APPLICATION OF A POROUS INTERLAYER FOR ROAD TEMPERATURE CONTROL

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2. Concept “porous interlayer”
3. Key issues of the investigation
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1. INTRODUCTION

During the winter months, the weather-related decrease in road skid resistance affects traffic safety – especialy at neuralgic areas

- increased risk of accidents due to glaze ice or packed snow

- Travel time losses due to weather-related stagnation of traffic flow (traffic jam)

- extensive use of gritting material and de-icing salt is required

► Possible solution: Road temperature control during the winter months

1. INTRODUCTION

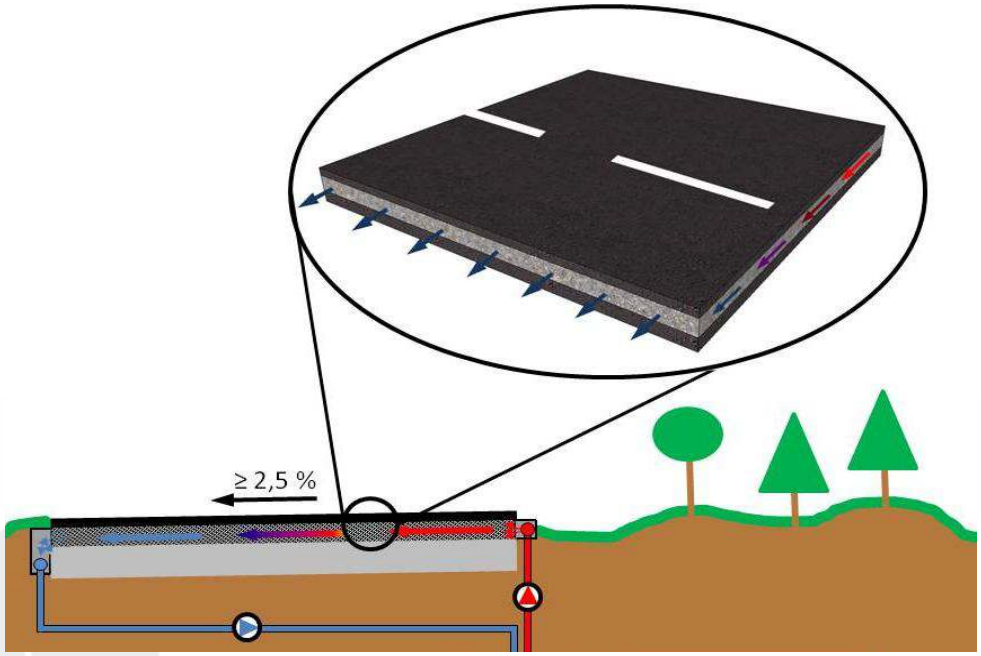
Negative aspects of previous approaches:

- The pipes can have a negative influence on the durability/stability of the asphalt
- Fixation of the pipe register is required
- Higher costs due to additional materials and additional installation
- Increased demands on the installation process of the asphalt – higher costs

► Development of a new concept without pipes is necessary ….

2. CONCEPTUAL APPROACH

The concept of a „porous interlayer“ for temperature control



Main ideas:

- Using a porous asphalt for the transmission of warmed water (no pipes)
- arrangement of the porous interlayer under the topcoat
- Possible installation with normal asphalt pavers

3. KEY ISSUES OF INVESTIGATION

The concept requires the investigation of the following questions:

1.Is the porosity of a porous interlayer adequate for the continuous transmission of water?

→ Investigation of the hydraulic properties of the concept

2.Will the overall construction be affected by the porous interlayer (resistance to deformation and rutting)?

→ Investigation of the mechanical properties of the concept

4. EXPERIMENTEL WORK

Investigation variants:

- Using of two investigation variants with interlayer and one reference variant without interlayer

1. Reference variant:	SMA 8 S + AC 16 B S
2. PUR-variant:	SMA 8 S + PA 8 S (PUR bounded) + AC 16 B S
3. PA -variant:	SMA 8 S + PA 8 S (Bitumen bounded) + AC 16 B S

- The taste plate preparation was carried out with the roller compactor according to TP Asphalt / DIN EN 12697-33

4. EXPERIMENTEL WORK

Investigation variants – Interlayer variants:

Properties of the PUR-layer:

Thickness: 40 mm

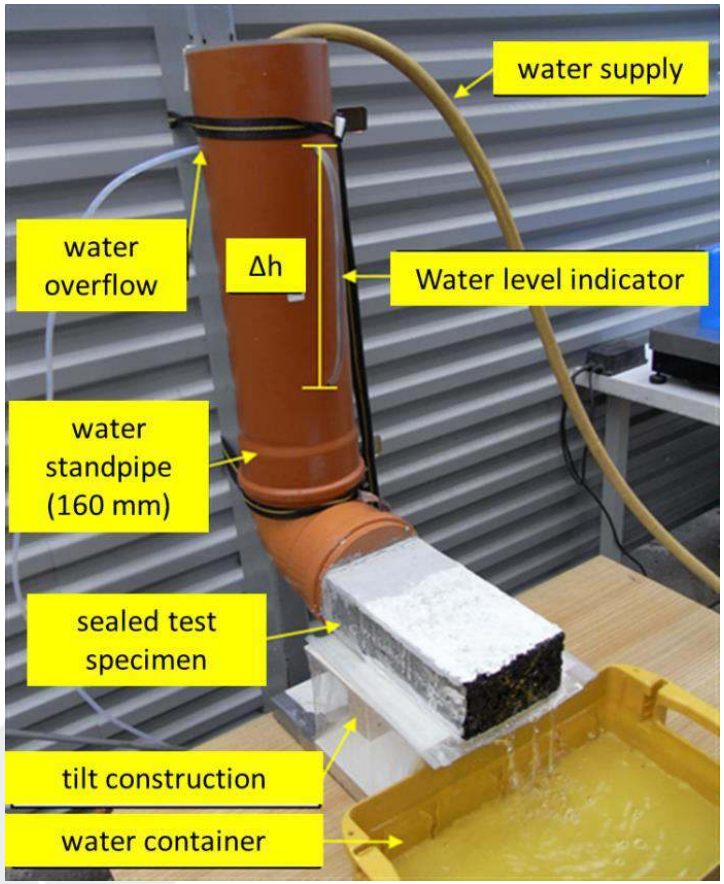
void content : 32 – 33 Vol.-%

Properties of the PA-layer:

Thickness: 40 mm

void content : 22 – 24 Vol.-%

4.1 HYDRAULIC PROPERTIES



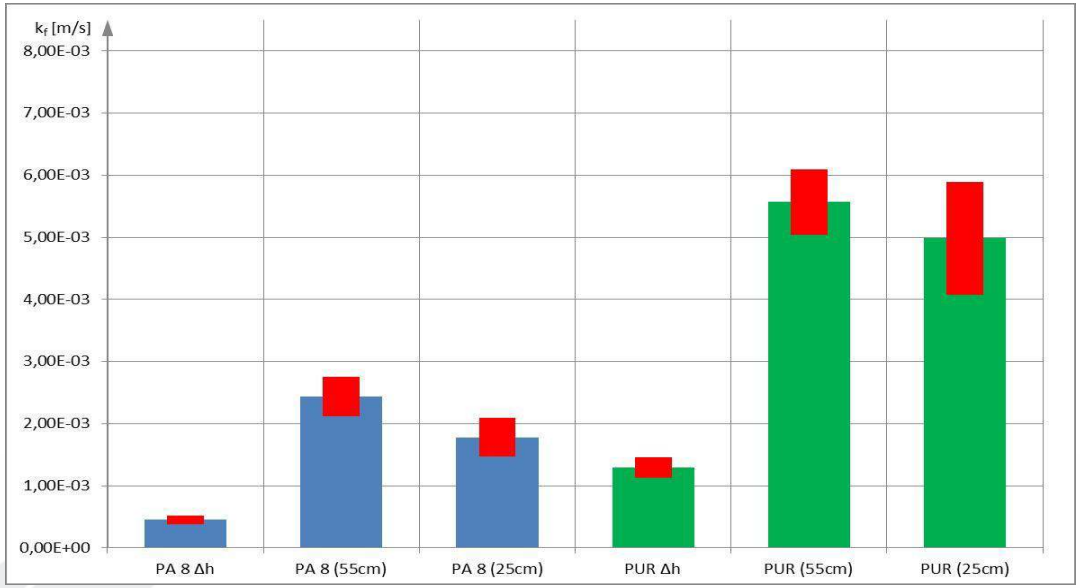
Test set-up

Test parameters:

- Testing of the horizontal flow with a slope of 2,5 %
- Test plates sealed at all sides (only horizontal flow)
- Test with decreasing water level (decreasing water pressure)
- Test with a water column of 55 cm and 25 cm (constant water pressure)

4.1 HYDRAULIC PROPERTIES

Results:

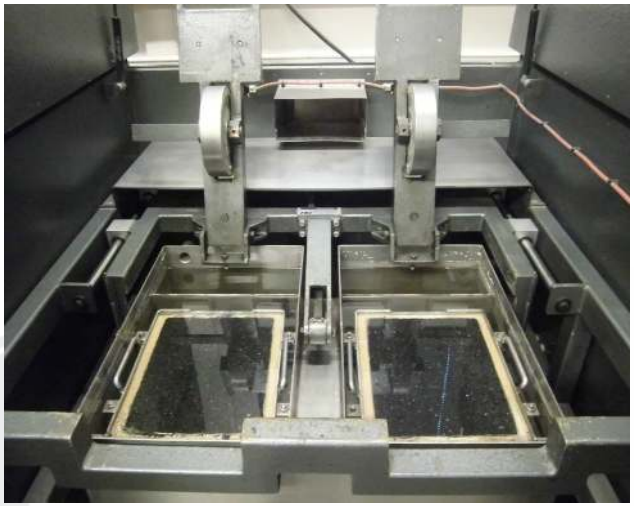


- the PUR variant shows greater permeability compared to the PA variant
- Higher flow with water pressure
- After a short test-duration decreasing water flow at the PA variant (adhesion?)

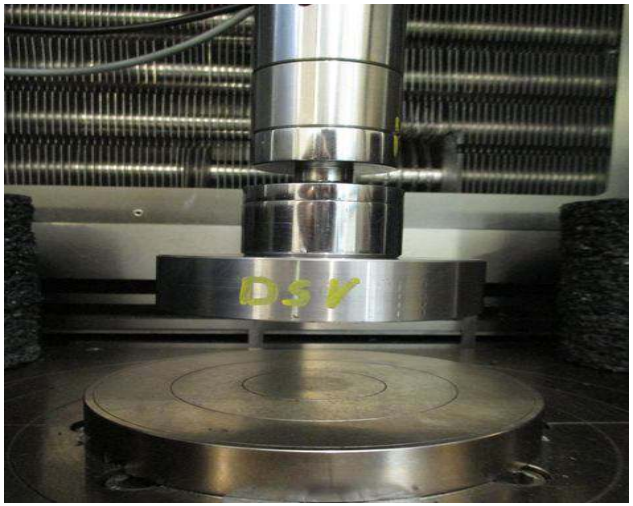
► Suitability of the PUR variant is given from the hydraulic perspective

4.2 MECHANICAL PROPERTIES

Step 1:
Wheel-tracking-test
(TP Asphalt / DIN EN 12697-22)



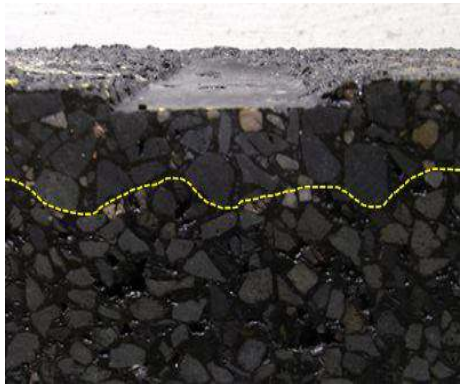
Step 2:
Cycling-compression-test
(TP Asphalt / DIN EN 12697-25)



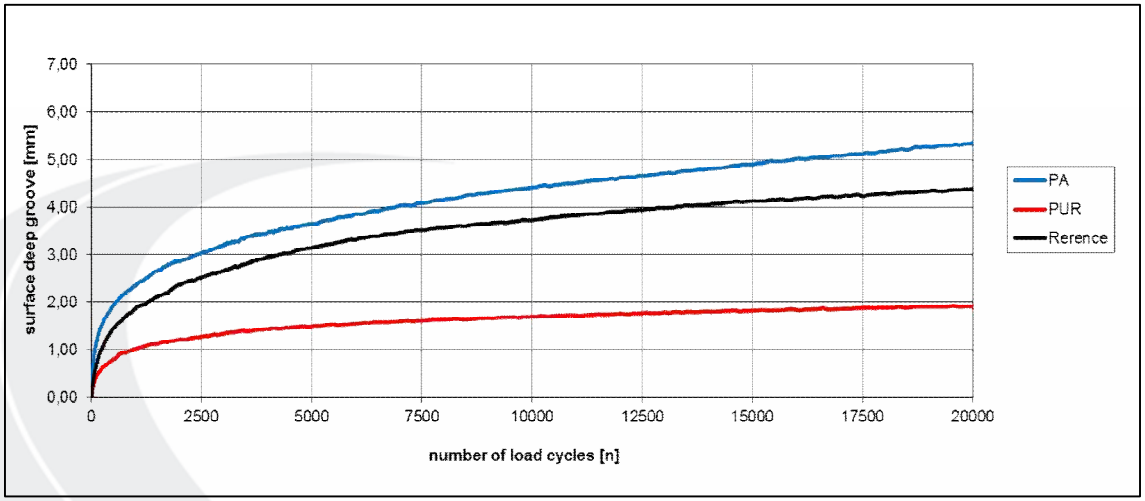
4.2 MECHANICAL PROPERTIES

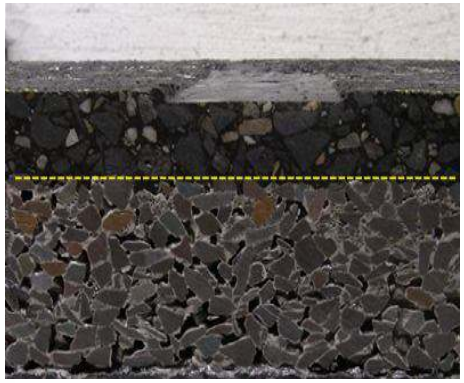
Results: Wheel-tracking-test

Test parameter	PUR	PA	Reference
Expansion after 10.000 load cycles [mm]	2,3	6,8	4,6
Relative rut depth after testing [%]	11	34	23



PA-variant





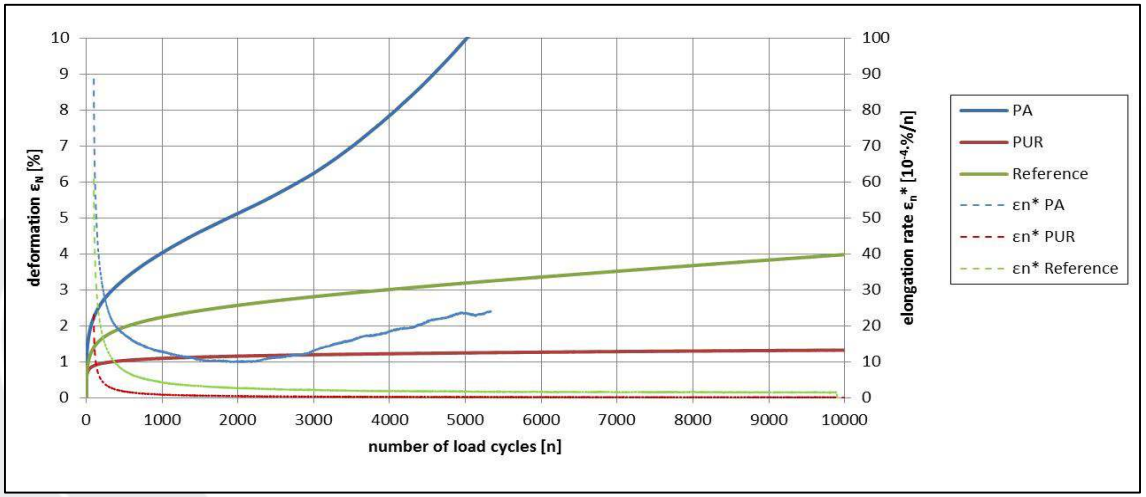
PUR-variant

4.2 MECHANICAL PROPERTIES

Results: Cyclic-compression-test

Test parameter	PUR	PA	Reference
Expansion after 10.000 load cycles [%]	1,3	*	4,1
Deformation after 10.000 load cycles [mm]	1,2	*	3,7

* Testing after ~1500 load cycles cancelled – Expansion 5,0 mm



PA-Variante

PUR-Variante

4.2 MECHANICAL PROPERTIES

Results:

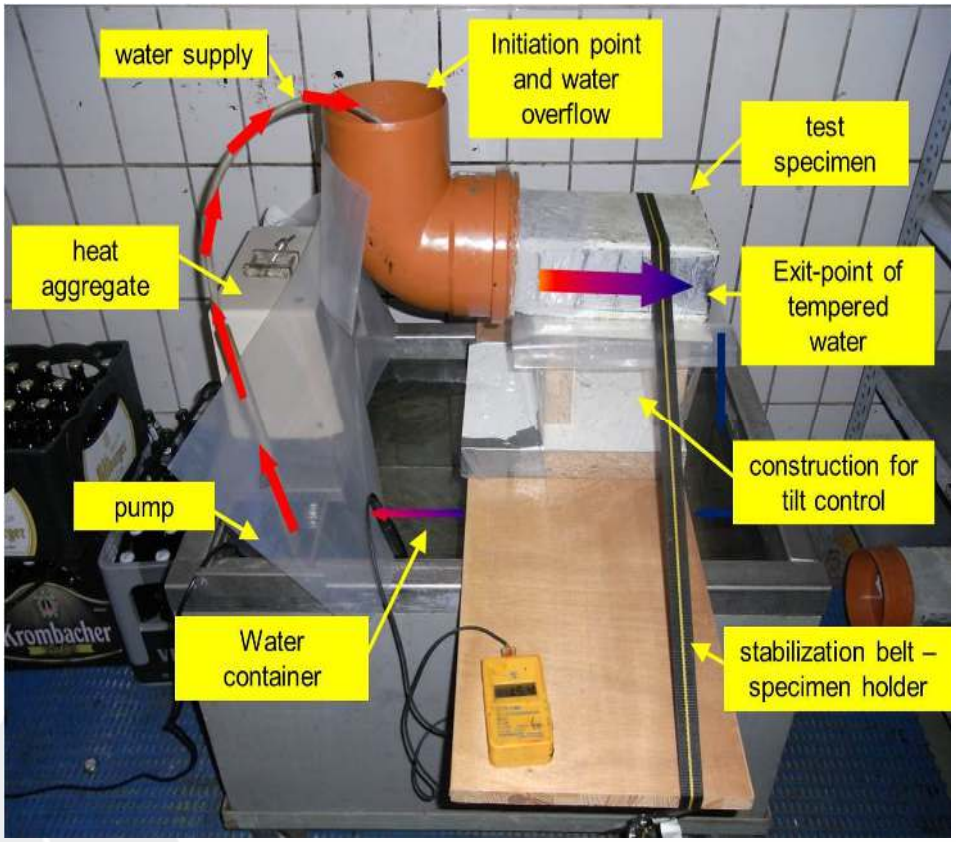
- The PUR variant shows the best results for both the wheel-tracking-test and the cyclic-comression-test - high resistance to rutting and deformation

- The PA variant shows the worst results – low resistance to rutting and deformation

- The PUR variant exceeds the zero variant regarding the tested properties

► Suitability of the PUR variant is given – the investigation of thermal effectiveness is therefore carried out with the PUR variant

5. DEMONSTRATOR - THERMAL EFFECTIVENESS



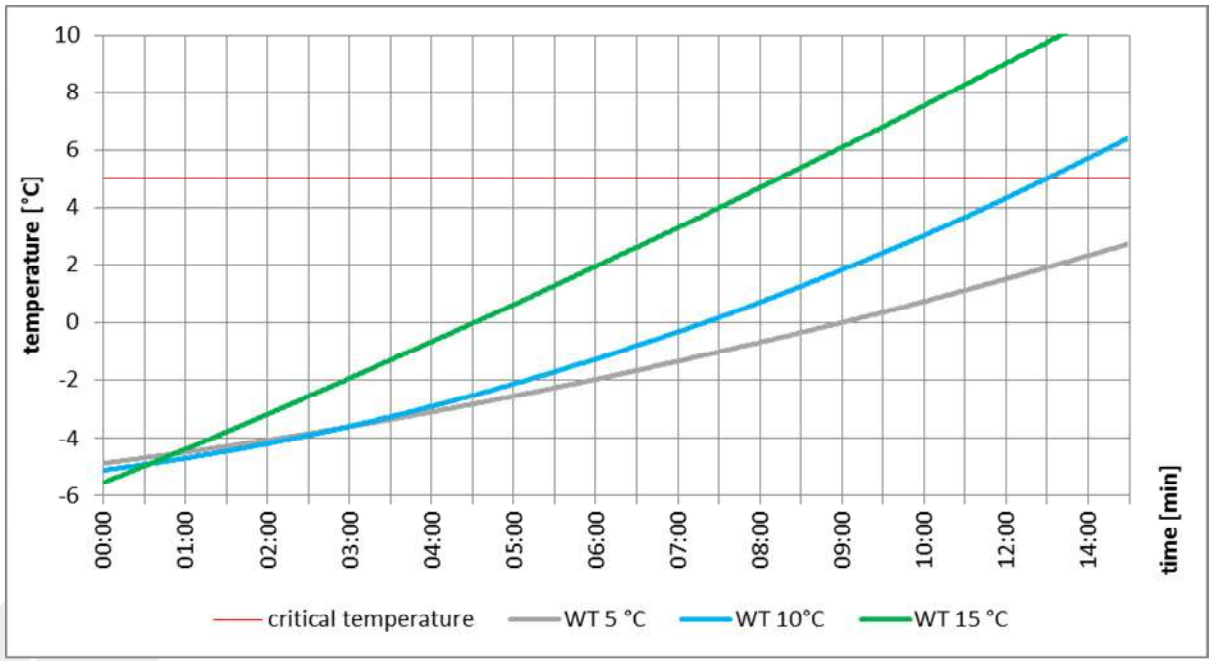
Test set-up

Test parameters:

- Horizontal flow at a slope of 2,5 %
- Air temperature during test = - 5°C
- Core temperature of the test plate at the beginning of the test = - 5°C
- Testing with three water temperatures (5, 10 and 15°C)

5. DEMONSTRATOR - THERMAL EFFECTIVENESS

Results: Thermal effectiveness

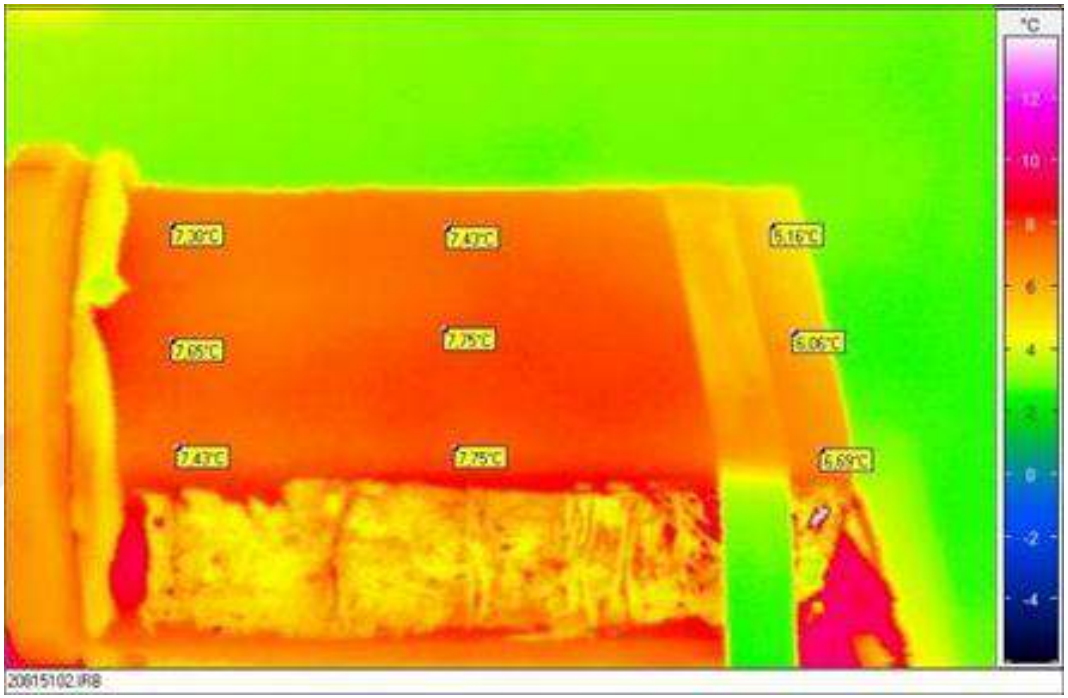


- A sufficient surface temperature of 5°C is already reached after 8 minutes at a water temperature of 15°C
- lower water temperatures lead to a slower rise

► The thermal effectiveness of the concept could be demonstrated in the laboratory for small specimens

5. DEMONSTRATOR - THERMAL EFFECTIVENESS

Thermal effectiveness – results (water temperature = 15°C):



after 15 minutes

6. CONCLUSIONS AND OUTLOOK

- The thermal effectiveness of the PUR variant could be demonstrated in small scale in the laboratory
- The overall construction of the road was strengthened by the PUR interlayer - no negative influence was detected
- Possibilities of water discharge need to be further investigated
- Examination of low-temperature behavior is required - failure of water flow is possible
- Large-scale testing of the system is to be sought

Thank you for attention

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