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Ageing and performance of warm asphalt mixtures

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ISAP Day
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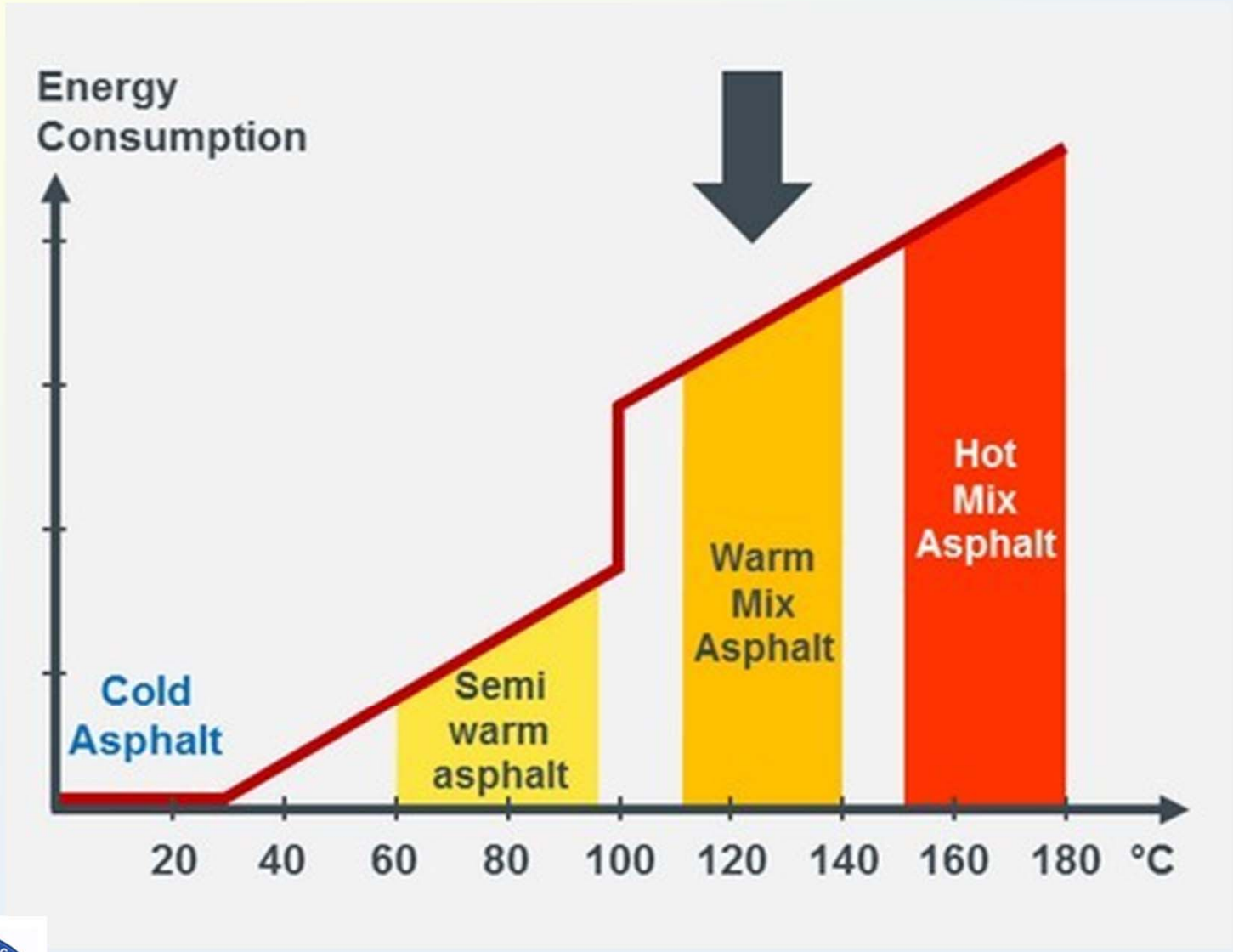
Problem statement



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Background: Research package PLANET

PLANET - Bituminous mixtures with low energetical and ecological impacts

- RS-1: Impacts on asphalt mixing plants
- RS-2: Energy and ecological balance of low temperature bituminous mixtures for asphalt pavements
- RS-3: Mix design and performance optimisation
- RS-4: Durability and ageing
- RS-5: Global evaluation model
- RS-6: Requirements and quality control
- RS-7: Occupational health

Goals and outline of research package PLANET

- to improve the acceptability of WMA
- to help authorities to choose the right WMA
- to evaluate different warm mix asphalt types in laboratory and in the field

Goals and outline of project

- Assessment of durability
- Assessment of ageing behaviour

deformation **fatigue**

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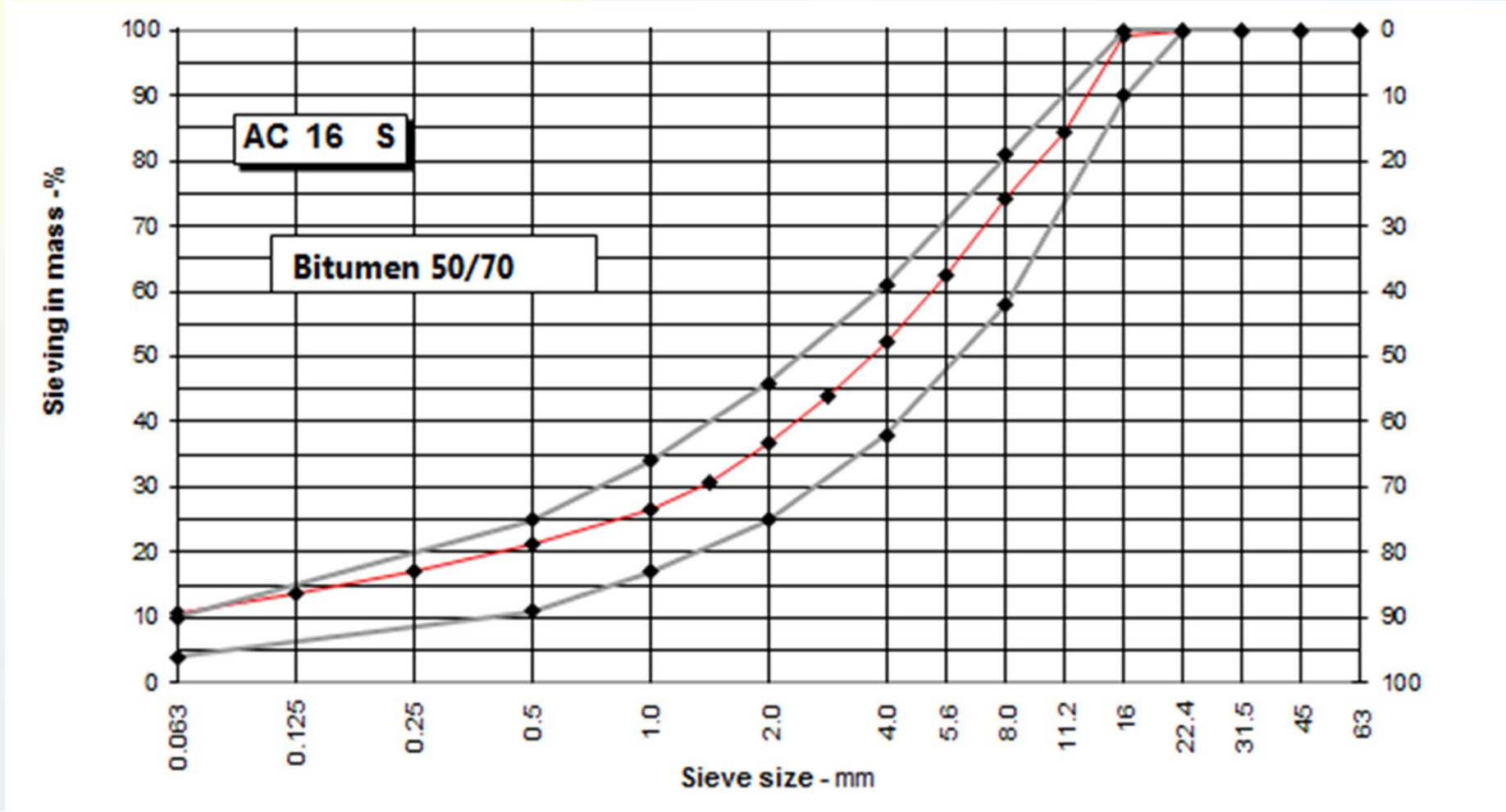
Material

AC 16 S Binder course
Bitumen 50/70, 4.6 M%



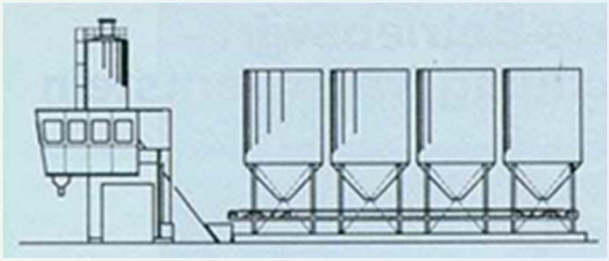
Materials

Product group	Name	Dosage	Binder	Temp.
Warm – chemical additive	FR-PACK	0.4%/binder	50/70	120° C
Warm – water containing zeolite	FR-ZEO	0.25%/mix	50/70	120° C
Warm - wax	FR-WAX	3%/binder	50/70	120° C
Warm – foam bitumen	FR-WATER	-	250/330, 35/50	100° C
Warm – foam bitumen+50% RAP	FR-WATER+RAP	-	250/330, 50/70	100° C
Half warm – cutback bitumen	PA-HWAM	0.3%/binder	250/330, 50/70	100° C
Warm – chemical additive	PA-PACK	1%/binder	50/70	120° C
Hot – classical hot mix	REF-HOT		50/70	160° C

Material

Laboratory mixtures

Plant mixtures



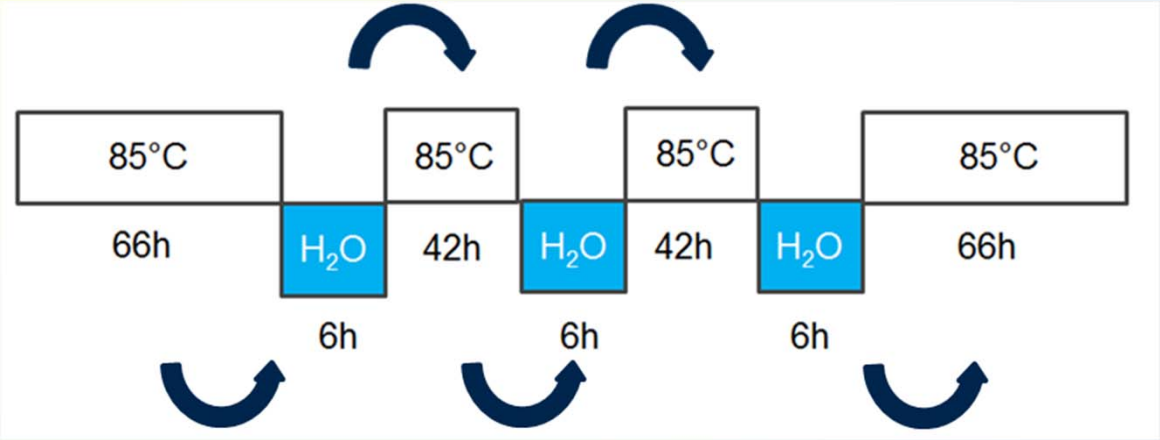
deformation

fatigue

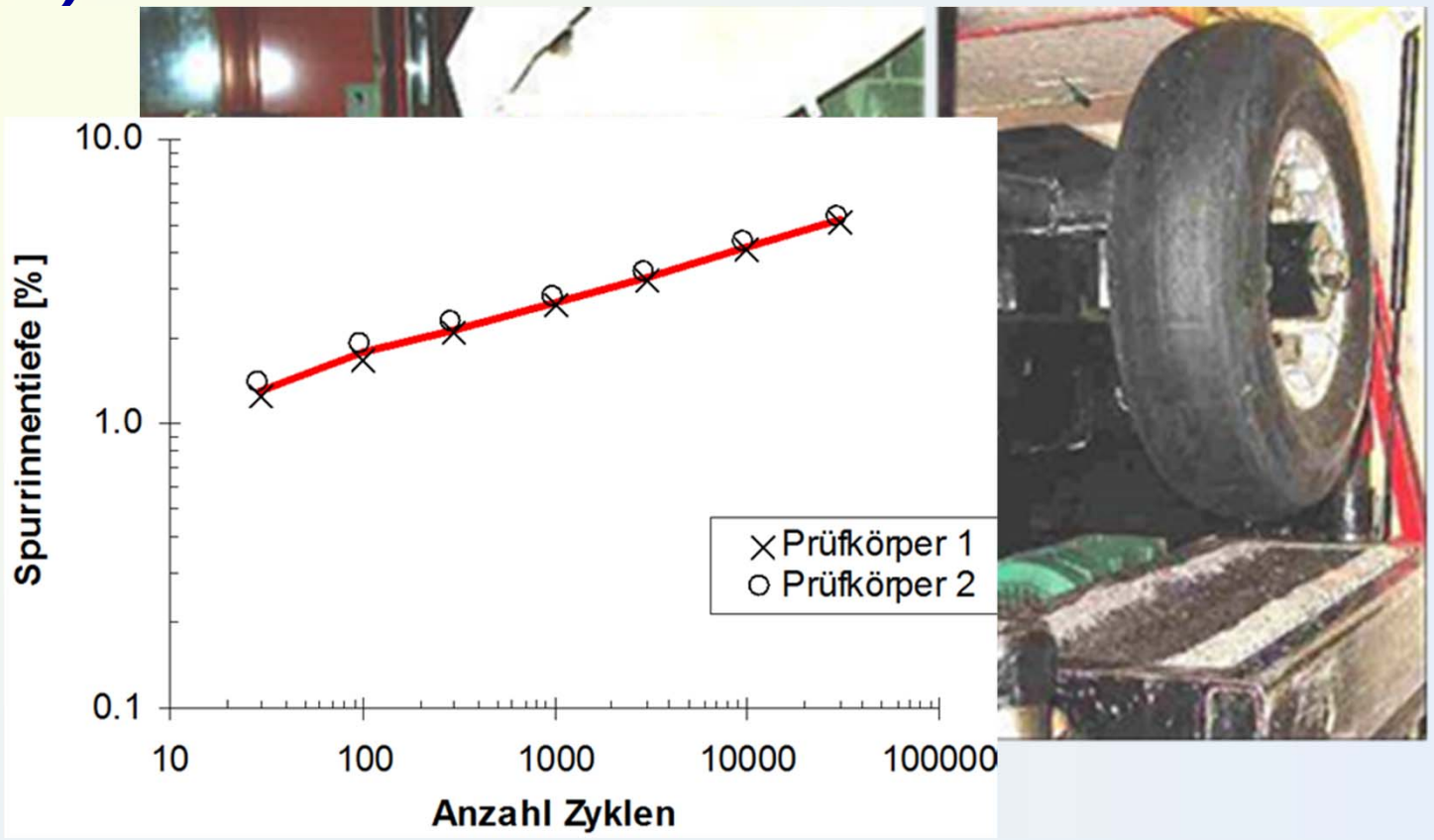
Ageing procedure

- Long term ageing
- Simulation of water (rain)
- Ageing of compacted specimens (Marshall and rutting test specimens)

Ageing procedure

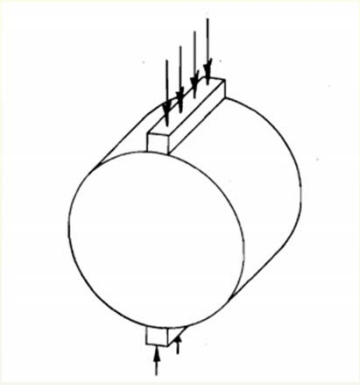


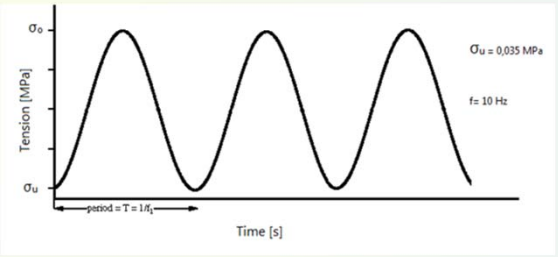
Testing – Rutting (EN 12697-22)

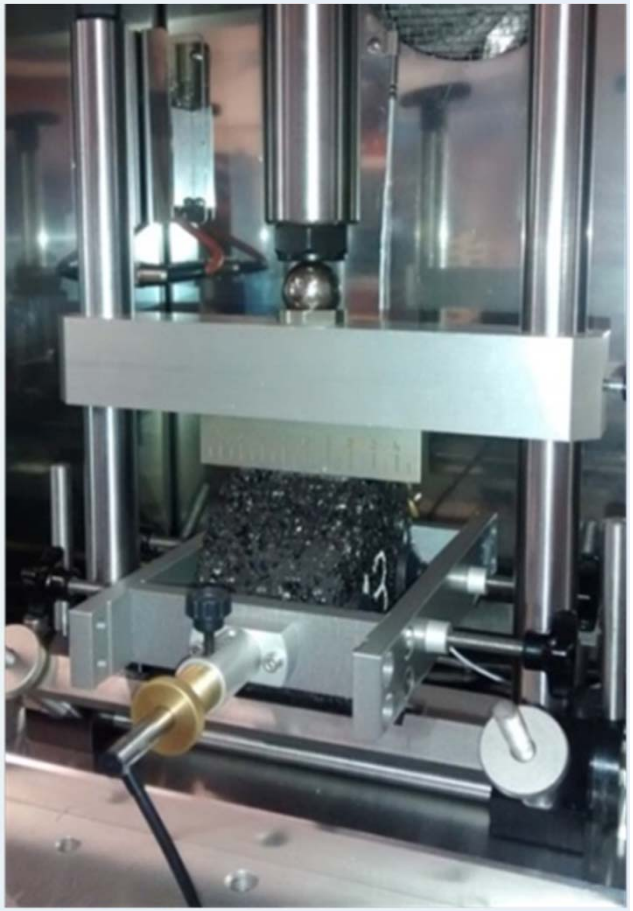


Temperature: 60°C
Specimen: 500 x 180 x 50 mm
No. of cycles: 30, 100, 300, 1000, 3000, 10'000 (30'000 for H)
Measurement: 3 measurements in 5 profiles
Result: proportional rut depth [%] of 2 specimens
Limit: 10% for type S (Swiss Standard)

Testing - Fatigue behaviour with CIT-CY (EN 12697-24 and AL-SpAsphalt 09)







Temperature: 20°C
Specimen: Ø 100 mm, 9 specimen at 3 strain levels
Loading: continous sinusoidal, 10Hz
Result:
- Stiffness Modulus [Mpa]
- Fatigue Function
- Fatigue resistance ε_6 at 1'000'000 cycles
  (Initial elastic deformation at 1'000'000 cycles ε_6)

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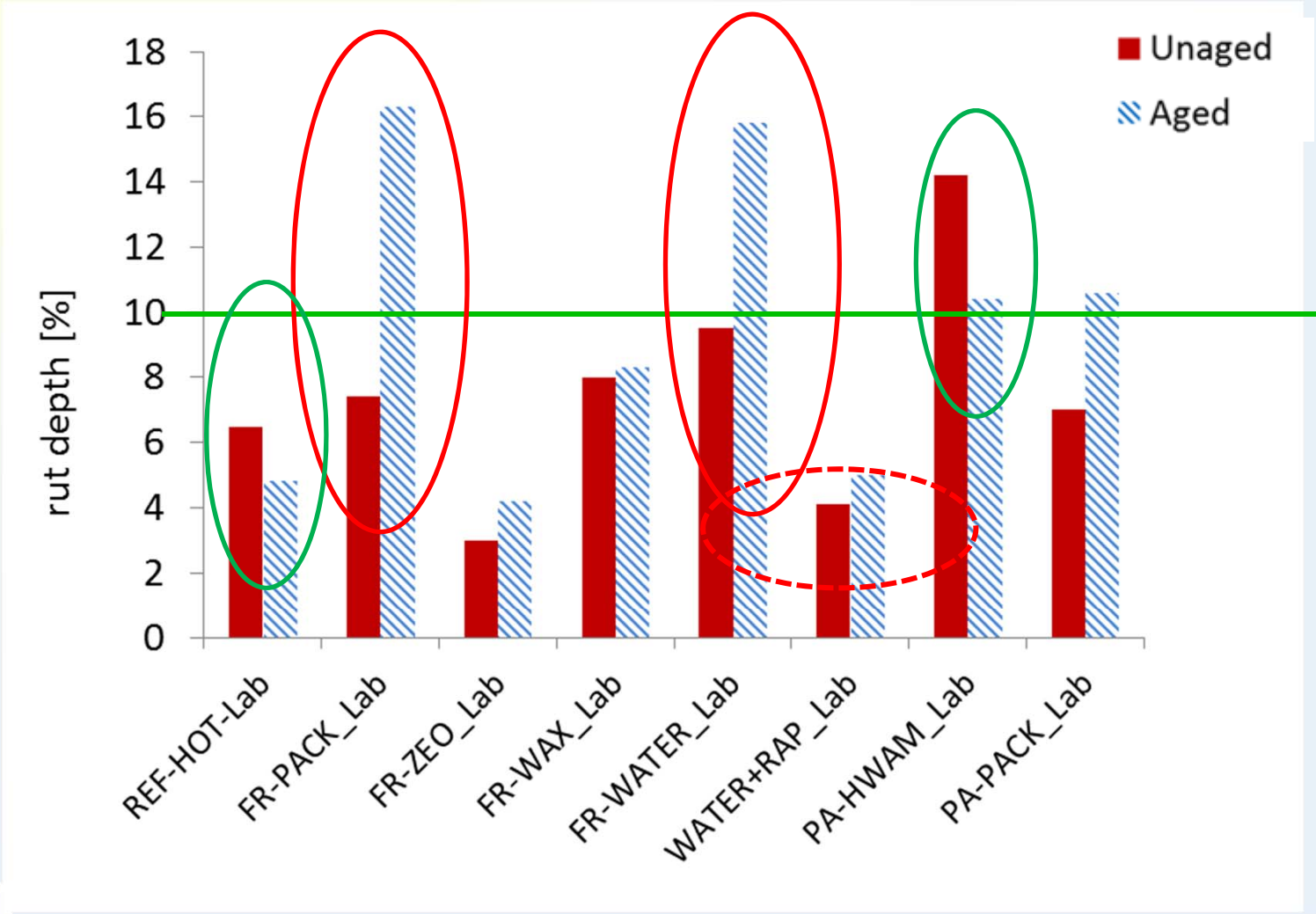
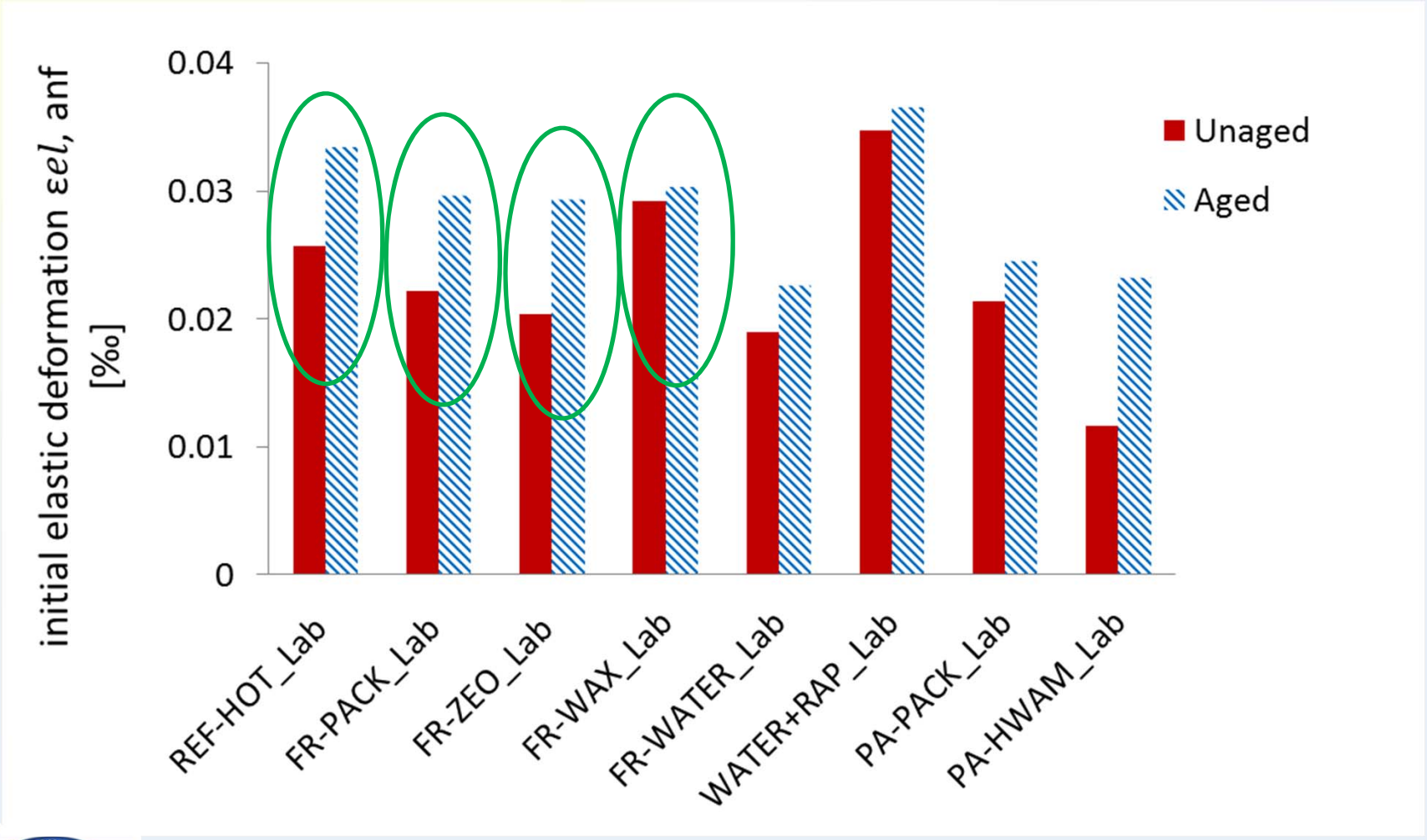
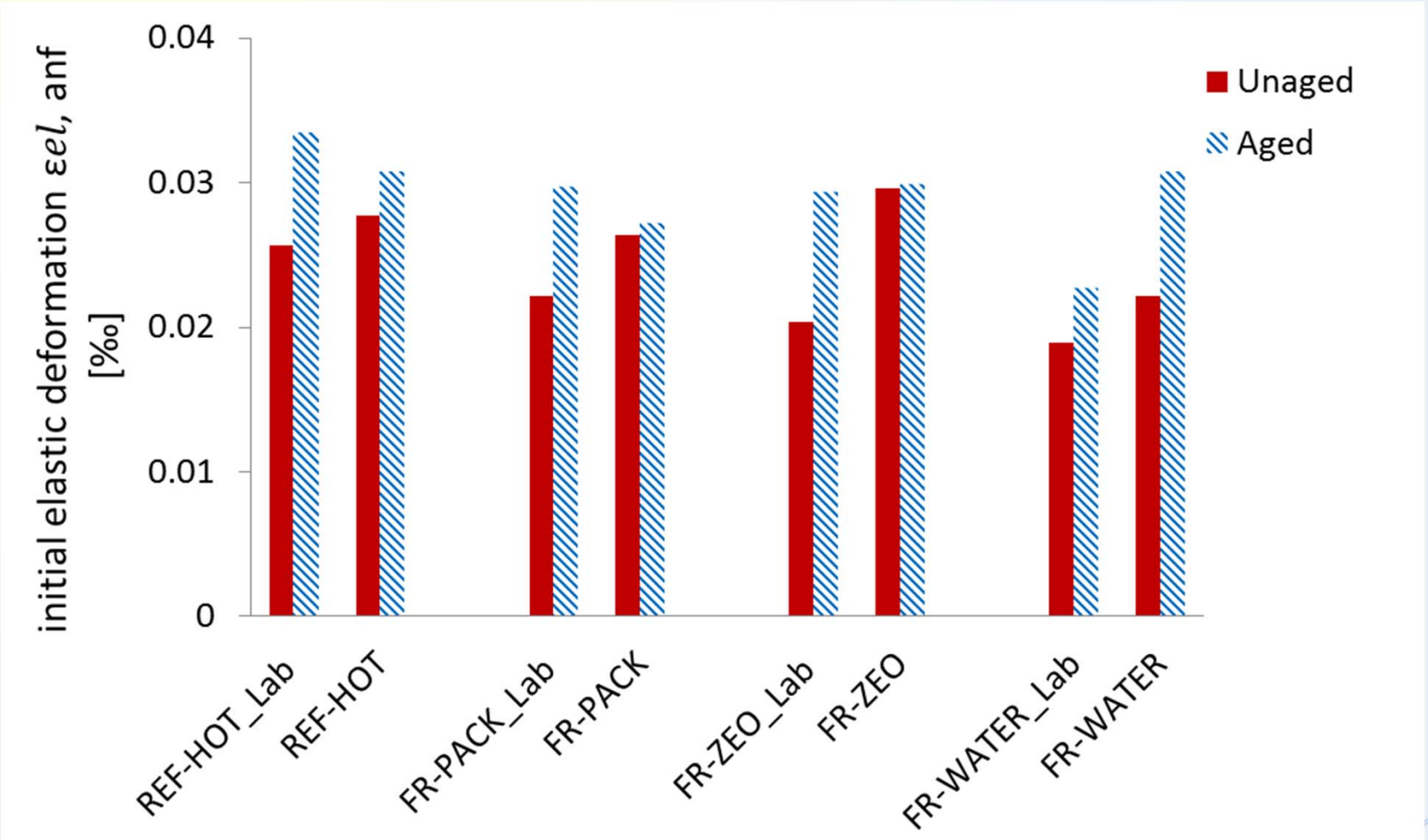
Results – Rutting
Lab mixtures



Results – Fatigue
Lab mixtures



Results – Fatigue
Plant and Lab mixtures



Summary +Conclusions - 1

- For the investigation and simulation of the long term ageing behaviour of different WAM a special laboratory ageing protocol with different heating and watering cycles was developed.

- As for the rutting controversial results are found with most of the WAM showing an **increase in rut depth**. Especially the WAM with chemical additive FR_PACK and foam FR_WATER depict extremely high rut depth values of >15%. In case of the foam asphalt mixture with reclaimed asphalt (RAP), the RAP seems to lead to stiffening and increased resistance against permanent deformation already for the unaged mixture.

- The results indicate that for WAM the **resistance against permanent deformation could become critical**.

Summary +Conclusions - 2

- As opposed to this finding, **fatigue resistance** of all aged WAM compared to unaged WAM **improved significantly** resulting in an increase of fatigue life for the aged mixtures. This is true for **laboratory mixtures as well as plant mixtures**.

- Although, attention has to be paid to the rutting behaviour, overall findings lead to the conclusion that the ageing of WAM is not very critical and that the application of such pavements therefore provide a good solution for saving CO_2 emissions and prolonging the installation season.

- Nevertheless, all findings have to be validated by **long term investigations and field trials**, where especially the resistance against deformation requires special attention.

First Announcement

9th International Conference on Maintenance and Rehabilitation of Pavements

July 1st – July 3rd, 2020

Call for Abstracts: Spring 2019
Reserve date now! More details will be announced later.
Chair: Christiane Raab, Empa, Dübendorf, Switzerland

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