FIELD EXPERIENCE of LONG-TERM EVOLUTION of SBS POLYMER MODIFIED BINDER

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DURABILITY : Highway field experiment

The stakeholders:
- The Swiss Road and Transportation Association
- The Valais Canton
- The University of Lausanne – EPFL / LAVOC

Site conditions

Traffic pressure
- 24000 vehicles per day between 1988 and 2007
- Heavy goods vehicles: 6% of the overall traffic

Climate
- Specific weather station near the sections since 1992
- Temperature sensors placed at the different depth of the structure
- Humidity sensor
- Radiometer measures visible and infrared solar radiation
- Typical weather of the alpine valleys:
  - Long periods of sunshine (270 days per years and $T^\circ$ over 30°C on a regular basis)
  - Cold conditions, under -10°C and days with very quick cooling-down speeds (5°C/h)

Road surface structure
- Standard bituminous concrete 16S, 4cm thick
- Binder content and thickness of the wearing course are identical for all products
- Heavy goods vehicles: 6% of the overall traffic
LAVOC Field validation study from 1988 to 2002/ 2007

16 comparative test sections of 300 m length each on CH-N9 highway (repaved in 2002)
1 complementary test section of 4 km with Styrelf 13/80 (repaved in 2009)

Comparison test section structure
1988 – 2002
Lot 342 between Junction Vétroz–Conthey and Ardon (Switzerland)

Section 11
Styrelf® 13/80
AB 16S
AB 25 uS
HMT 0/32
HMF 0/40

5.5 cm
5.5 cm
8.5 cm
14 cm
42 cm

Structure and foundation of the highway (test and complementary section)
Field validation: Observations after 14 years

Cracked!

Un-Cracked!
LAVOC field results

Monitoring of the evolution of binders and asphalt mixes during the pavement life

On site inspection of the surface layer durability: Cracking

Rutting not an issue

- Observations made after 4, 7 and 10/14 years of traffic

Binder extraction and analysis ⇒ Aging

- Binder extraction according to SN 670 401a and EN 12697-3:2005
  - Recovery of 150g residual asphalt by toluene – optimized method
- Classical characterization (Pen, R&B, Viscosity, Elastic Recovery)
- Low temperature behavior: Fraass brittle point, BBR
- Chemical analysis: Gel permeation chromatography, Oxidation degree by FTIR-spectroscopy (CO and SO-Index)
LAVOC Field results: CRACKING AMPLITUDE INDEX

On site inspection of the surface layer durability: Cracking

- Observations made after 4, 7 and 10/14 years of traffic

![Graph showing cracking extent and severity measurements]
LAVOC Field results : BINDERS PROPERTIES

Samples
- Section 15 (80/100), Section 11 (Styrelf 13/80) and Styrelf 11bis (Styrelf 13/80)
- After 2 years, 8 years, 14 years and 19 years (11 bis)

Binder extraction and analysis ⇒ Aging
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LAVOC Field results : BINDERS PROPERTIES

- Constant evolution of the pure bitumen during road service
- The PmB evolution stabilizes after 8 service years
Same tendency for BBR results.

The increase in the temperature at which the stiffness is 300 MPa is limited to only 4 °C for the PmB, as opposed to 12 °C for the asphalt.

The limiting m-value temperature evolves more than the iso-stiffness one for the neat asphalt.

This result indicates a lower cracking risk for the PmB.
The PmB elastic recovery remains at a high level even after 19 service years (only 13 % loss) showing a good and durable relaxation ability at 25°C.
LAVOC Field results:
MIX PROPERTIES vs ROAD OBSERVATIONS

- TSRST test on samples after one year on the road
- Correlated with the degradation of the road after 10 years of service

Planche 11

Styrelf®

TSRST failure temperature

R² = 0.79

Pure bitumen
Polymer modified bitumen
Additivated bitumen

Cracking extent evaluation
The CO and SO indexes reach a peak after 4 years before decreasing slightly up to 19 years.

The chemical stability for PmB reflects that of the performances.
CONCLUSIONS

➤ Field ageing affected the pure asphalt much more than the polymer modified binder Styrelf 13/80
  ▪ Lower ageing sensibility of crosslinked PmB

➤ Confirmation of visual observation by binder characterization
  ▪ Zero low temperature cracking on the section 11 and 11bis

➤ Globally, the long term behavior of the crosslinked PmB used in this study presents a high and outstanding performance level
  ▪ Polymer effect reduced but still present, even after 19 years in service

➤ Good performance at the lab (binder and mix characterizations) reflected the very good onsite behaviour

➤ Very good durability of motorway with Styrelf 13/80
THANK YOU FOR YOUR ATTENTION

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