AV '23 CONFERENCE ASPHALT PAVEMENTS 2023

VYHODNOCENÍ CHOVÁNÍ RC POJIVA NA POKUSNÝCH ÚSECÍCH V ČESKÉ REPUBLICE

EVALUATION OF THE BEHAVIOUR OF RC BINDER ON THE TRIAL SECTIONS IN CZECH REPUBLIC

Markus Spiegl, Michal Varaus, Siegfried Kammerer

28. – 29. November 2023, České Budějovice

SDRUŽENÍ PRO VÝSTAVBU SILNIC
ČESKÁ SILNIČNÍ SPOLEČNOST CZECH ROAD SOCIETY
EAPA
PRAGOPROJEKT

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FAKULTA STAVEBNÍ ústav pozemních komunikací

Brno University of Technology
Faculty of Civil Engineering

OMV Refining & Marketing GmbH

- Dr. Ing. Markus Spiegl
- Ing. Siegfried Kammerer

OMV

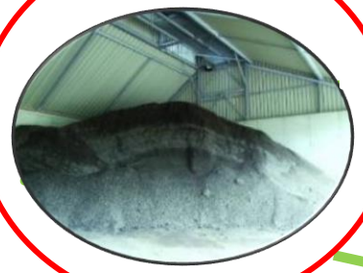
CZ research partner who sponsored the test track

- Státní fond dopravní infrastruktury / State Fund for Transport Infrastructure

Asphalt mix production and road paving

Reclaimed Asphalt Pavement
- Old asphalt (after 10-20 years)
- 100% recyclable / reusable
- Solid
- Bitumen is hard and brittle

RAP



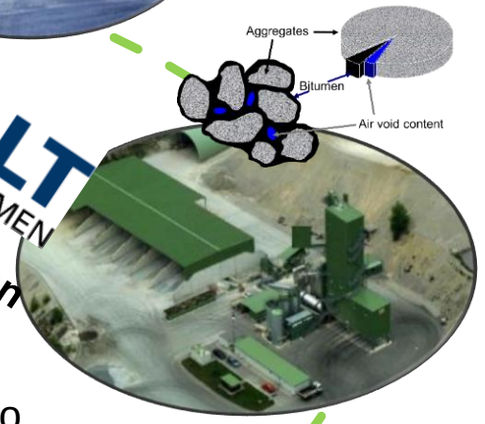
Refinery

OMV STARFALT HIGH PERFORMANCE BITUMEN

For Highway construction

Bitumen transport

- Truck
- Liquid
- Hot (170-200°C)
- ADR relevant



Asphalt mixing plant

Transport to construction site

Road paving

Road under traffic

Road maintenance

Recap presentation 2019

1/2

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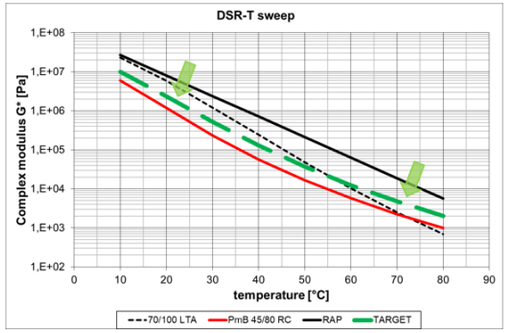
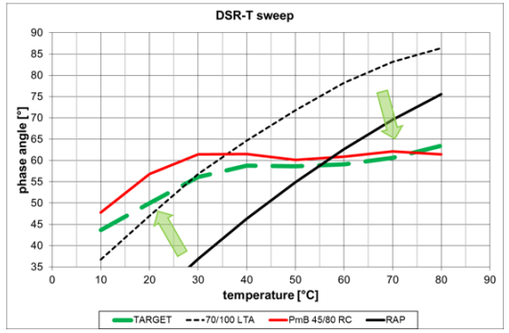
Product development

Rheological properties - DSR

Complex Shear Modulus (G*)



Phase Angle (δ)



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First trial sections – Austria – L384

Asphalt mixture	planned RAP content [%]	actual RAP content [%]	Binder Fresh OMV Starfalt PmB 45/80 RC	Binder - RAP	Binder - total	Void content [%]
AC 16 surf RA15	15	15	4,5	0,8	5,3	2,4
AC 16 surf RA20	20	19	4,3	1,0	5,3	3,0
AC 32 bin RA15	15	14	3,8	0,6	4,4	3,4
AC 32 bin RA20	20	21	3,5	0,9	4,4	2,3

Road Condition in Laßnitzthal after 9 years in use

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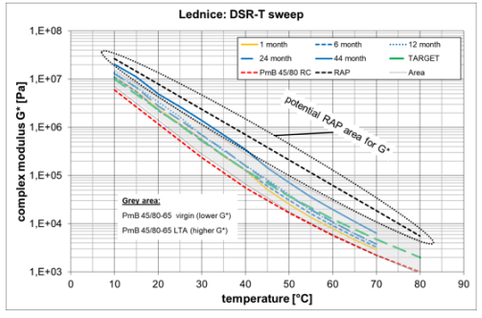
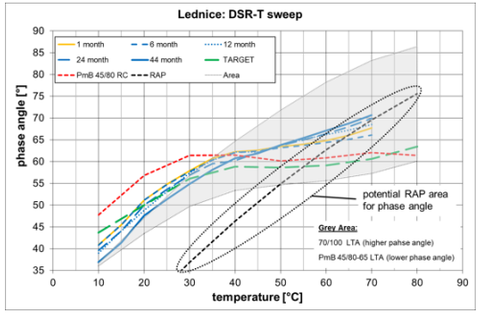
Test results and interpretation - CZ - Lednice

Rheological properties DSR of RAP, ACP 22 S (RA20), neat PmB 45/80 RC and target product

G* of RAP, ACP 22 S (RA20), PmB 45/80 RC and target product



Phase Angle of RAP, ACP 22 S (RA20), PmB 45/80 RC and target product



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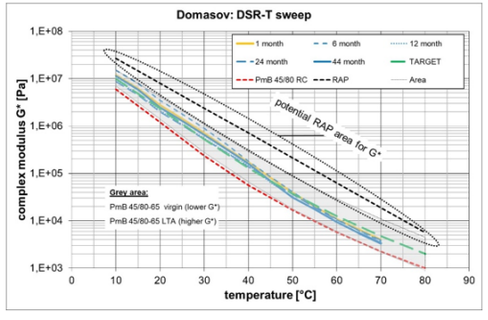
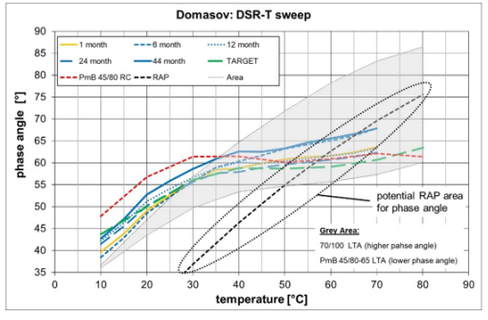
Test results and interpretation - CZ - Domasov

Rheological properties DSR of RAP, ACO 11+ (RA15), neat PmB 45/80 RC and target product

G* of RAP, ACO 11+ (RA15), PmB 45/80 RC and target product



Phase Angle of RAP, ACO 11+ (RA15), PmB 45/80 RC and target product



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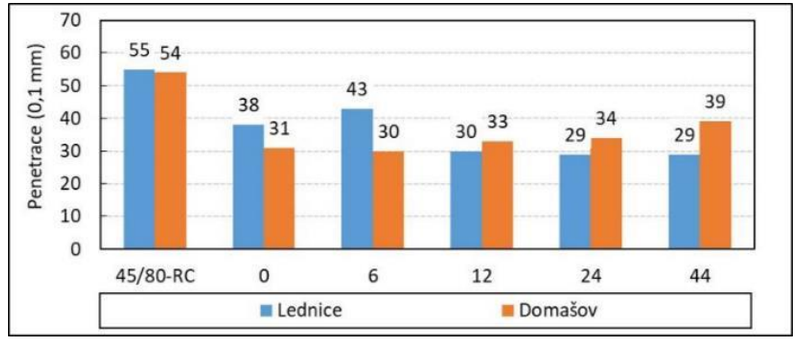
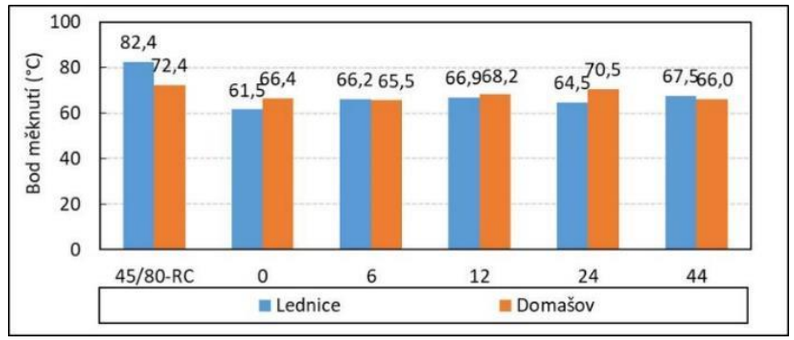
Test track – Lednice & Domasov built in 2015

Results of the first 4 years

Penetration of the neat PmB 45/80-RC and the recovered binder (variation in time)



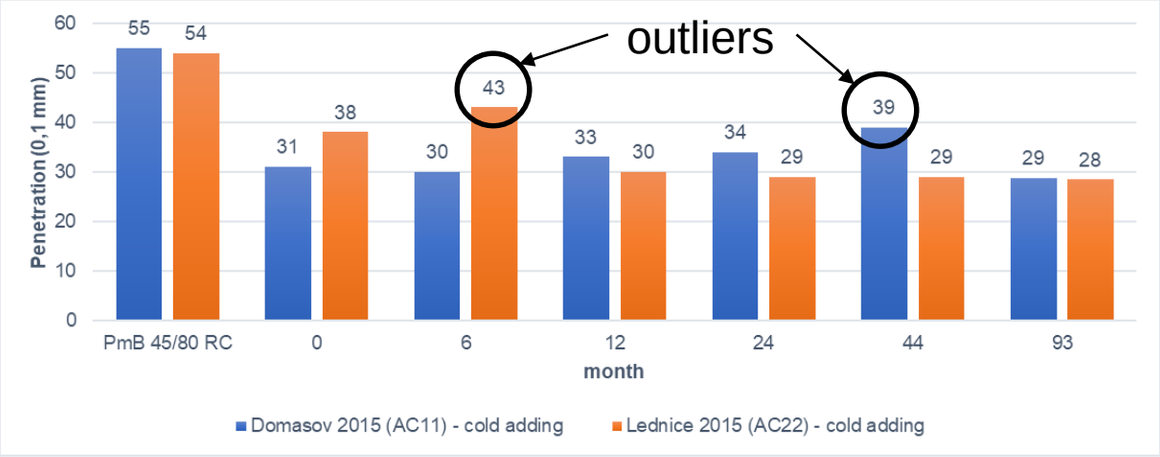
Softening point of the neat PmB 45/80-RC and the recovered binder (variation in time)



Test track – Lednice & Domasov – test results

Penetration

fresh PmB 45/80 RC and the recovered binder after 0, 6, 12, 24, 44 and 93 months.

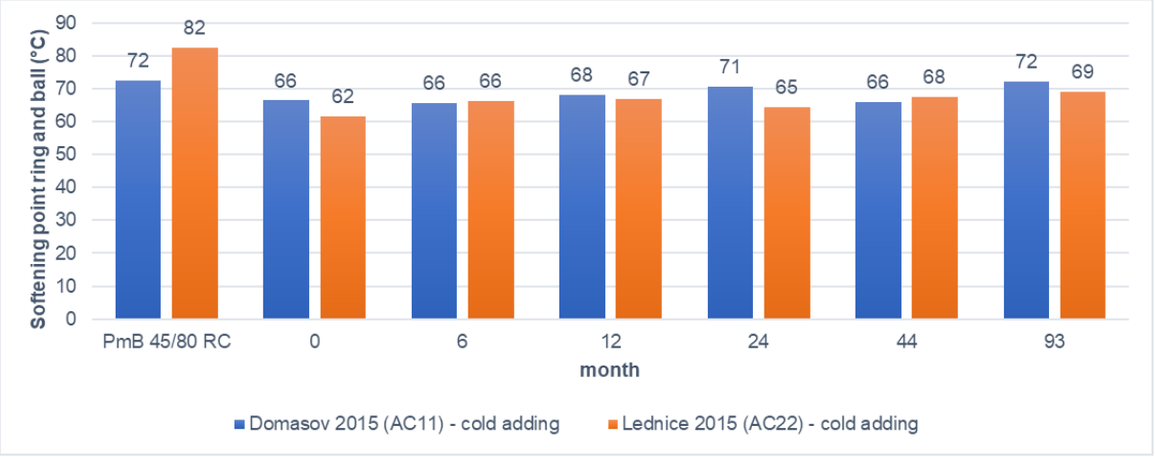


Penetration:

- Lednice – stable
- Domasov – slightly harder
- Value slightly below 30

Softening point R&B

fresh PmB 45/80 RC and the recovered binder after 0, 6, 12, 24, 44 and 93 months.

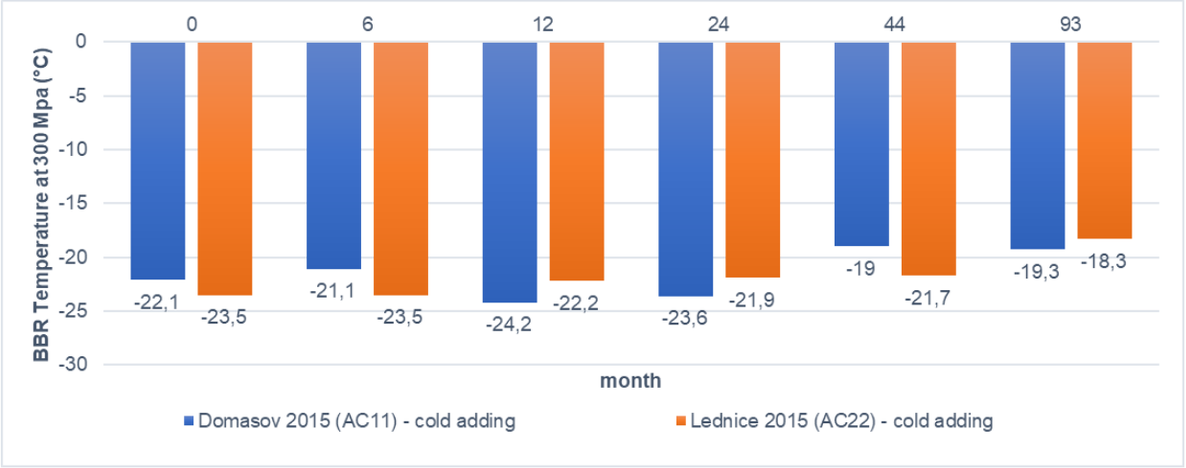


Softening point:

- Lednice – slight increase
- Domasov – slightly increase

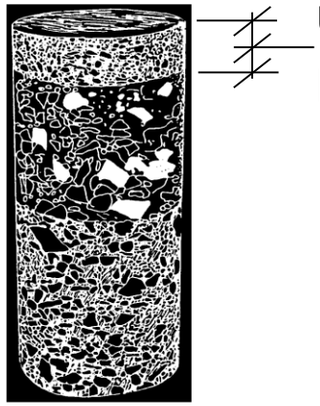
Test track – Lednice & Domasov – test results

BBR - Critical temperature
with a bending stiffness S = 300 MPa
after 0, 6, 12, 24, 44 and 93 months

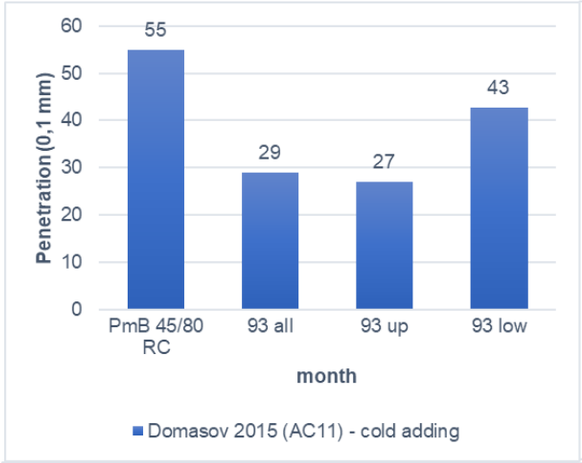


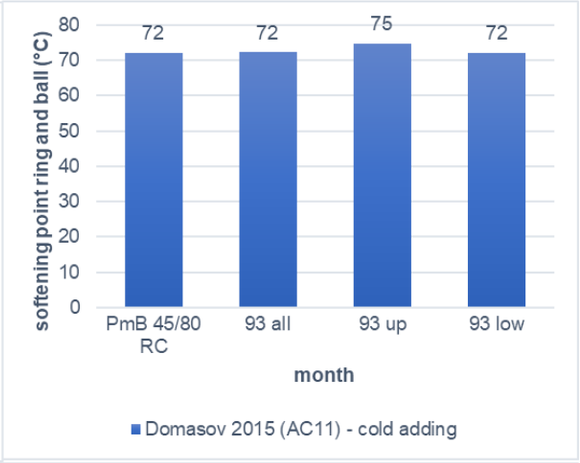
Critical temperature – for both test track slightly increasing, but not dramatically for 8 years
Domasov – increase of 3°C
Lednice – increase of 5°C

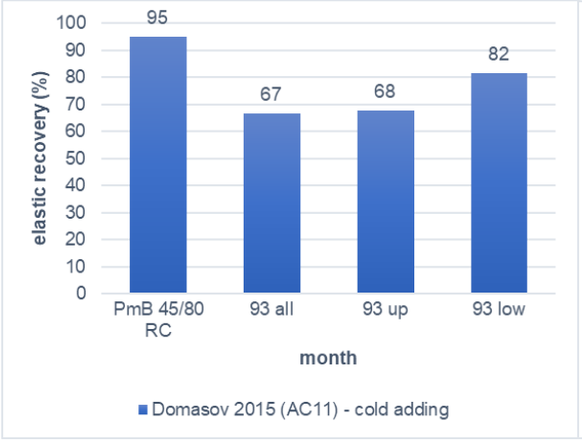
Test track – Domasov – test results AC 11

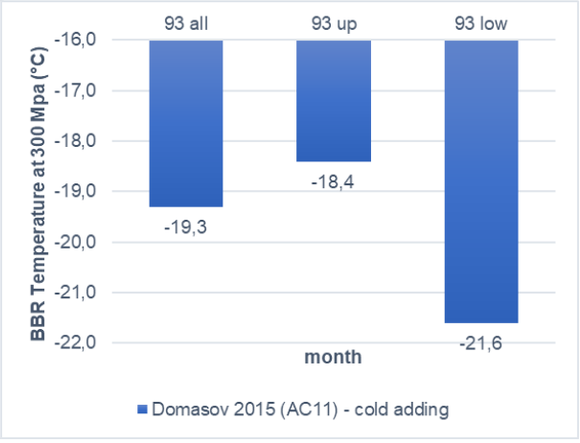


- Pen: “up” – significantly harder
- SP: “up” – slightly higher
- el. Recovery: “up” – lower, but still good with 68%
- Critical temp.: “up” – higher, but still good with -18,4°C
- Upper 2 cm – stronger ageing



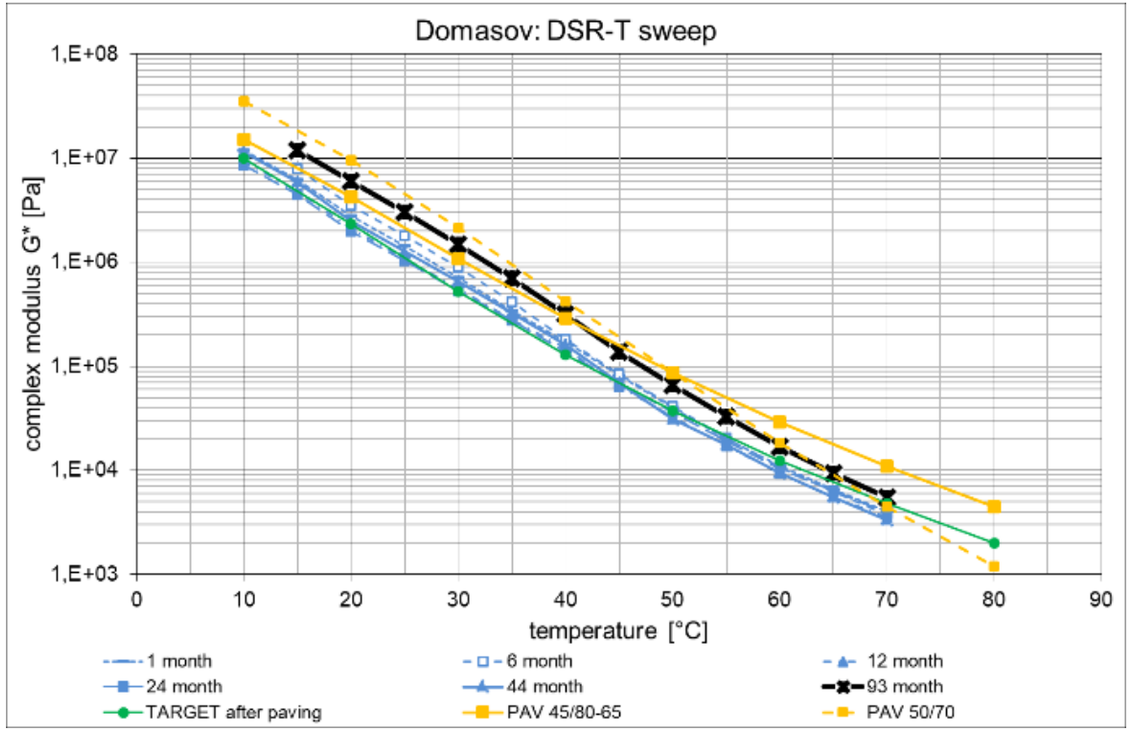


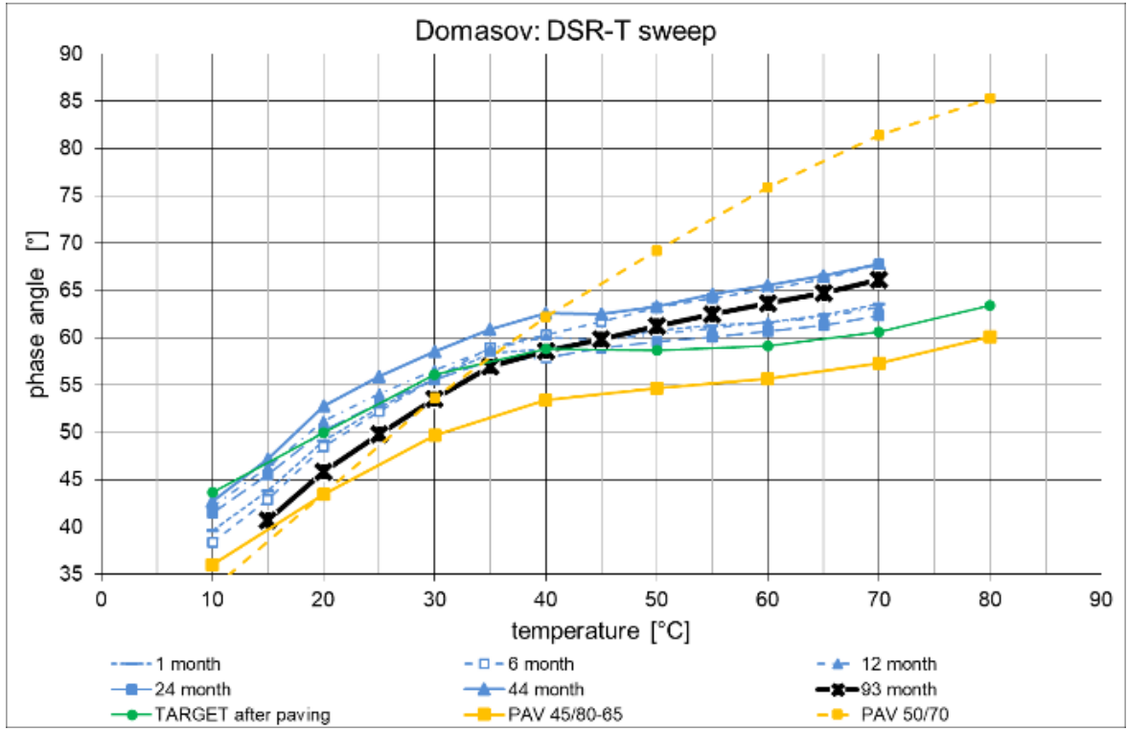




Test track – Domasov – DSR test results AC 11

- G* is increasing over time, but still moderate increase and asphalt mix does have an excellent performance in reality
- Still “S-curve” can be seen, which shows the “activity” of the SBS – confirms el. Recovery value

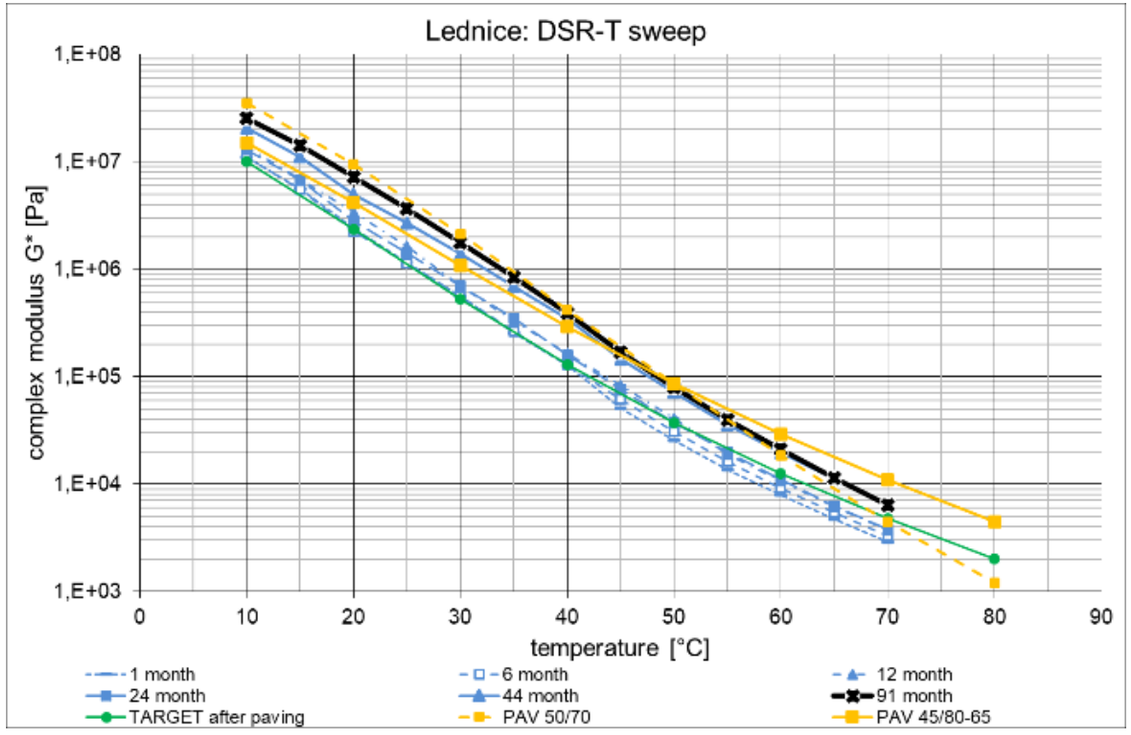


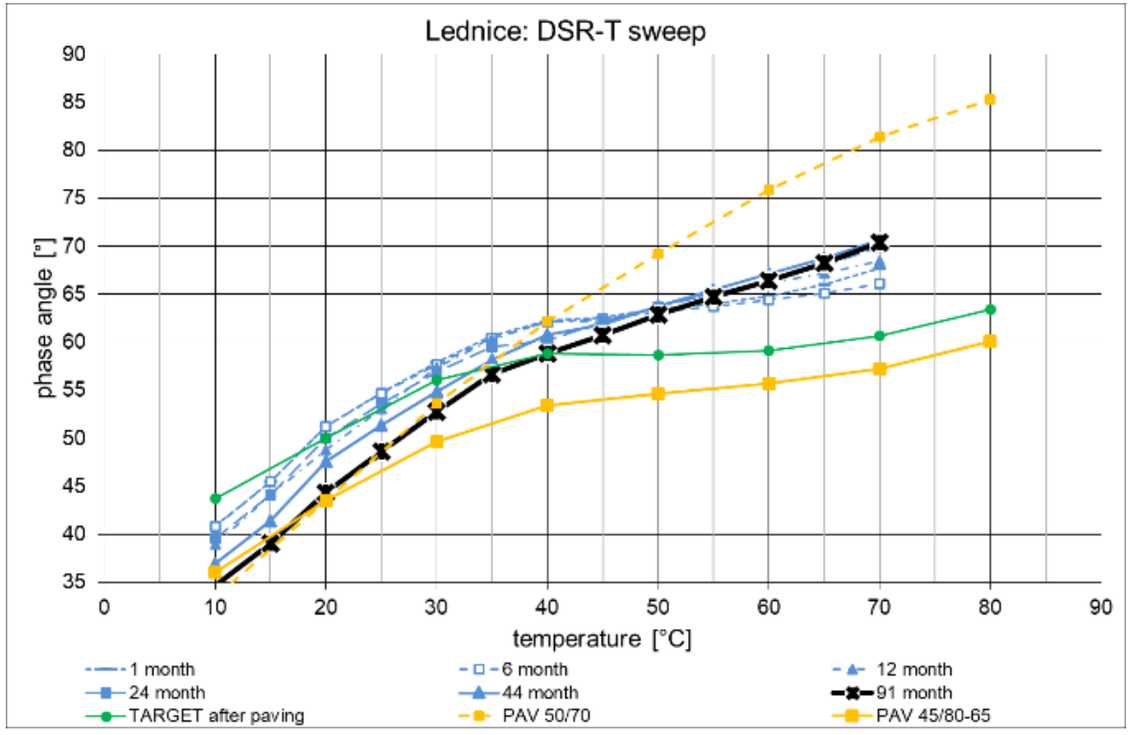


Rheological properties DSR (complex shear modulus G* (left) and phase angle (right)) of RAP, neat PmB 45/80 RC and target product for Domasov.

Test track – Lednice – DSR test results AC 25

- G* is increasing over time, but still moderate increase and asphalt mix does have an excellent performance in reality
- Still “S-curve” can be seen, which shows the “activity” of the SBS





Rheological properties DSR (complex shear modulus G* (left) and phase angle (right)) of RAP, neat PmB 45/80 RC and target product for Lednice.

Test track with 40% RAP

		PE-Stelle	recovered binder	recovered binder	recovered binder	recovered binder	recovered binder	recovered binder	recovered binder
		date	RA 40 10/2019	RA 40 04/2020 6 month	RA 40 10/2020 12 month	RA 40 10/2021 24 month	RA 40 05/2023 43 month	Lednice RA20 44 month	Domasov RA20 44 month
Property	test method		result	result	result	result	result	result	result
Penetration at 25°C	EN 1426	1/10 mm	31	29	30	25	32	29	39
Softening point ring and ball	EN 1427	°C	69,2	68,8	70,4	69,6	70,1	67,5	66,0
el. Recovery	EN 13398	%	61	62	65	62	56		
property at low temperature (BBR)	EN 14771 after recovery of binder								
Temperature at 300 Mpa		°C	-20,8	-21,0	-20,6	-19,5	-19,2	-21,7	-19,0
Temperature at m = 0,3		°C	-20,5	-20,6	-19,9	-17,3	-17,6	-21,4	-15,1
Critical temperature difference (ΔTc) [MPa-0,3m]		°C	-0,3	-0,4	-0,7	-2,2	-1,6	-0,3	-3,9

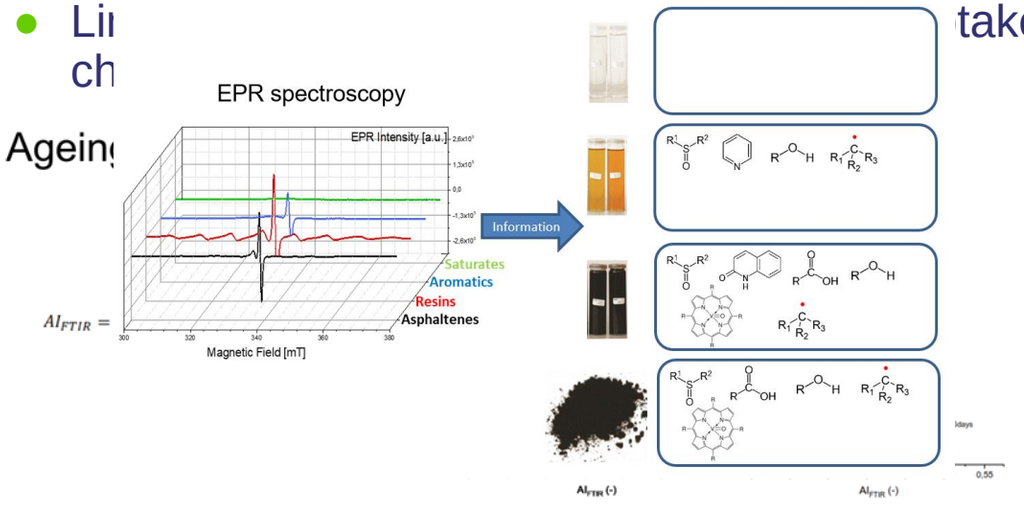
- Similar Pen level
- Softening point for AC with RA 40 is higher than with RA 20
- El. Recovery still close to 60% with RA 40
- Critical temp.: similar level with RA 40 than wit RA 20

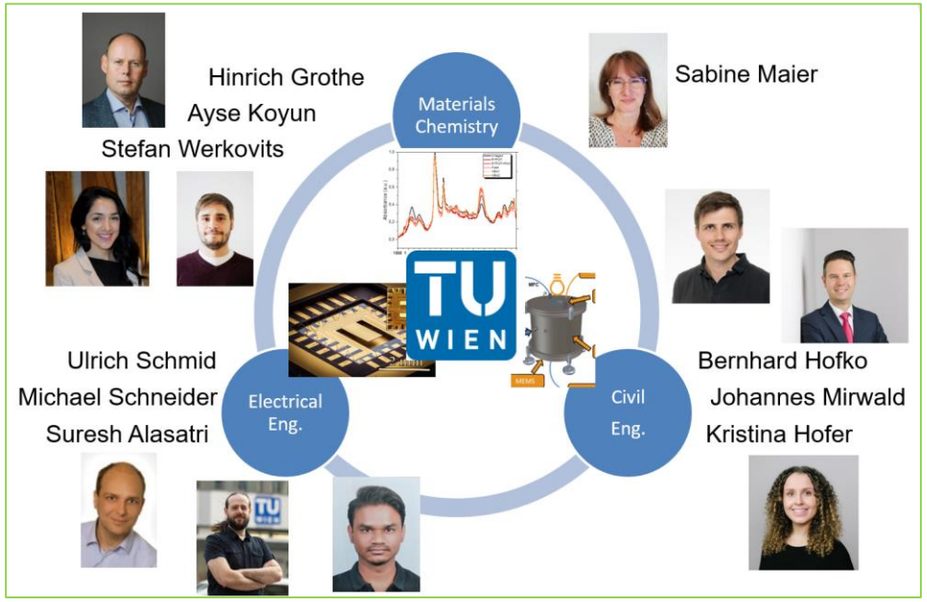
CDL Chemo-Mechanical Analysis of Bituminous Materials

Christian Doppler Forschungsgesellschaft

Development of a "**chemo-mechanical toolbox**" to better analyze complex bituminous materials

- Obtaining more information from **mechanical testing**
- Using modern **spectroscopic techniques** to obtain insight on the molecular level
  - Where can we find specific molecules?
- **Correlation** between chemistry and rheology
  - Li… take) to ch…





How does our material change with **ageing**?
What **ageing factors** do we need to consider?

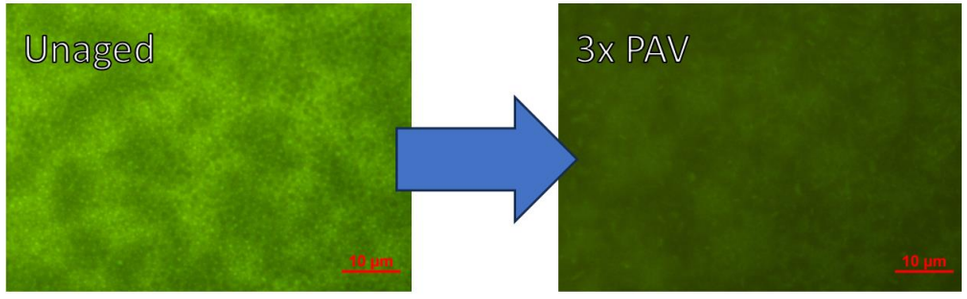
Which **tools** can we use?

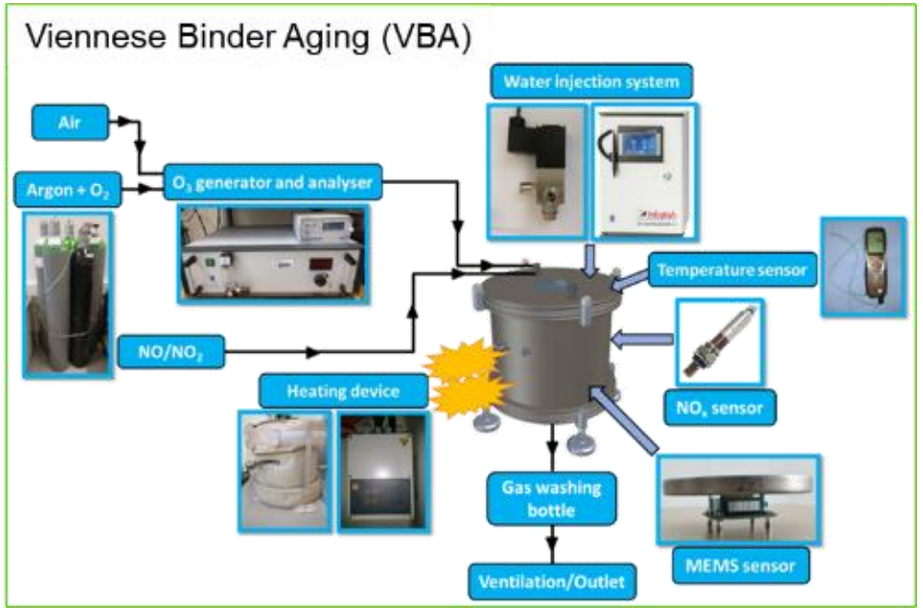
CDL Chemo-Mechanical Analysis of Bituminous Materials

Christian Doppler Forschungsgesellschaft

Using the tools to better understand the fundamentals in bitumen ageing

- Development of a realistic ageing approach (VBA) by incorporating all **environmental ageing factors**
- Compare results to real field aged bitumen
- Evaluate the ageing behavior of **polymer modified bitumen**
  - Effects of ageing on the **polymer network**
  - **Link** between mechanical behavior, microstructure and changes in the chemical composition





Conclusion – Main take aways

- Long time experience with OMV Starfalt® PmB 45/80 RC
- Excellent performance and all test tracks are still in a good condition
- Ideal product for reuse of RAP for heavy traffic roads (highways, express ways)
- Suitable for cold adding of RAP (up to 25%) and warm adding of RAP (up to 40%)
- Low temperature performance still excellent after 8 years (-18 / -19 °C)
- Modification still active and good (DSR (phase angle), el. recovery)


Questions?
Markus Spiegl, OMV
Michal Varaus, VUT v Brně
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