

KONFERENCJA - Nowoczesne nawierzchnie drogowe

Recykling w konstrukcjach nawierzchni drogowych

CONFERENCE - Modern Road Pavements

Recycling in road pavement structures



mrp23.ibdim.edu.pl

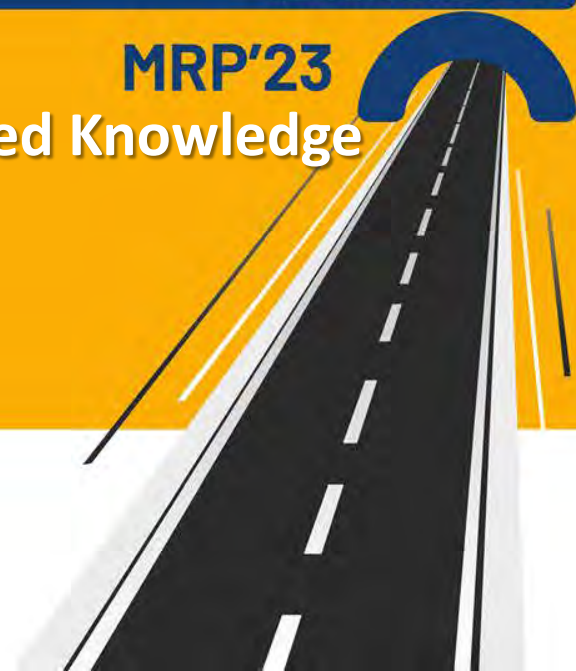
Warsaw, 18 October 2023

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Cold Recycling with Foamed Bitumen, gained Knowledge from a Test Track in Germany

Mehdi Kalantari

BASt / Germany



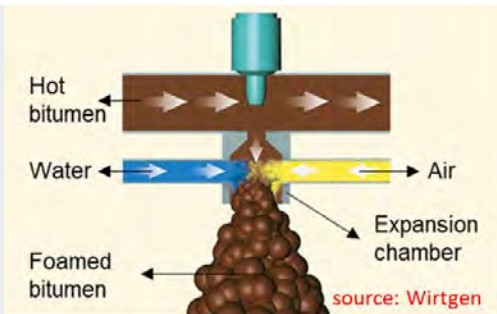


Mehdi Kalantari / Germany

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Cold Recycling

- It is cold! not the bitumen, the aggregate mix
- Bitumen: Emulsion or Foam
- Composition: Aggregate mix + Bitumen + hydraulic binder + water -> curing over the **time**
- Depending to the binders' content -> different behaviors
- In-Place or In-Plant



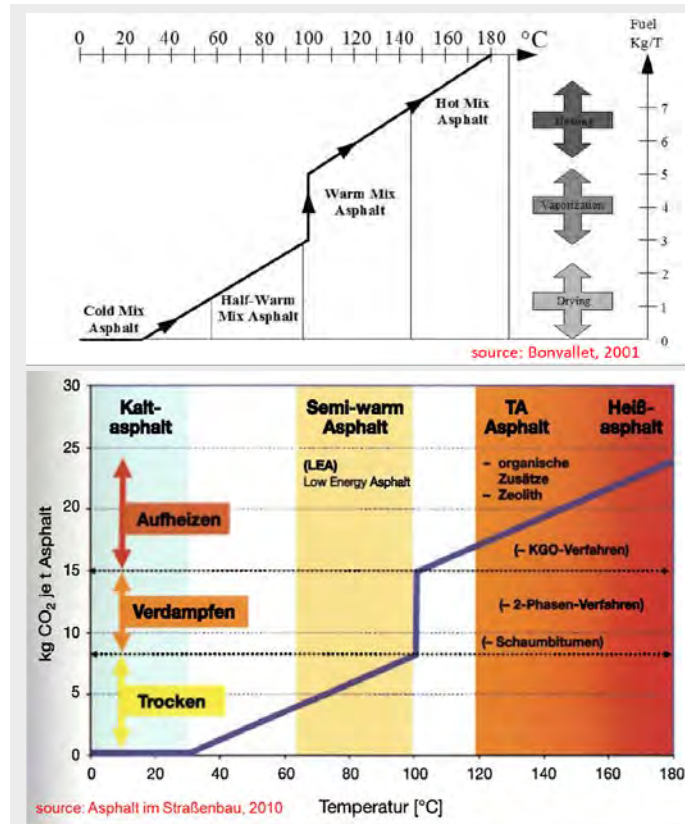
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Why Cold Recycling?

- Because it is recycling -> sustainability point of view
- It is Cold -> therefore less energy and also less emission comparing to Hot
- It is cold -> it is possible to use high amounts of RA comparing to Hot
- Yes, you are right!

It is not as durable as HMA but it is possible to integrate it into pavement and reach the same or higher durability than conventional pavements!



Aim

- To gain experience on different aspects of a cold recycled material with foamed bitumen, containing low amounts of bitumen and cement (Known as Bitumen Stabilized Material)

Method

- By comparing a CR pavement with a conventional reference pavement (the same traffic class)
- Through an APT (Accelerated Pavement Test) program
 1. Test facility
 2. Loading device

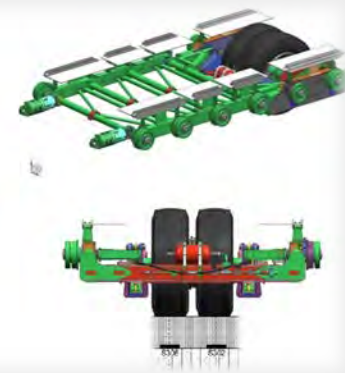
duraBAST - the research area of the BAST

- Demonstration, investigation and reference area of BAST
- 2015-2017, construction
- www.durabast.de



Accelerated Pavement Testing Packet

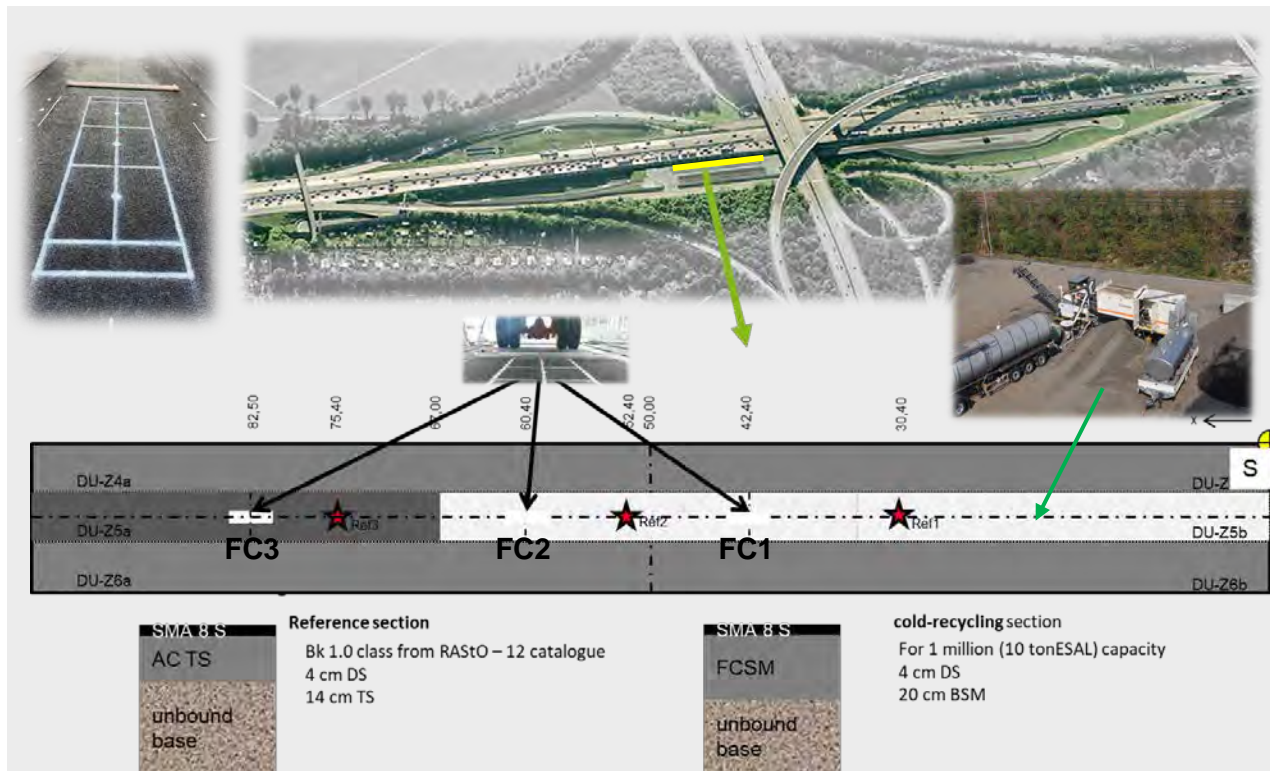
- MLS30 (super single, 50 kN and 6000 cycles per hour)
- Monitoring of the pavement response
 - FWD, Cross Profile, Surface pictures, Sensors data, GPR, Cores and cuts



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Out line

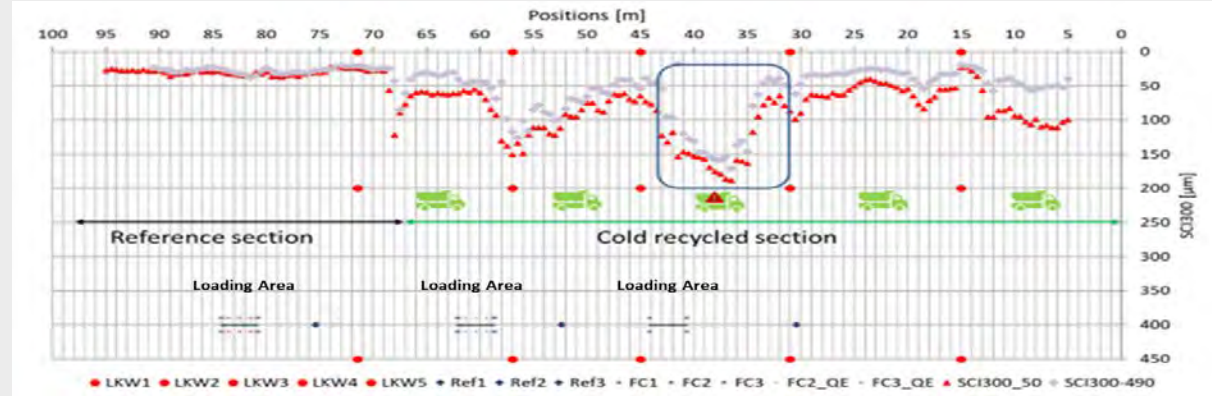
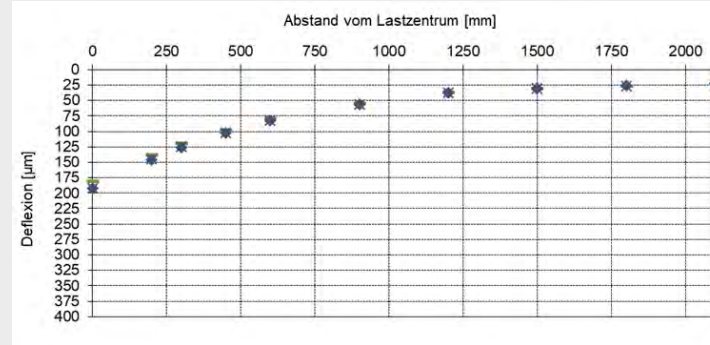
- Construction 2019
- In-Plant production
- 75% RAP + 25% Sand (0-2mm)
- 2.2% bitumen, 1% cement (1-425N)
- Loading 2020 -22, total of 10.9 Million (10 ton axle)



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Homogeneity

- We used FWD to look at the homogeneity of the bearing capacity along the test section
- SCI300 (d300-d0) is an indicator of the upper layers' bearing capacity
- SCI300 at each 50 cm

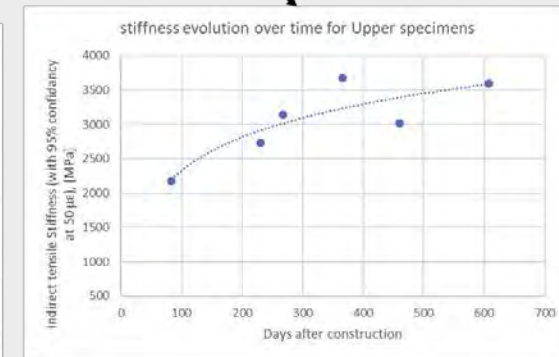
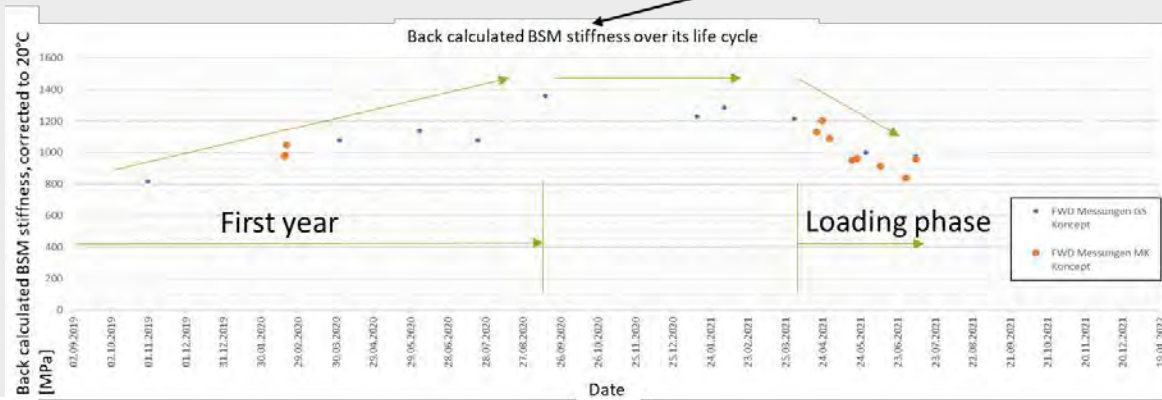
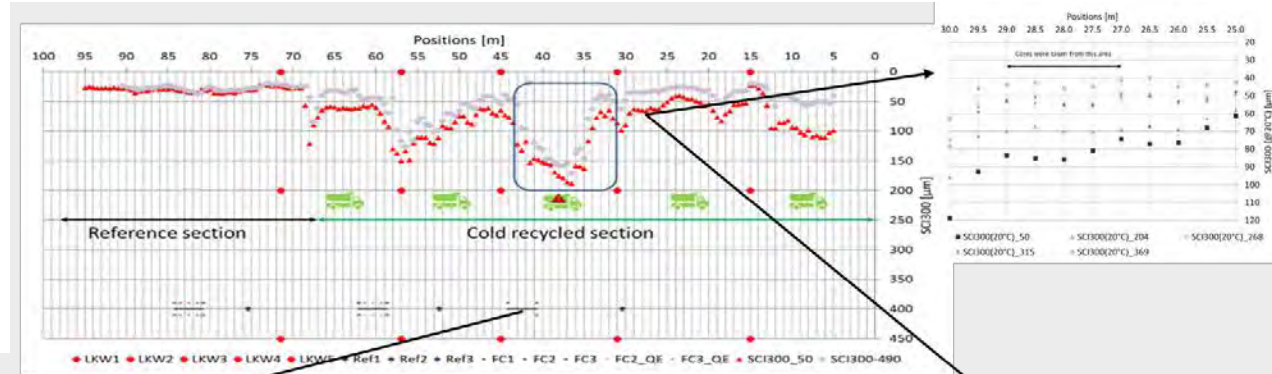


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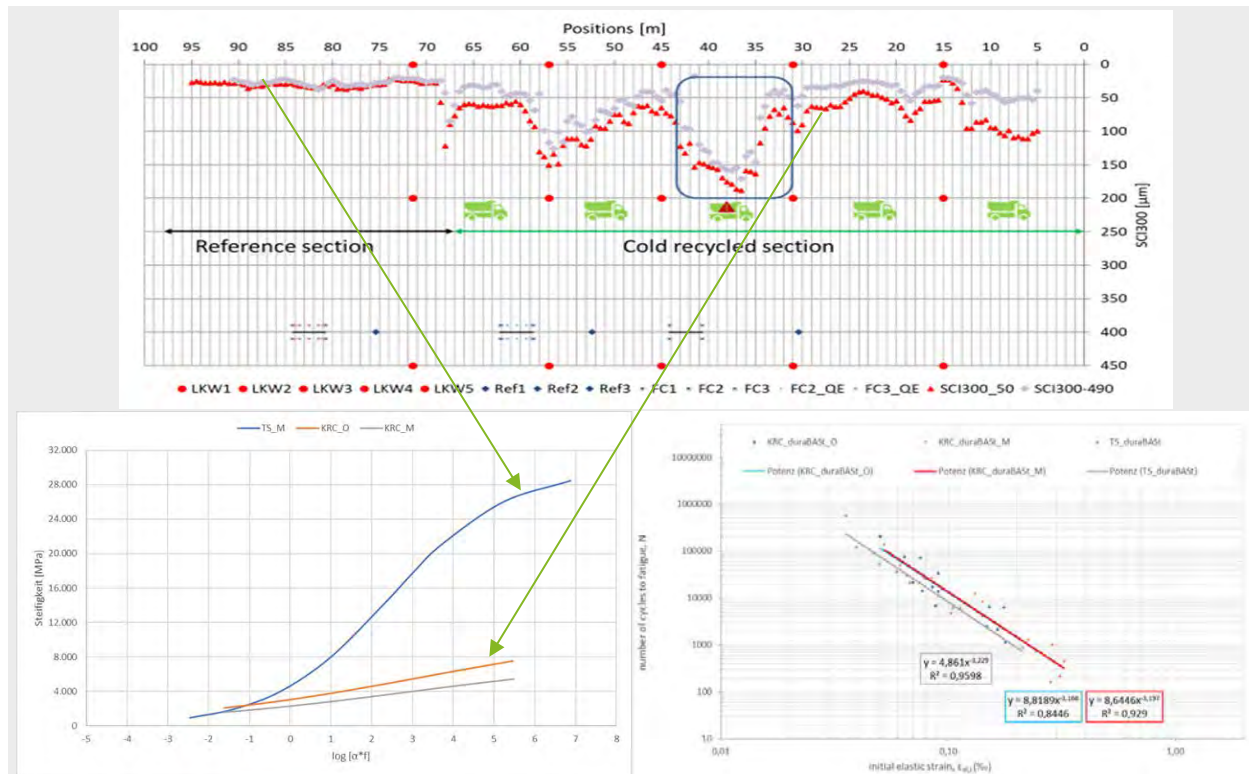
Material behavior

- Curing phase
- Loading phase

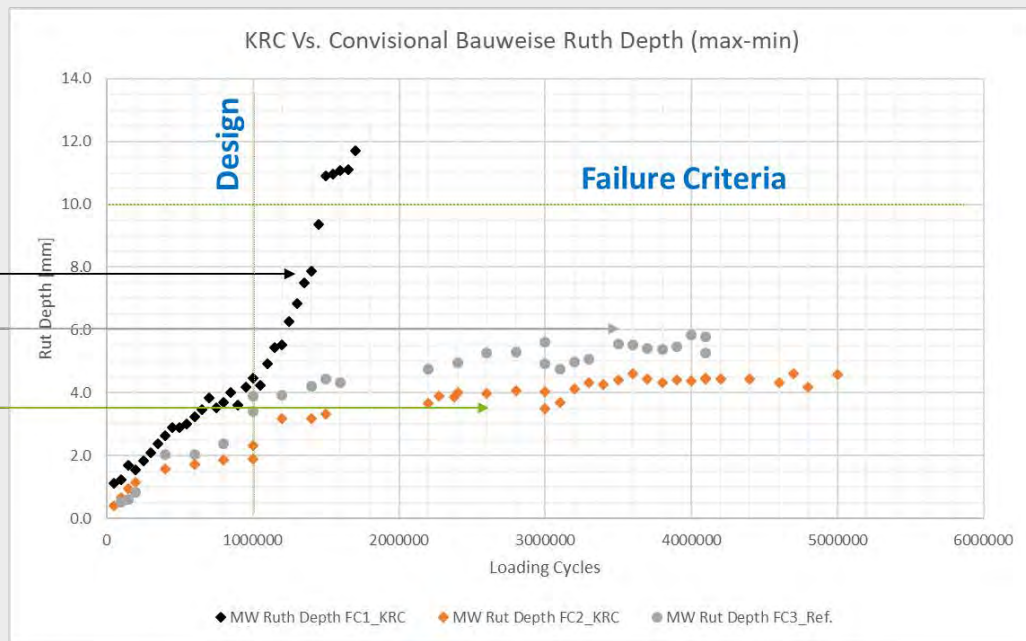
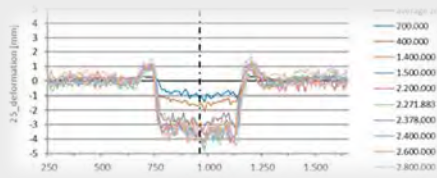
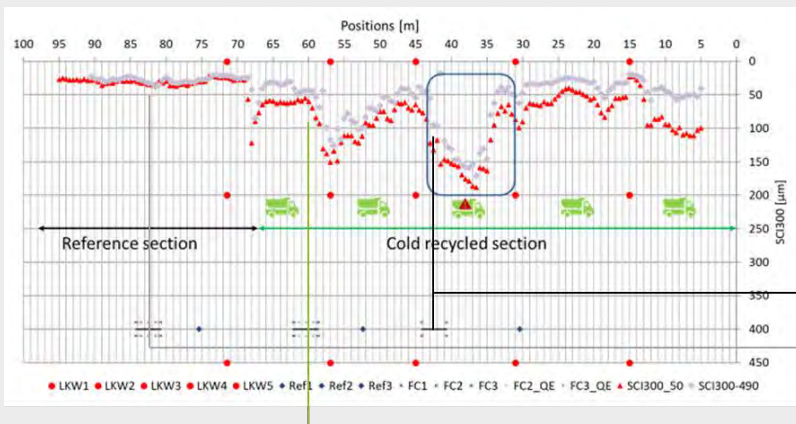


Material behavior

- Lower stiffness and Temp. dependency than HMA
- Almost same fatigue line (after 460 days)

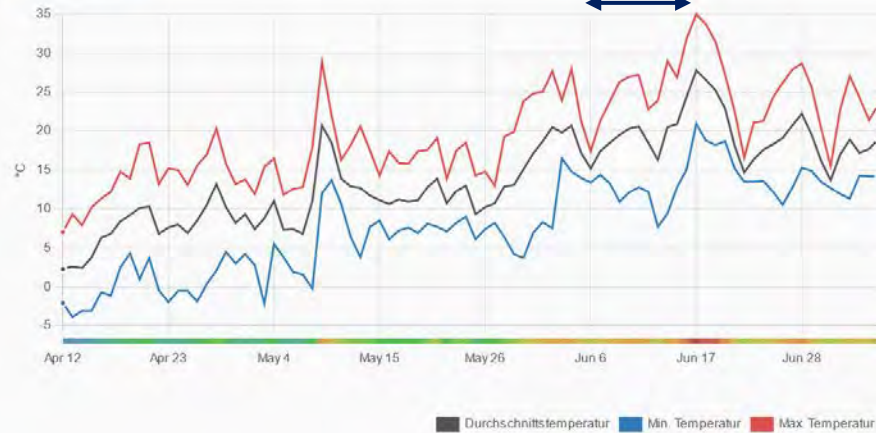


Permanent deformation

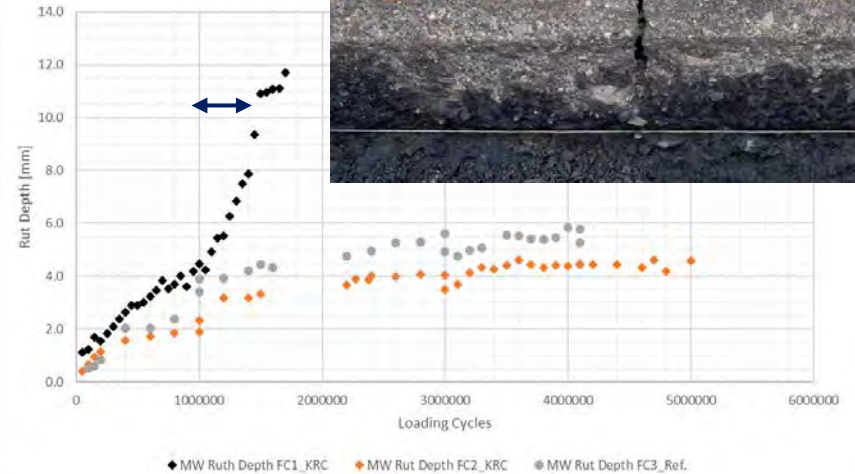


Permanent deformation & temperature

Temperatur

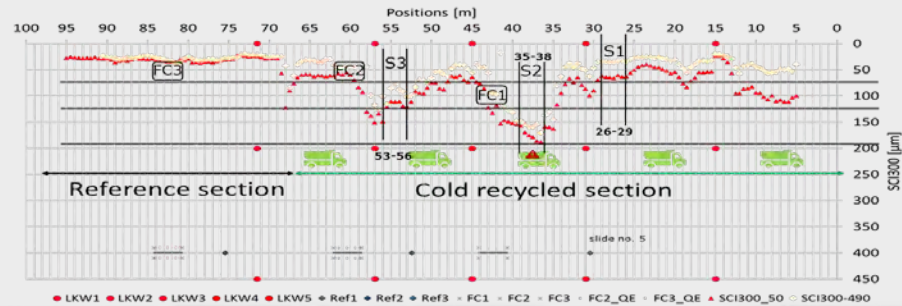


KRC Vs. Convisio



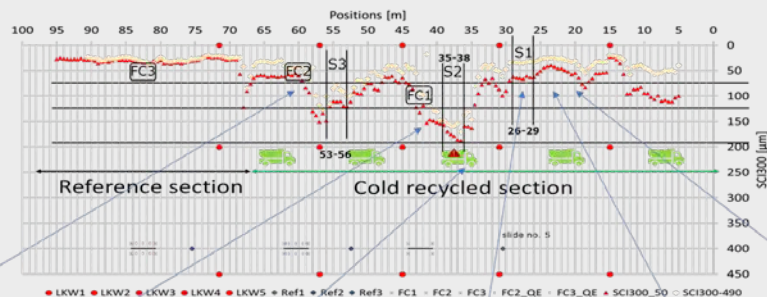
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Detailed survey



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Drainage and moisture



Take away points

- It is possible to produce and design **pavements** with cold recycled layers with the **same or even better performance** than conventional pavements.
- **Homogeneity** is an important topic
 1. Input material (RAP sources and types)
 2. Preparation process (crushing and sieving)
 3. Production (dosing and mixing, production uniformity)
 4. Beneath layers (foundation properties)
 5. Construction (evenness, thickness, segregation)

Take away points

- Permanent deformation is the failure mode of this cold recycled material type (BSM)
- Stiffness is not only temperature dependent but also stress history dependent. It is therefore important to consider both in determining the input design stiffness for ME methods
- Factor of 1.5 to transfer the thickness of HMA base to CR base is conservative but safe in case of high material variation
- Fast curing in laboratory (72 hours, 40°C) is equal to one year field curing in west Germany's climate (also can be considered as central EU climate)



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THANK YOU FOR YOUR ATTENTION