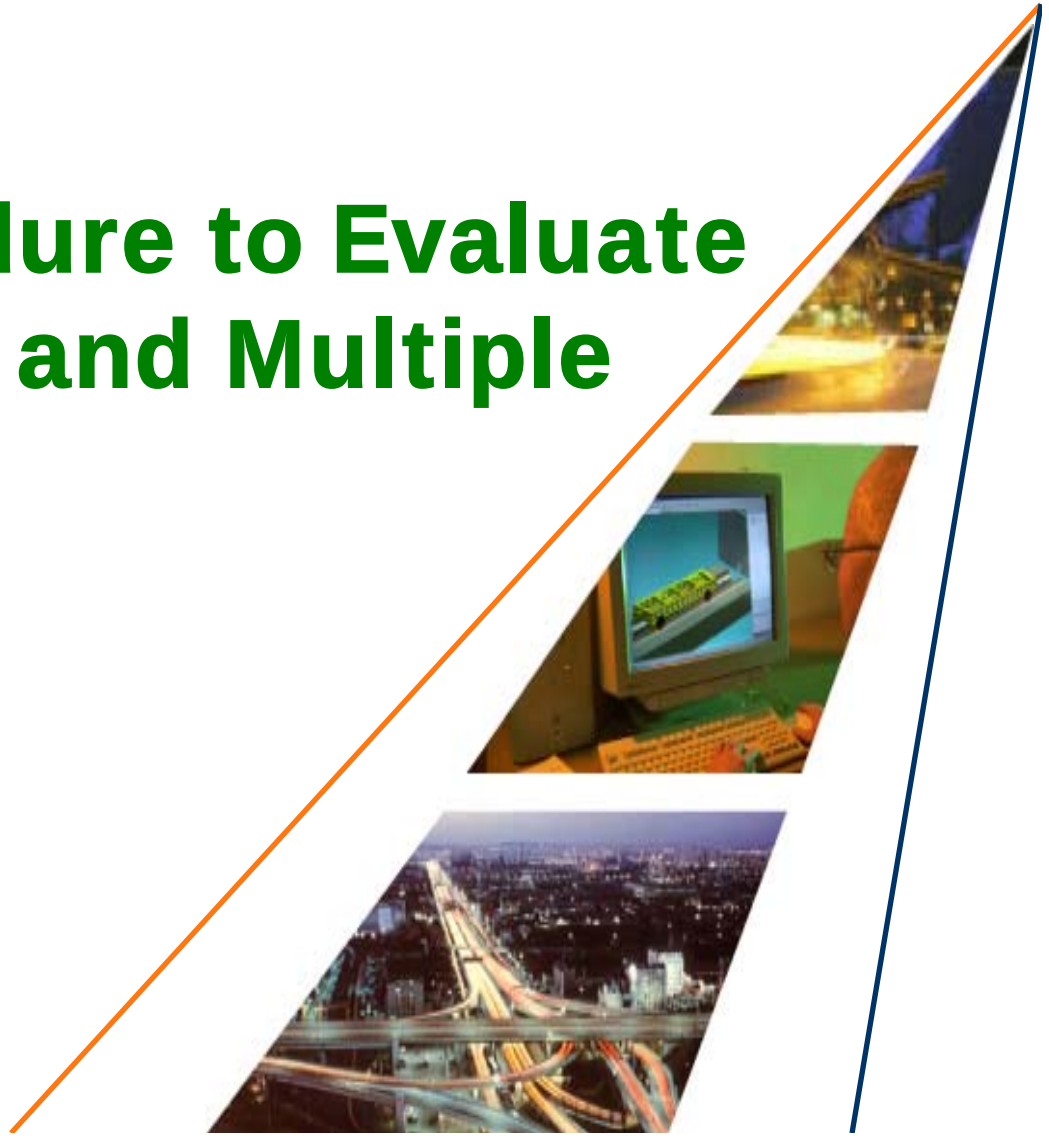
Lab Aging Procedure to Evaluate RA Compatibility and Multiple Recycling

Brussels, 13th November 2012
Konrad Mollenhauer



Overview on WP2

Impact of RA quality and characteristics on mix design and performance of asphalt containing RA

- Work Task 2.1 (IFSTTAR, BRRC, TUBS, ZAG)

  RA compatibility with new binder (conventional and modified), *Virginie Moulliet*

- Work Task 2.2 (BRRC, LCPC, TUBS, DRI, UNOTT)

  Impact of RA on mix design and laboratory performance, *Joëlle De Visscher*

- Work Task 2.3 (TRL, DRI, VTI)
  - Field validation, *Ian Carswell*

Research Items of Task 2.1

- Chemical compatibility (application and modification of test methods)
- Physical / Mechanical compatibility: resulting binder properties
- Indication of potential of rejuvenators
- Develop a laboratory aging procedure for asphalt mix
- Effect of multiple recycling cycles

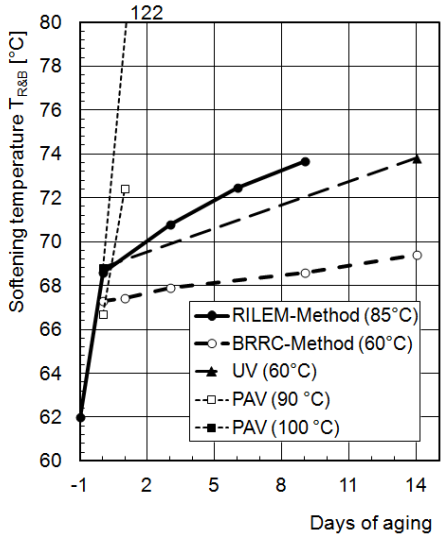
Selected Research Results

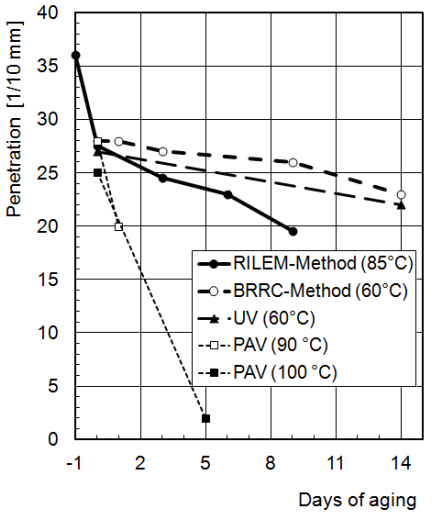
- Laboratory conditioning procedure for asphalt mixes to simulate long-term aging
  - Development
  - Estimation of test precision
- Application of aging procedure to analyse
  - Compatibility of polymer modification in RA and fresh bitumen
  - Multiple Recycling of surface asphalt mixes

Laboratory conditioning procedure

Principle

1. Place loose asphalt mixture on trays just after mixing
2. Short-term conditioning
3. Long-term conditioning
4. Sampling as appropriate

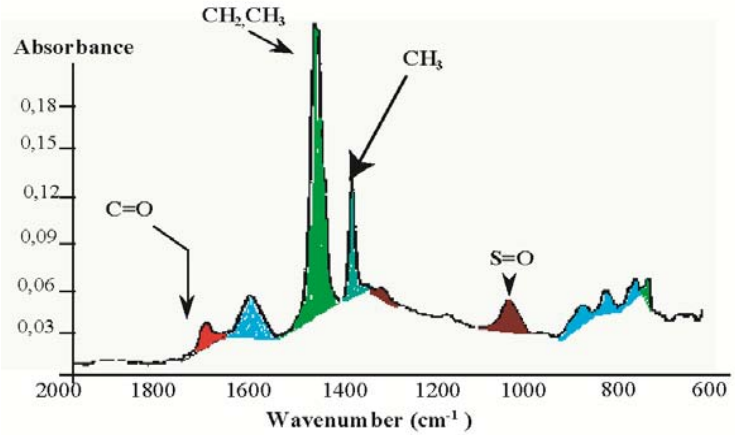


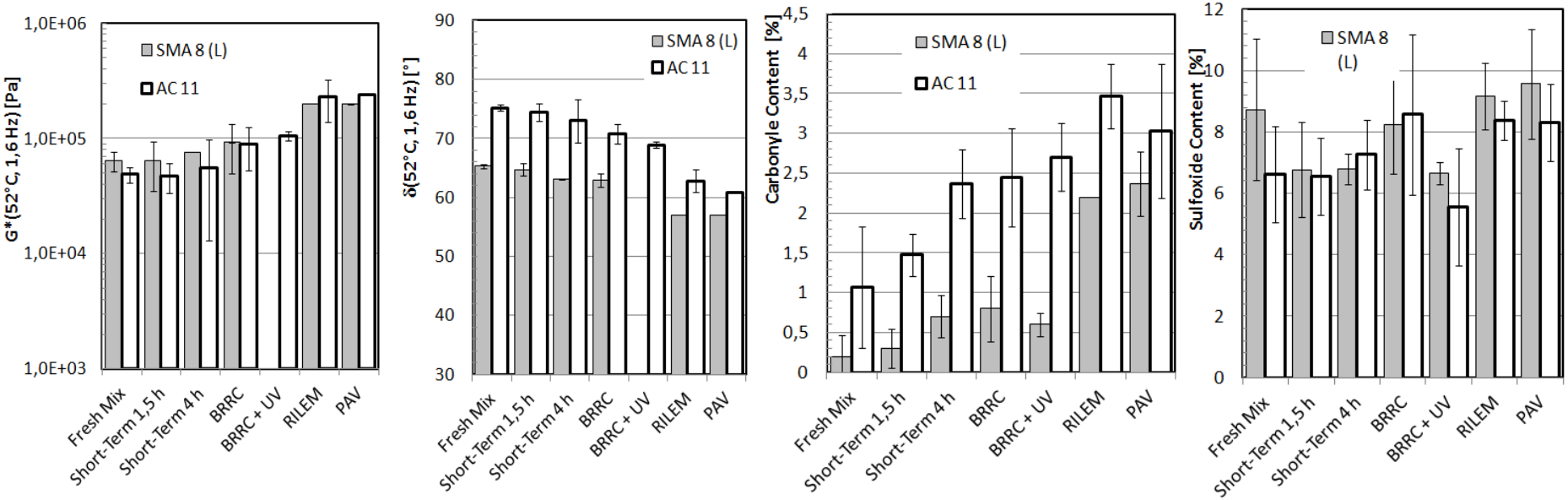


Name of Aging Procedure	Mixing temp-erature T [°C]	Short-term aging		Long-term aging			
		Temp-erature T [°C]	Dura-tion [h]	Temp-erature T [°C]	Pressure p [MPa]	UV-Radi-ation	Aging duration t [days]
BRRC	165	135	4	60	-	-	0; 1; 3; 9; **14**
RILEM			1,5	85	-	-	0; 3; 6; **9**
PAV			4	90	2,1	-	**1**; 5
UV			1,5	60	-	x	**14**

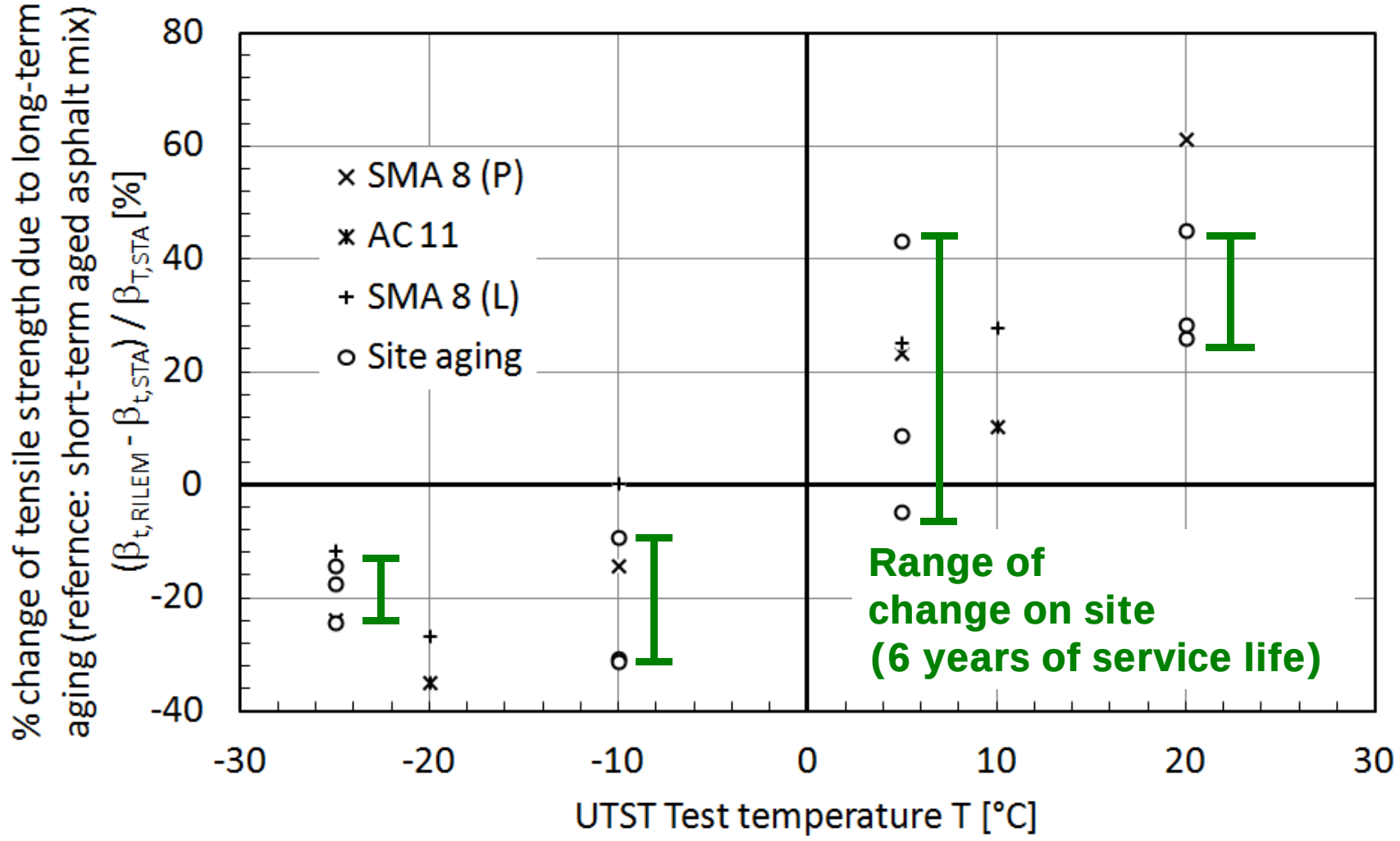
Laboratory conditioning procedure

- Analysis of binder aging
  - Binder performance tests (DSR, Force ductility)
  - FTIR measurements





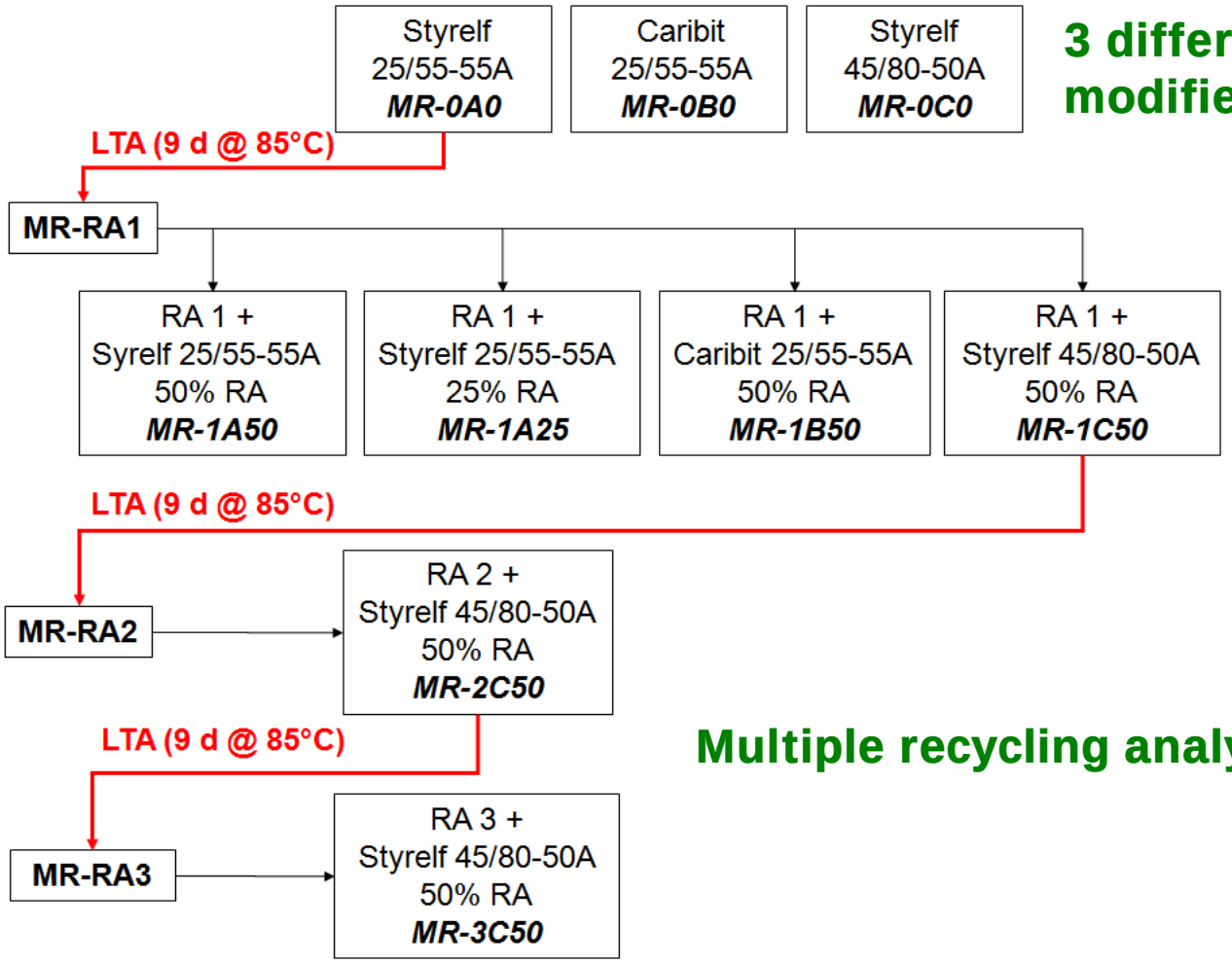
Evaluation of asphalt properties



Results

- Oven conditioning is suitable to simulate long-term aging
  - The higher the temperature, the faster the aging
  - Polymer degradation was observed at 85 °C but not at 60 °C aging
  - Preparation of asphalt specimens from aged loose mix is possible to evaluate end-of-life properties
- Resulting precision
  - binder test scatter for samples extracted from aged mix slightly higher compared to those extracted from freshly mixed material
  - 60 °C aging results better precision than 85 °C aging

Multiple Recycling Study



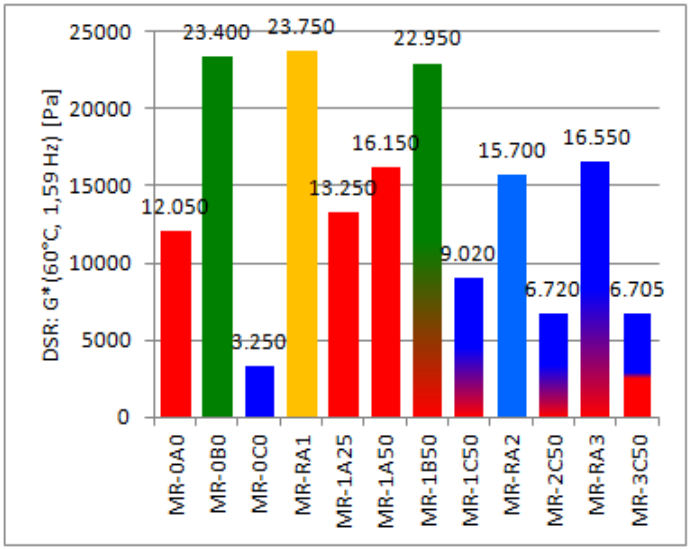
3 different SBS modified binders

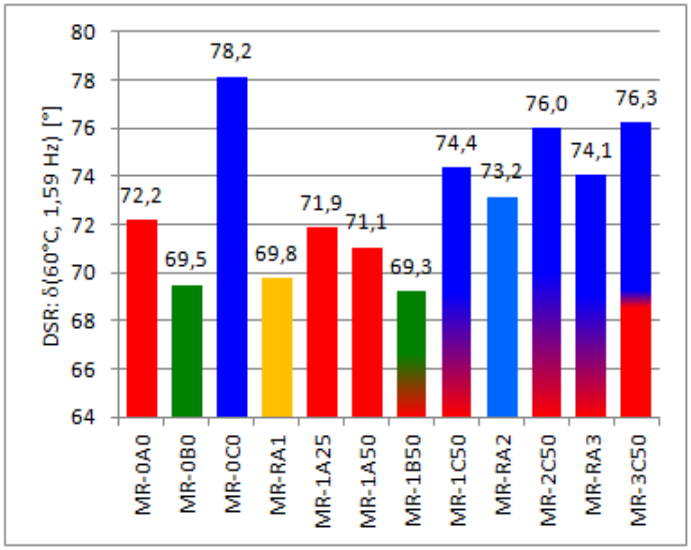
Compatibility analysis

Multiple recycling analysis

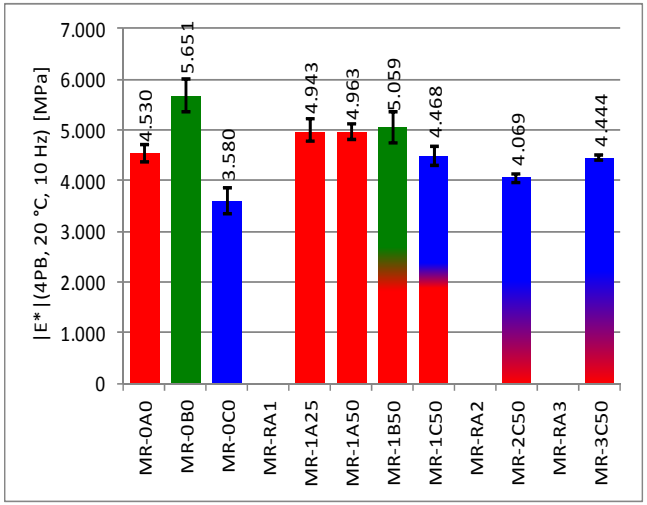
Compatibility analysis

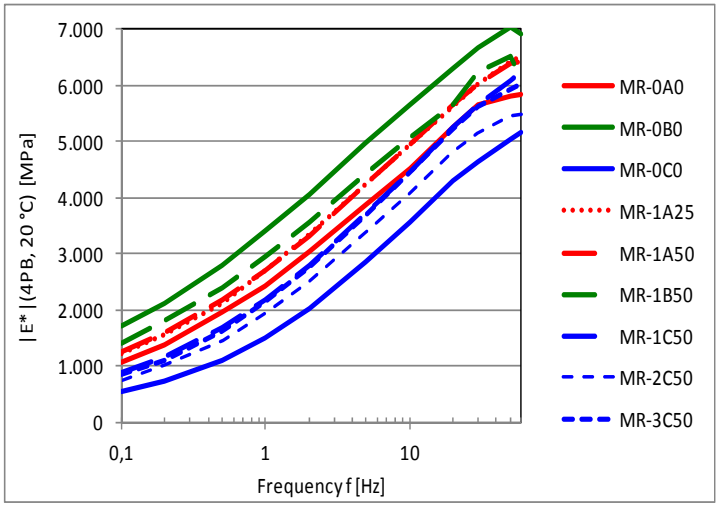
Recovered binder properties DSR G*, δ





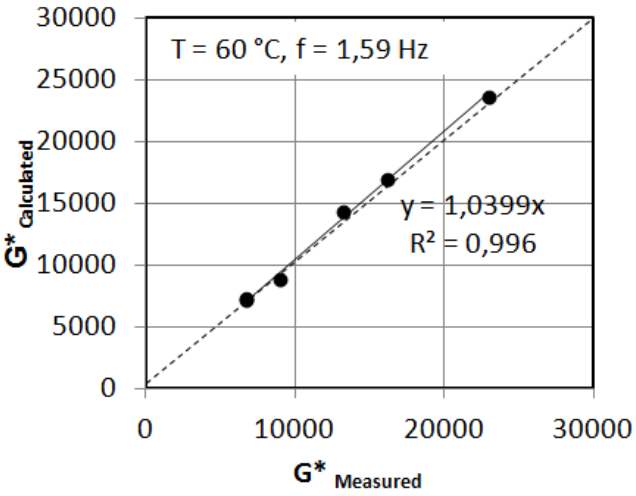
Asphalt specimen properties |E|(4PB)

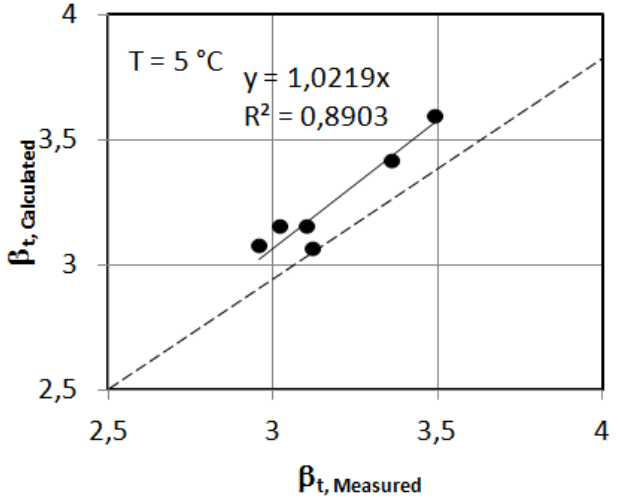




Applicability of mixing law

binder property	logarithmic mixing law $\log i_m = \frac{b_0}{100} \cdot \log i_0 + \frac{b_{RA}}{100} \cdot \log i_{RA}$ with i: binder property	
	a	R^2 [%]
$T_{R\&B}$	1.004	92
Pen	1.028	94
F_{Max}	0.995	94
$E'_{0.2}$	0.959	94
$E'_{0.2\text{-}0.4}$	0.937	90
$G^*_{60°C.1.59Hz}$	1.040	100
$\delta_{60°C.1.59Hz}$	0.997	99
Asphalt mix properties		
UTST: β_t	1.02	0,89
UTST: ε_F	0.92	0,87





Multiple Recyclibility

- Experimental setup:
  - Control mix: SMA 8, 25/55-55 A
  - 3 recycling cycles, RA addition: 50 %
  - New binder for mixes containing RA: 45/80-50 A
- Observations for mixes with 50 % RA
  - All relevant mechanical properties are in the range of fresh mixes with 25/55-55 A (2 different polymers)
    - Compactibility (impact compaction)
    - Resistance against rutting (Cyclic triaxial stress test)
    - Stiffness (4-Point-Bending)
    - Low-temperature cracking (TSRST + UTST)

WP2: Deliverables available soon

Thank you very much!

Ian Carswelll, Joëlle De Visscher,
Thomas Gabet, Robert Karlsson,
Rawid Khan, Dina Kuttha, Davide Lo Presti,
Konrad Mollenhauer, Virginie Mouillet,
Nathalie Piérard, Jørn Raaberg, Marjan Tušar,
Ann Vanelstraete