage
- HiMA mix shows better cracking resistance



Thin overlay – Kalety Poland 2013

First project in Poland on secondary road

Pavement at the end of its life with severe distresses

Thin overlay 2.5-3 cm SMA 5 DSH with HiMA 65/105-80

No cracking even after 5 years

Initial pavement condition - 2013

Pavement condition after 5 years - 2018

Conclusion

- Use of balanced mix design to evaluate asphalt materials
- HiMA in structural asphalt layer can meet EME type specification
  - ➡ No need for higher binder content as for EME mix type
- Enable the use of Reclaimed Asphalt without adverse effect
- Better cracking resistance
- Already track records in Eastern Europe

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