Asphalt construction surveys

Avoid premature road damage with modern technology right from the asphalt installation stage

Measures to increase the quality of asphalt for the construction of trunk roads and municipal roads in Germany

GB

Conventional thermally insulated (dumper) vehicles

Transport solution with push-off technology

CONTENTS

High-quality asphalt roads are important for road safety. Potholes, blow-ups or damaged roads can quickly become a danger to all road users. It is therefore all the more important to use the right vehicles in road construction: Fliegl has been working very intensively on development for many years and has been exploring the transport and installation process in road construction. It has always been very important to us to locate existing weaknesses and find appropriate, innovative and effective solutions. **We have managed to perfect the technology required for the current requirements in road construction with push-off technology, which has been proven worldwide a thousand times over and which has long since become the state of the art** (there are many manufacturers).

A recent study by TUM has confirmed: The **average loss of temperature during transport is reduced by only 3.2 °C** when thermally insulated dumper bodies are used compared with conventional dumper bodies – but the average temperature of the installed mix has not usually been a problem in recent decades!

Even when mixes are transported using conventional thermally insulated vehicles, the main problem encountered in asphalt road construction – segregation – is not solved.

Key criteria in the construction of asphalt roads are the temperature and homogeneity (of the temperature and grain structure). The installation results only satisfy the highest standards if these are both consistently high – only then are the compaction ratio, void content, binder agent content, evenness, etc. of the new road surface perfect and thus impervious and durable. Dumper vehicles with push-off function will ensure this consistency of temperature – and perfect the process of road construction.

The installation quality required when constructing asphalt roads can usually not be achieved with classic tipping technology due to negative factors, such as time spent in inner-city traffic jams, overhead tram cables, traffic lights, crossroads, subways, roadside trees, installation obstructions, e.g. gullies, manholes, etc. A continuous installation process with a high or optimum installation temperature and homogeneity can therefore not be guaranteed in practice (especially with highly sensitive noise-reducing asphalt surfaces), particularly in municipal road construction and maintenance management, with conventional transport technology. These problems are a thing of the past when thermally insulated vehicles with push-off technology are used.

This is based on years of research:
A large number of studies and research projects, e.g. TU Darmstadt, TU Vienna, TU Brunswick,... commissioned by the respective public bodies responsible for road construction have revealed the causes, problems and solutions in asphalt road construction.

One great advantage over conventional tipping technology is that it **continues to mix during the unloading process** and yields significantly better homogeneity of the temperature and stone structure on the finished asphalt surface even when installed without a feeder. It has therefore been shown that the installation quality and thus the durability of roads can be significantly improved with push-off technology, which is consequently an essential contribution to process safety in road construction.

It is now up to the responsible building authorities to demand this technology in their tenders for future road rehabilitation or new construction projects.

We would be delighted to share our enthusiasm for innovative road-construction solutions that will make your roads more durable with you.

We would be happy to send you detailed results from additional research projects or explain these to you in a personal consultation.

“Dumper vehicles with push-off technology represent a milestone for quality improvement in asphalt road construction.”

We would be grateful if you were able to suggest a date.

I would be pleased to assist and am at your disposal on Tel.: + 49 (0) 8631/307 381 or email: martin.fliegl@fliegl.com.

Martin Fliegl
Head of Research and Development
Fliegl Bau- und Kommunaltechnik GmbH

Asphalt construction surveys

Avoid premature road damage with modern technology right from the asphalt installation stage

Asphalt construction

Measures to increase the quality of asphalt for the construction of trunk roads and municipal roads in Germany

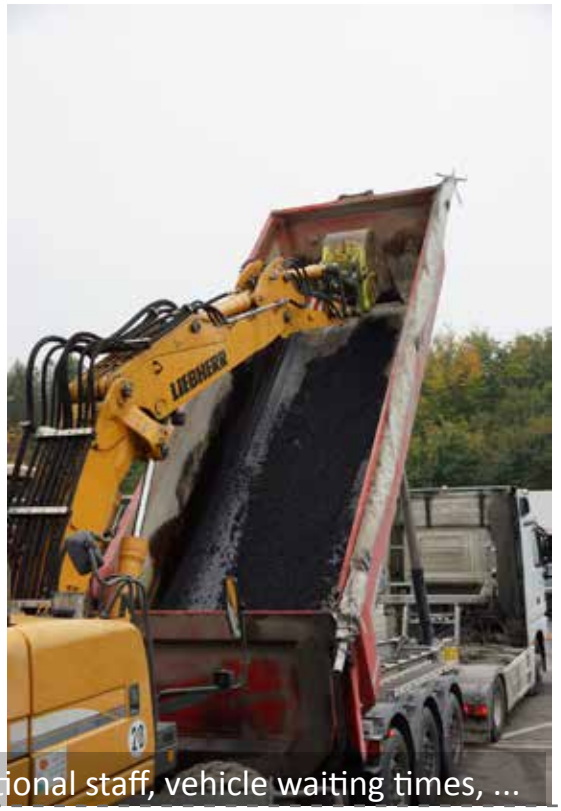
The perfect transport system for road construction

The ingenious solution for construction sites with obstructions, such as trams, overhead cables and power lines, subways, tunnel sections, and for municipal road construction

PUSH OFF instead of tipping

Residues of mix in dumper bodies
→ cause unnecessary downtimes and costs

A lot of residues of mix in the dumper bodies
with SMA, OPA, PmB, ...



Additional costs for excavators, additional staff, vehicle waiting times, ...

**Large quantities of mix (already paid for)
that have to be disposed of**

Long vehicle waiting times

Very time-consuming and difficult scraping out the dumper bodies
➔ the "cycle time" for the delivery of mix doesn't go to plan
➔ fresh supplies break off and the paver comes to a standstill

Clean and completely emptied with the push-off technology
even with difficult mixes, such as OPA, PMA, LOA, DSHV,
rubber or polymer-modified bitumen

ASW Asphaltprofi Thermo
Installation of porous asphalt

ASW Stone truck -

in use on construction sites all year round

ASW ASPHALTPROFI THERMO

Extremely low loading height

Munich Mittlerer Ring orbital motorway, Luise Kisselbachplatz Leitenmaier

Continuous mixing throughout the unloading process –
same effect as the truck mixer
for construction engineering

Continuous mixing

Centring plates for paver use – thus reducing asphalt segregation

ASW with metering wedge (plug-in / retrofitting) Brilliant for manual installation in municipal areas

Manual installation with metering wedge

Paver operation with metering wedge ➔

Correct trench closing – direct and metered transfer into the sidewalk paver

Asphalt installation for "secondary areas" such as sidewalks and trenches for utilities – without excavators, less manual work.
Fast, effective, **hot and homogeneous ➔ long-lived**

← "Wiesel" distribution screw can be simply attached / retrofitted

Avenue trees or overhead lines are no obstacle for the ASW Asphaltprofi

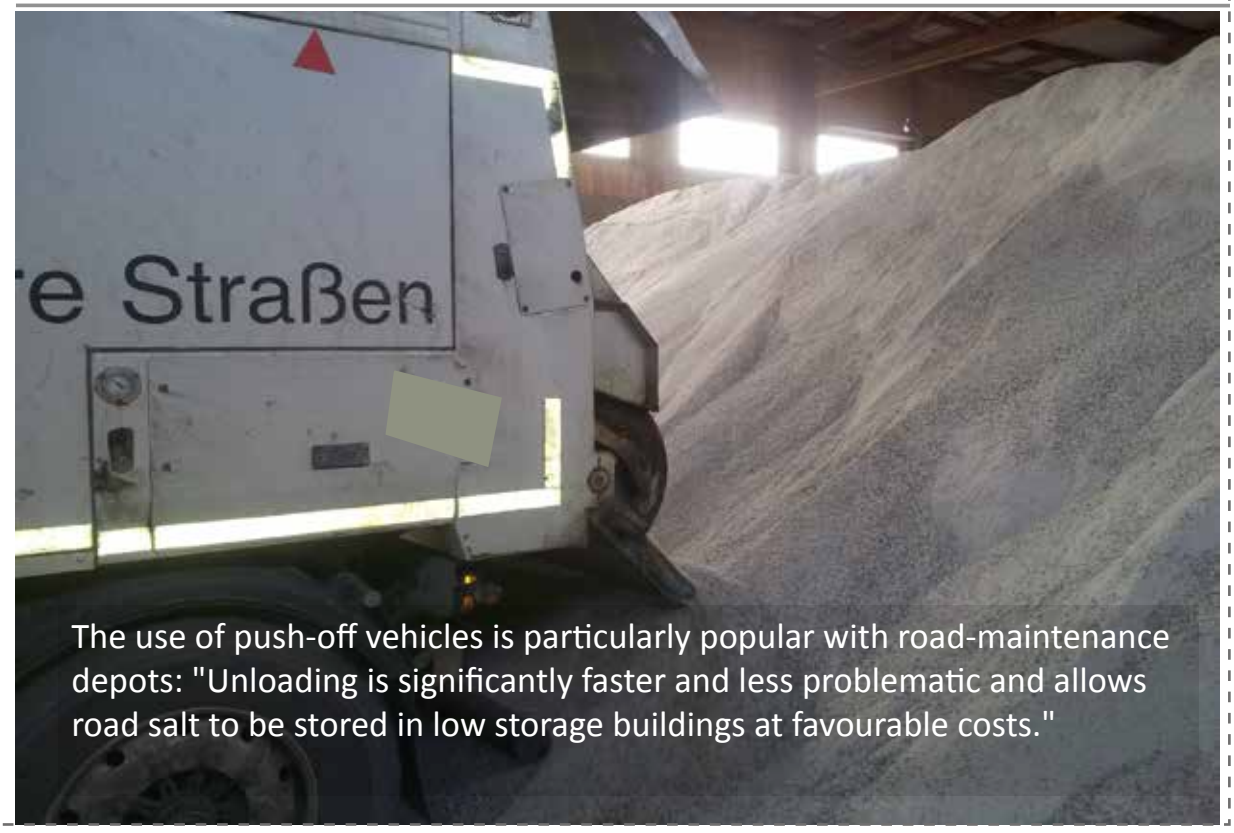
Continuous asphalt installation WITHOUT STOP AND GO
➔Improved quality and greater daily performance

Continuous asphalt installation without stop-and-go even in the event of obstacles and structures …

Process reliability with special coatings e.g. DSHV, PA, PMA, LOA

Asphalt installation while airport operations continue without restrictions from air-traffic control's radar

Transportation and storage of road salt Unloading in low storage buildings – no problem



The use of push-off vehicles is particularly popular with road-maintenance depots: "Unloading is significantly faster and less problematic and allows road salt to be stored in low storage buildings at favourable costs."

Circular letter RS 10/2013 from the BMVBS / BMVI

Thanks to a phased implementation of the new requirements, the building contractors carrying out the work are granted enough time for the implementation:

Phase 1 **valid from 2015**
When laying an asphalt surface of between 18,000m² and 60,000m²
(Major projects are excluded for the time being)

Phase 2 **valid from 2017**
For all measures with an asphalt surface larger than 18,000 m²

Phase 3 **valid from 2019**
For laying all asphalt surfaces

- Thermally insulated vehicles for transporting the asphalt mix for base, binder and surface layers must be required in the specifications.

Circular letter RS 10/2013 from the BMVBS / BMVI

The regulation applies to all vehicles the transport asphalt mix

- **Vehicles with dumper trailers (box and rounded bodies)**
- **Two to four-axle vehicles with a three-way dumper or rear dumper**
- **Vehicles with push-off function (recommended by the BMVI)**
  ➔Reduced asphalt segregation in the silo due to the continuous homogenisation of the material during unloading
- **Vehicles with closed transport containers (concrete mixer vehicles)**

Report: Berlin has made it official –
capital city requires insulating and push-off technology

"Experts have recognised the added value that push-off technology generates for the installation quality and durability of road surfaces. It is therefore logical and understandable that more and more authorities are defining thermally insulated transport vehicles with push-off function as the binding standard for asphalt delivery and are incorporating them as requirements into their specifications."

Circular letter RS 10/2013 from the BMVBS / BMVI

- **Feeder vehicles are going to be increasingly required in specifications**
- **The local framework conditions for the use of feeders must be reviewed in regard to equipment width, installation areas, space – particularly where (smaller areas) and branches are concerned…**
- **The deployment of vehicles using push-off technology has proved itself as an alternative and recognised method of construction as a "quality-improving" component in the process chain where the use of feeders doesn't offer any benefits (space / costs)**

Circular letter RS 10/2013 from the BMVBS / BMVI

The following must be available to ensure the adequate thermal insulation of the transport bodies:

The wall / floor structure of a thermally insulated transport body must have a thermal resistance (R-value) of at least >1.65 m^2 k/W (at 20°C).

The temperature resistance of the insulating material must be 200°C

Fliegl HIGH INSULATION Asphaltprofi Thermo

"Asphaltprofi Thermo"

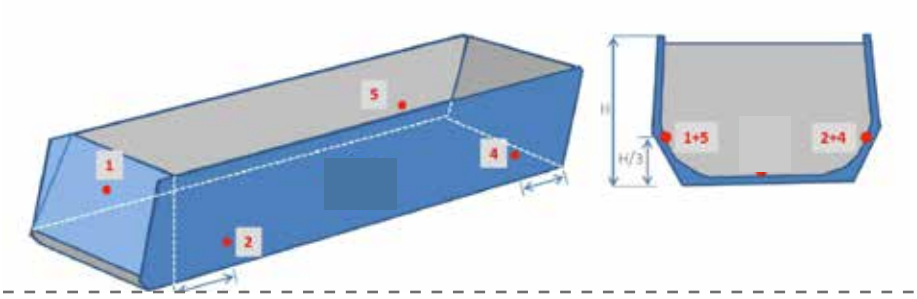
- **HIGH INSULATION**
- **Side walls, floor, front and rear wall designed with insulation that is at least 70 mm thick**

Fliegl Isotherm also offers the following:

- **High thermal insulation (Lambda value below 0.028)**
- **Complete moisture resistance**
- **Impact and vibration resistance**
- **Temperature stability in continuous use above 200°C**
- **➔R-value of 2.5 (required value is 1.65 according to RS 10/2013)**
  - **The higher the value, the better the insulation**
- **This corresponds to a K-value of 0.4**
  - **The lower the value, the better the insulation capacity**

Circular letter RS 10/2013 from BMVBS / BMVI

Requirements for existing vehicles
Subsequent thermal insulation of the side surfaces (includes front and rear wall) with suitable materials is sufficient as a transitional solution for existing vehicles (see below for deviating requirement for new vehicles). In addition to the thermal insulation of the outside surfaces of the transport body, the vehicle must be equipped with a covering mechanism (for example traps based on silicone/polyurethane or comparable as well as a folding covering mechanism) to minimise temperature losses during transport and wait times. Asphalt mix temperature are measured with a calibrated temperature measurement device that makes it possible to read the temperature of the asphalt mix in the four corner points of the transport body (figure 1, measuring points 1, 2, 4 and 5). (The measuring device can be installed in the vehicle or can be used as a transportable device.)



Temperature display

Analogue
Temperature display

Telematics interface
SAE J 1939 is globally standardised

- FCT digital temperature measuring system with mobile printing unit.
- Operated via smartphone or tablet.
- Data transfer possible through an external telematics system.
- Bluetooth interface.
- APP-based interface permits data transfers for software solutions, planning, control and documentation of the construction site logistics, e.g. HiQ, BPO Asphalt, practical computer processing…

The RS 13.12/2016 again drew attention to the requirement for a logistics concept and software solutions for process optimisation and temperature monitoring.

Temperature display

Transportation of asphalt

- **The mix must always be fully covered and protected from the wind!**
- The requirement to cover the mix is usually only intended to prevent temperature losses.

  "**This cannot really be too great** over shorter transportation distances or if outside temperatures are higher".
- The **risk of oxidation of the binder agent** is overlooked (as people are usually not aware of this).
- This occurs when **oxygen** is fed into the loose, porous mix due to the wind flow.
- The consequence: Damage to the binder agent, whereby its adhesive strength is lost and therefore no durable grain bond is guaranteed.

Binder agent oxidation / feeders

- **Increased oxidation of the binder agent with the use of feeders**

  (Especially with installation quantities of up to approx. 1000 tonnes/day)

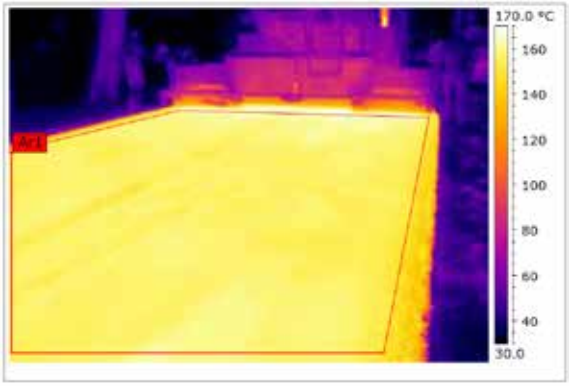
  - "Small construction sites" are, however, around 90% of measures)
- **Costs for small measures per tonne mix??**

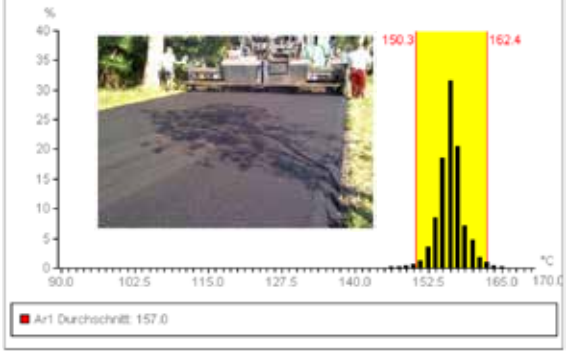
  Costs per tonne of mix for feeder deployment??

  (frequently € 2.00 to € 6.00 and more per tonne for small construction sites)

Thermal cover – <u>the cover stays closed on push-off vehicles during unloading</u>!!

Rehabilitation of a district road – the local circumstances require the deployment of push-off technology. This was already set out in the specifications.





Temp.Spanne	12,1 °C
Durchschn. Einbautemperatur	157,0 °C

Requirements and regulations, e.g. in accordance with ZTV Asphalt

(Theory)

Requirements and regulations
Theory

- The mix in the paver bucket should
  a) in regard to the **temperature** (in accordance with ZTV Asphalt)
  b) in regard to the **grain structure** (grading curve)

  be **evenly** distributed

- The basic prerequisite for long-lived asphalt surfaces !!!

Mix temperatures

As specified by ZTV Asphalt-StB 07:
Tab.: Lowest and highest temperature of the asphalt mix in °C

Binding agent	Type of asphalt mix	
TL bitumen	**AC**	**SMA**
30/45	155-195	
50/70	140-180	150-190
70/100	140-180	150-180
10/40-65	160-190	
25/55-55	150-190	150-190

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Mix temperatures

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30/45	155-195	
50/70	140-180	150-190
70/100	140-180	150-180
10/40-65	160-190	
25/55-55	150-190	150-190

- The lower limits apply with deliveries to the construction site
- The upper limits when leaving the asphalt mixing plant and the silo. Information provided by the manufacturer must also be observed

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Requirements and regulations
from practical applications

PROBLEMS IN ASPHALT ROAD CONSTRUCTION

With conventional transport technology

Even when transporting mix materials with conventional thermally insulated (dumper) vehicles, one of the main problems in asphalt road construction has not been solved – SEGREGATION

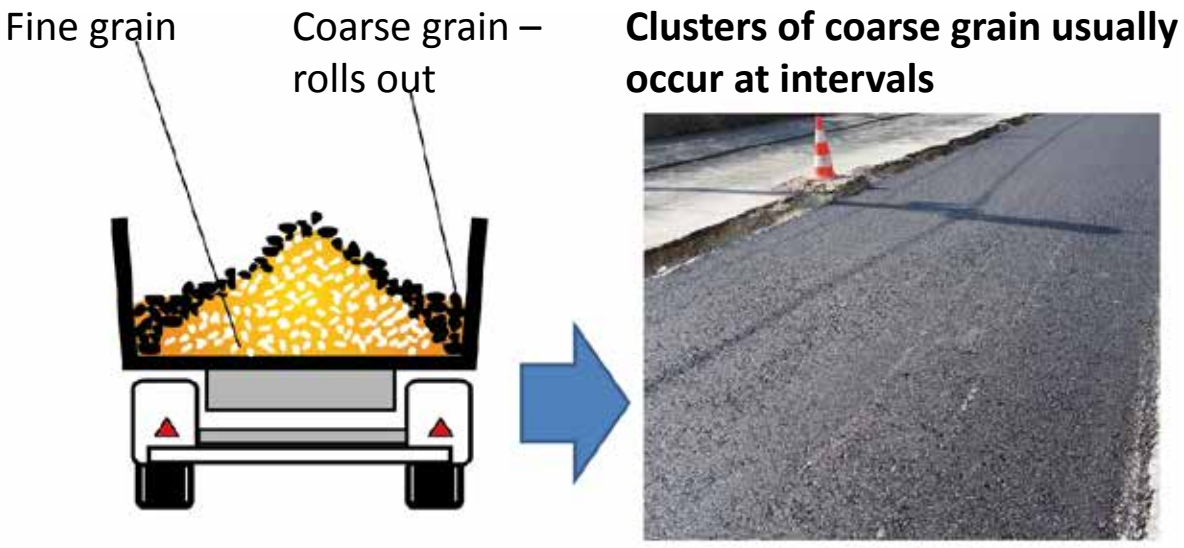
Requirements and regulations – practical problems
1. MECHANICAL AND GRANULAR SEGREGATION

- The mix in the paver bucket should be **evenly** distributed in regard to **temperature and grain structure**

Requirements and regulations – practical problems
1. MECHANICAL AND GRANULAR SEGREGATION

Consequences of mechanical segregation with conventional transport technology

Cause of granular segregation
coarse grains roll outward – coarse grains come out at the start



$$\frac{\text{Tonnage per truck load}}{\text{Installation depth (m) x installation thickness (m) x 2.5 to/m}^3} = \text{Distance (m) from clusters (coarse grain and cold spots)}$$

Requirements and regulations – practical problems
1. MECHANICAL AND GRANULAR SEGREGATION

Homogeneous mix ??

LOTS OF COARSE GRAIN is what comes out first during tipping
(from the top layer, which slips down first)

Requirements and regulations – practical problems
1. MECHANICAL AND GRANULAR SEGREGATION

Homogeneous mix ??

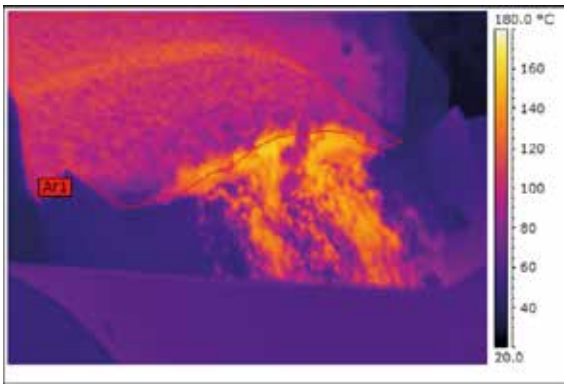
Early consequential damage, e.g. loss of material, grain break out, frost damage, is inevitable here

Requirements and regulations – practical problems
2. THERMAL SEGREGATION

Average mixing temperature of approx. 165°C

distance from mixing plant to construction site: approx. 15 km / max. 20 min.
weather: Sunshine, no wind, approx. 33-35°C

"Crust" temperature on thermal vehicles: approx. 99°C



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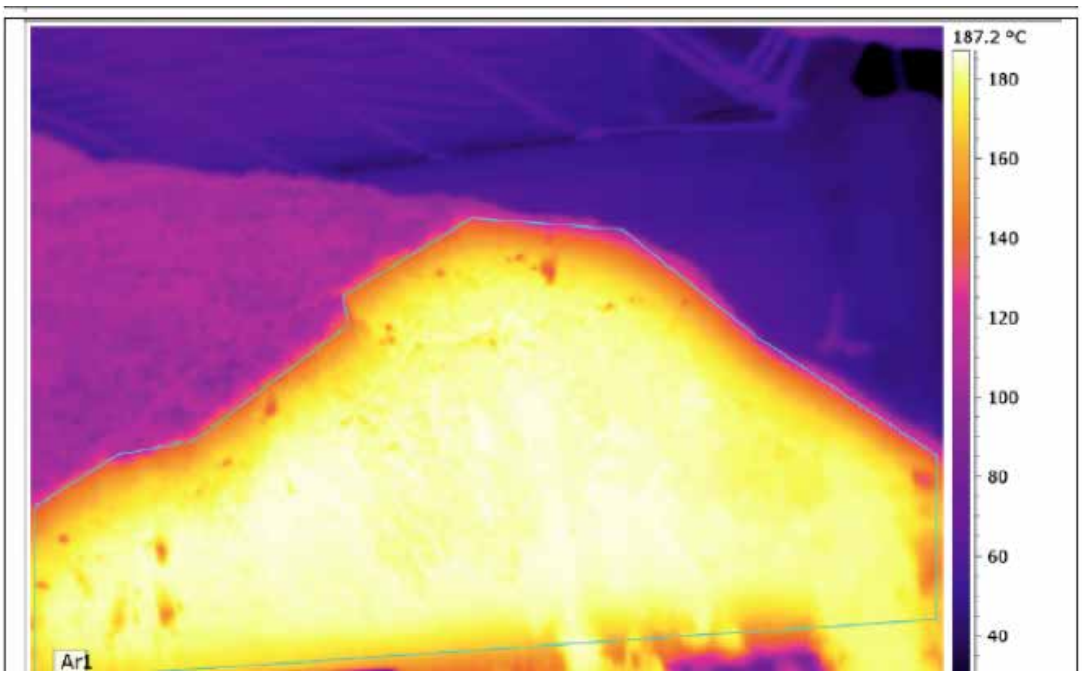
Requirements and regulations – practical problems
2. THERMAL SEGREGATION

Causes of thermal segregation – cold layer clearly visible on the top



Requirements and regulations – practical problems
2. THERMAL SEGREGATION

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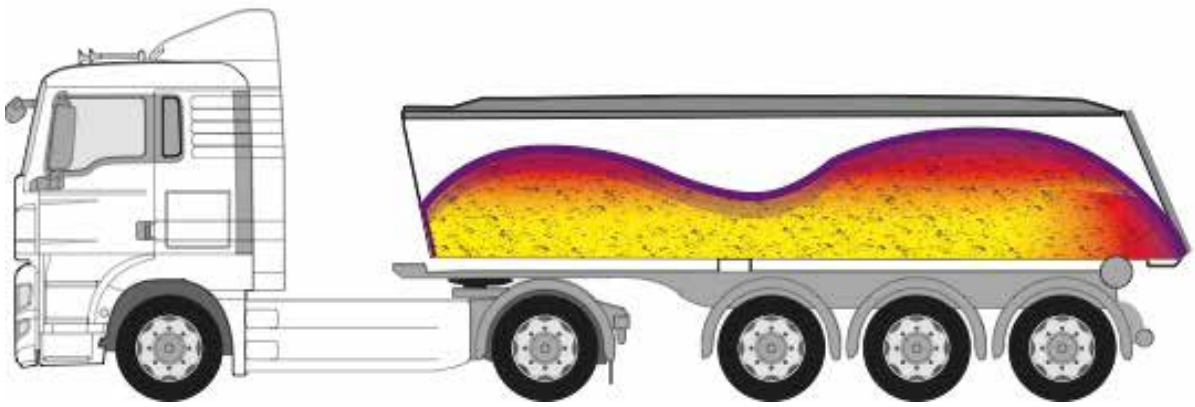

Requirements and regulations – practical problems
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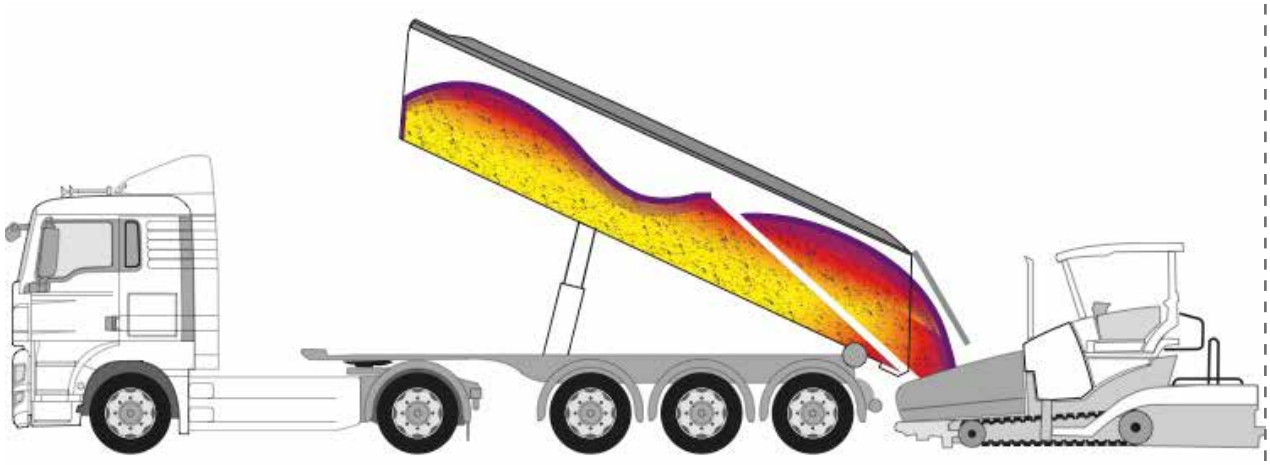

Requirements and regulations – practical problems

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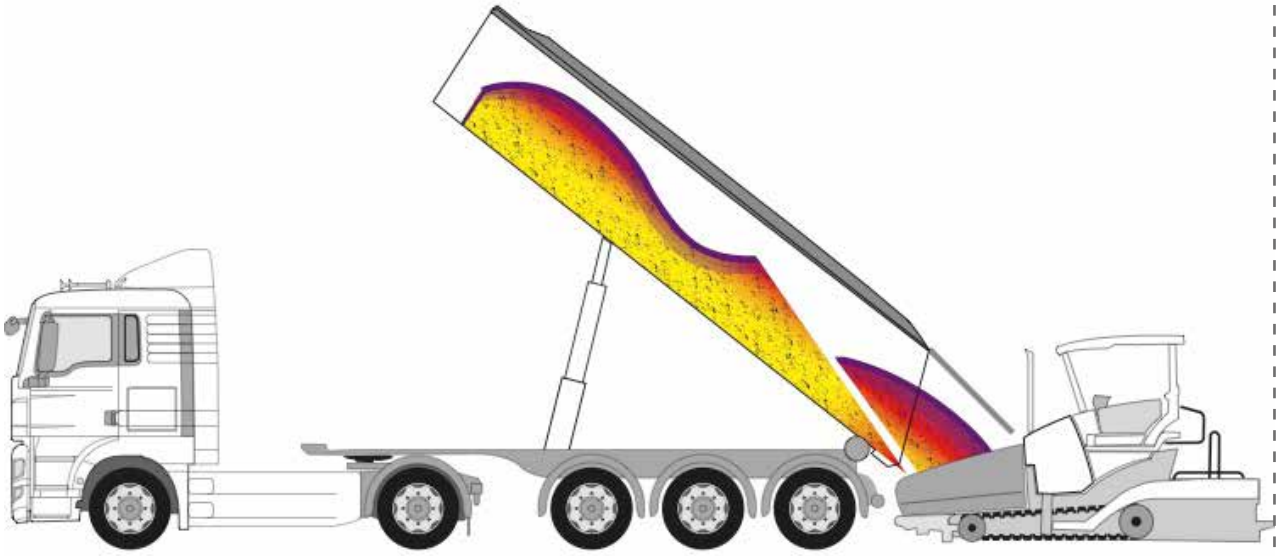
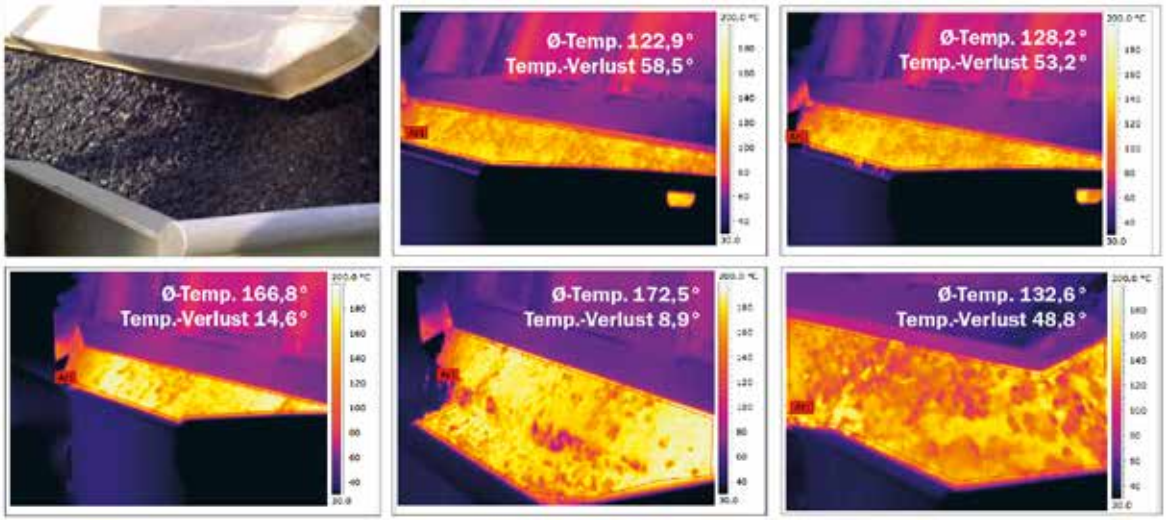


Requirements and regulations – practical problems
2. THERMAL SEGREGATION

Thermal segregation during asphalt transport

Temperature progression during unloading (thermal dumper)

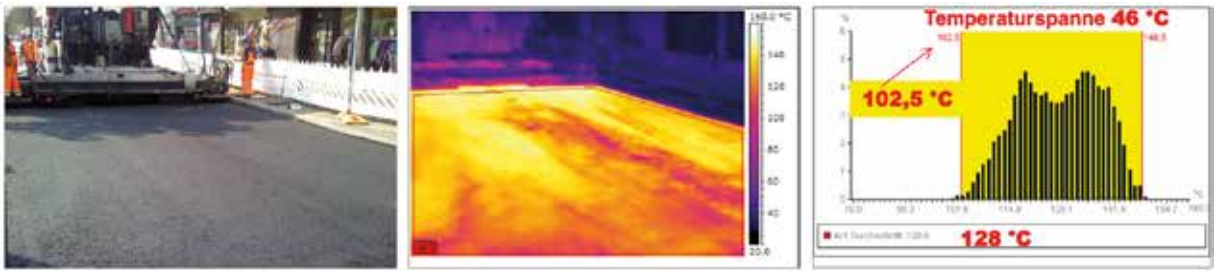


$$\frac{\text{Tonnage per truck load}}{\text{Installation depth (m) x installation thickness (m) x 2.5 to/m}^3} = \text{Distance (m) from clusters (coarse grain and cold spots)}$$

Requirements and regulations – practical problems
2. THERMAL SEGREGATION

Thermal segregation during asphalt transport

➡ Sometimes significant temperature differences on dumper vehicles before the first roller pass



The use of thermally insulated vehicles reduces the average loss of temperature by around 3-5°C compared with conventional vehicles that are not insulated –
but doesn't solve the problem of segregation.

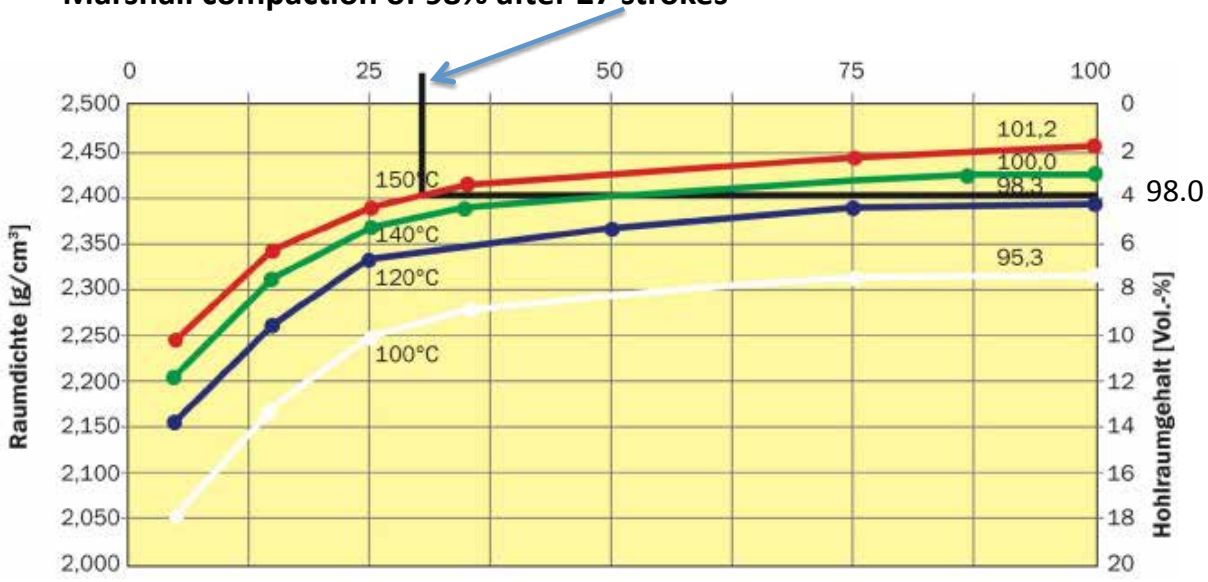
Relationship between compaction and mix temperature (Richter 1997)
2. THERMAL SEGREGATION

Analyses of different mix formulations

- **E.g. for a compaction ratio of 98% (in accordance with ZTV-Asphalt), approx. 27 strokes are required for a mix temperature of 150°C**

Relationship between compaction and mix temperature
2. THERMAL SEGREGATION

Marshall compaction of 98% after 27 strokes



98% ≙ Minimum compaction ratio

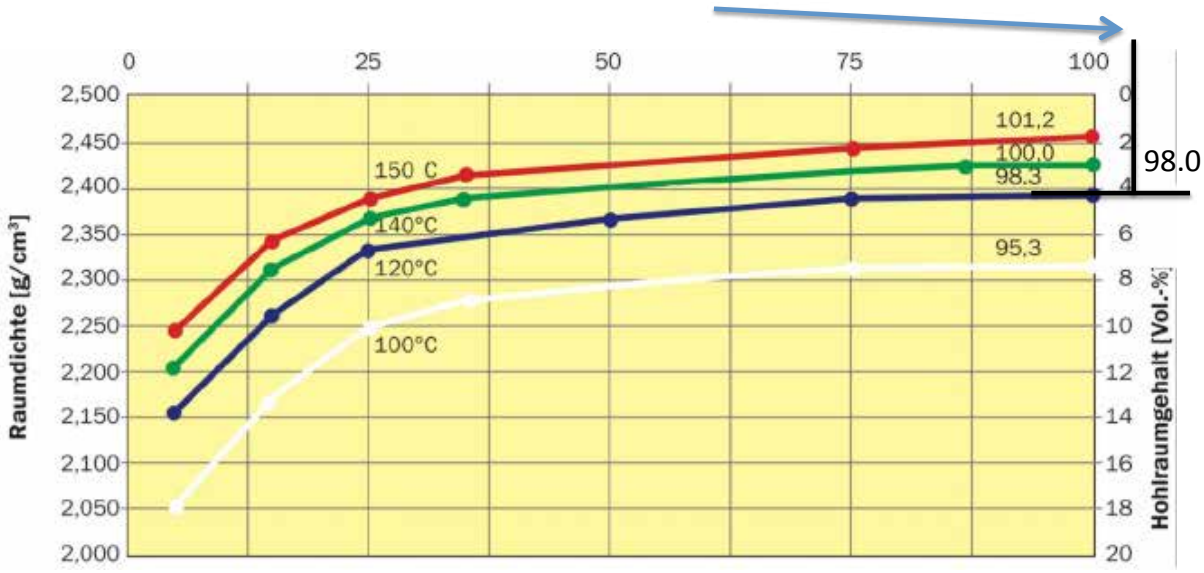
Relationship between compaction and mix temperature (Richter 1997)
2. THERMAL SEGREGATION

Analyses of different mix formulations

- **e.g. for a compaction ratio of 98%, approx. 27 strokes are required at a mix temperature of 150°C (in accordance with ZTV-Asphalt)**
- **More than 100 strokes are already required to achieve the same compaction at a lower mix temperature of 120°C (instead of 150°)**
- **It is no longer possible to achieve the required minimum compaction of 98% at a temperature of 100°C in spite of considerable compaction efforts!**
  Consequence➔ grain disintegration

Relationship between compaction and mix temperature
2. THERMAL SEGREGATION

Marshall compaction of 98% after more than 100 strokes



98% ≙ Minimum compaction ratio

Requirements and regulations – practical problems

3. BINDER-AGENT SEGREGATION **Practical example: PA**

While the test section was being installed, **accumulations of binder agent** were detected on the finished layer's surface in spite of continuous installation and constant temperature monitoring

Source: Dr.-Ing. Daniel Gogolin

Requirements and regulations – practical problems

3. BINDER-AGENT SEGREGATION

- This occurrence led to the suspicion that as result of the concept the binder and the corresponding fines had already precipitated to a certain degree during the transport.
  - Binder agent runs off (during transportation)
  - Binder agent doesn't run off (after installation)
- These accumulations on the surface would result from excess ratios of binder agent and fines during installation.
- The following trailers were accordingly not completely emptied.
- The material remaining in a trailer was subsequently analysed.

Source: Dr.-Ing. Daniel Gogolin

Requirements and regulations – practical problems
3. BINDER-AGENT SEGREGATION

The last third of the trailer load and the "dregs" therefore tend towards extreme overgreasing and therefore also towards accumulations of binder agent on the surface during installation.

Source: Dr.-Ing. Daniel Gogolin

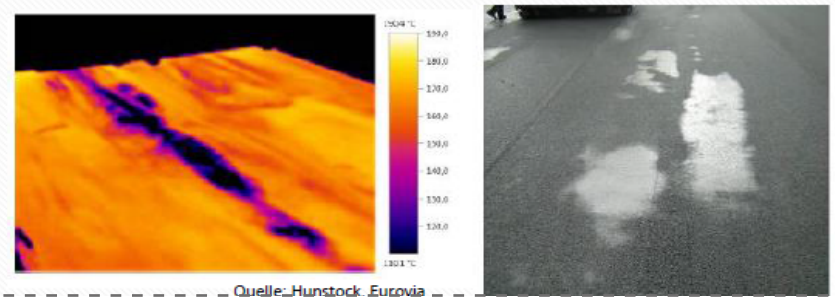
Requirements and regulations – practical problems
3. BINDER-AGENT SEGREGATION

» Probleme

DR. HUTSCHENREUTHER
Ingenieurgesellschaft für bautechnische Prüfungen mbH

Problems

- Many places / areas with high accumulations of binder agent at the surface
  Insufficient skid-resistance values
- Transport – segregation? – Separating agent?
- Binder agent doesn't run off (after installation)
- Binder agent runs off (during transportation)
- Irregular temperature distribution determined



Quelle: Hunstock, Eurovia

Requirements and regulations
from practical applications

SOLUTION: PERMANENT MIXING

Basic prerequisite for high installation quality

Requirements and regulations
from practical applications

CIVIL ENGINEERING

Transportation of concrete?
How would you handle transportation?

With dumper??
➡ Considerable segregation

with concrete mixer!
➡ Continuous mixing

'The main thing is that it's cheap??'

'Quality has priority!!!'

Requirements and regulations
from practical applications

Requirements and regulations
from practical applications

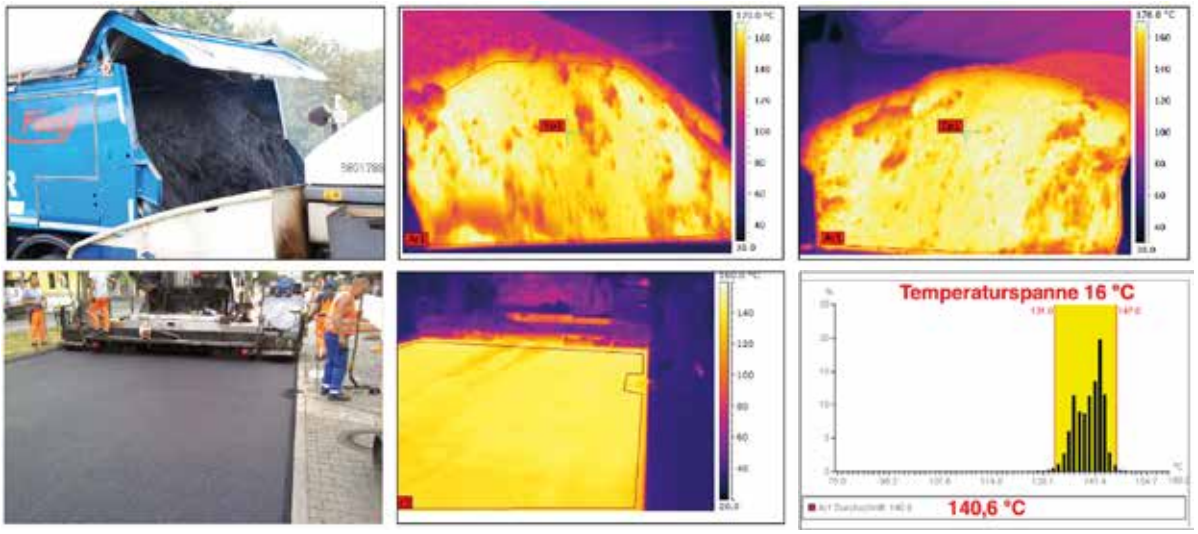
Requirements and regulations
from practical applications

Continuous mixing throughout the unloading process
(of temperature as well as bitumen and binder-agent proportions)

- even distribution of grain sizes (in accordance with grading curve)
- Dumper bodies clean and completely emptied – also without "Near-East" separator (diesel)

Requirements and regulations
from practical applications

Continuous mixing



Three determining factors for standard asphalt layers with high durability:

Three determining factors for standard asphalt layers with high durability:

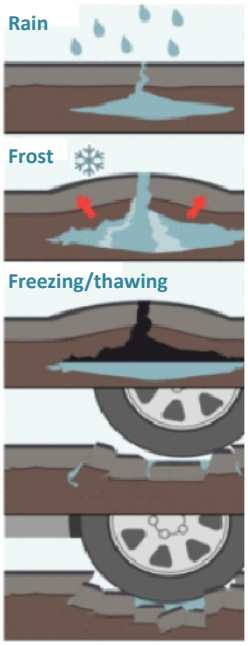
- 1. Void content
- 2. Void content
- 3. Void content

Dipl.-Geologe (Geologist) Bernd Dudenhöfer

A prerequisite for this is a **homogeneous structure of the mix** based on the grading curve and **optimum and uniform** mix temperatures at the delivery and transfer to the paver

Cause and origin of damage

- Freezing water in the surface layer (in combination with existing cracks or other damage to the surface and water, alternating freezing/thawing)



Source: ACE

Results from a number of studies (PRACTICE)

- **TU Darmstadt**
- **TU Vienna**
- **TU Brunswick**
- **BA Berlin**
- **BPS Austria**
- **KLB Cologne**
- **RUB Ruhr University**
- **Installation of noise-reducing layers**
  - **OPA – Porous Asphalt**
  - **LOA 5 D**
  - **PMA – porous mastic asphalt**

A3 Study

TECHNISCHE UNIVERSITÄT DARMSTADT

TEMPERATURE PROFILE IN ASPHALT CONSTRUCTION

Temperature measurements of asphalt from the mixing plant to installation

BAB 3: AS Niedernhausen – ARS Medenbach

UB 2014-0128

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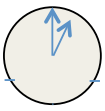
TECHNISCHE UNIVERSITÄT DARMSTADT

Ideal installation conditions

- **How often are SUCH optimum conditions encountered ???**



- Minimal distance from the mixing plant to the construction site: max. 30 min.

- Hot weather: midsummer temperatures of approx. 25 – 30 °C – sunshine and no wind

Analysis of conventional transport vehicles and thermally insulated vehicles with push-off system

1. **Day: installation with feeder**
2. **Day: installation without feeder due to restricted space**

Temperature measurement

A

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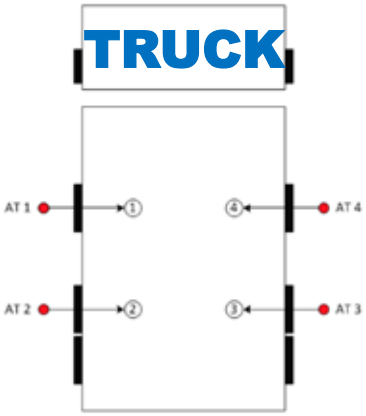
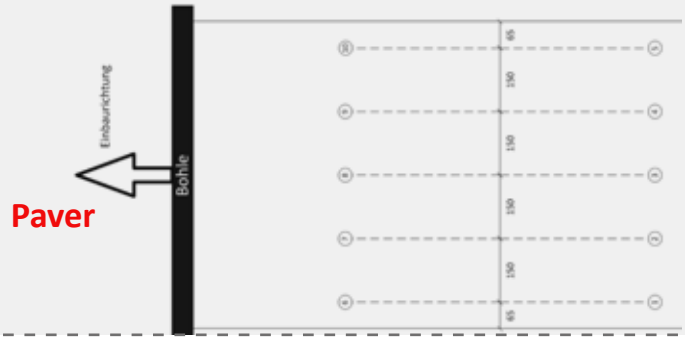
The temperature of the mix was measured at three different points in around 70 trucks:

- At the asphalt mixing plant / **ON** the trucks
- At the construction site **ON** the trucks before transfer to the feeder/paver



- On the installed asphalt binder layer, **BEFORE** the first roller pass



Evaluation of more than 220 thermal images

A3 Study

TECHNISCHE UNIVERSITÄT DARMSTADT

Figure 13 and Figure 14 show such a surface image – for a batch from a conventional body and from a push-off body respectively.

"The thermal images shown are representative of the other 220 images."

Evaluation of more than 220 thermal images **A3 Study**

TECHNISCHE UNIVERSITÄT DARMSTADT

2.6 Temperature measurement using thermal imaging

An additional thermal imaging camera was used to image the asphalt surface and map its temperature in order to gain an insight into how homogeneously the temperature is distributed across the surface.

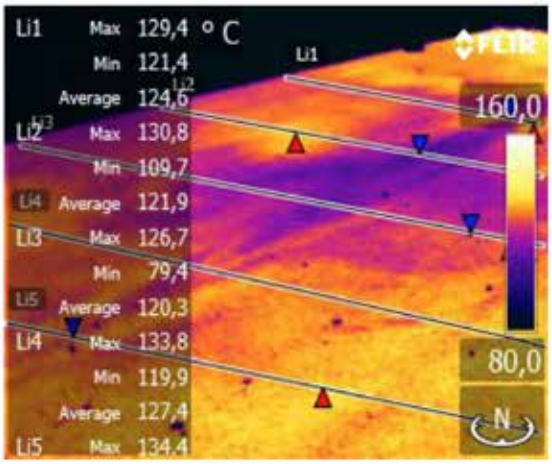


Fig. 13: Thermal image and analysis diagram of a batch from a conventional insulated dumper without feeder

Evaluation of more than 220 thermal images **A3 Study**

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2.6 Temperature measurement using thermal imaging

An additional thermal imaging camera was used to image the asphalt surface and map its temperature in order to gain an insight into how homogeneously the temperature is distributed across the surface.

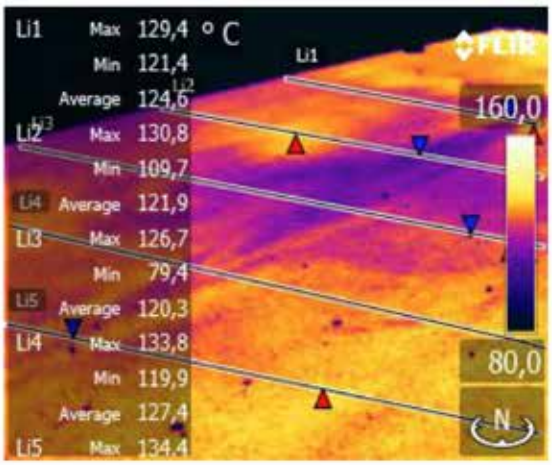

Fig. 13: Thermal image and analysis diagram of a batch from a conventional insulated dumper without feeder

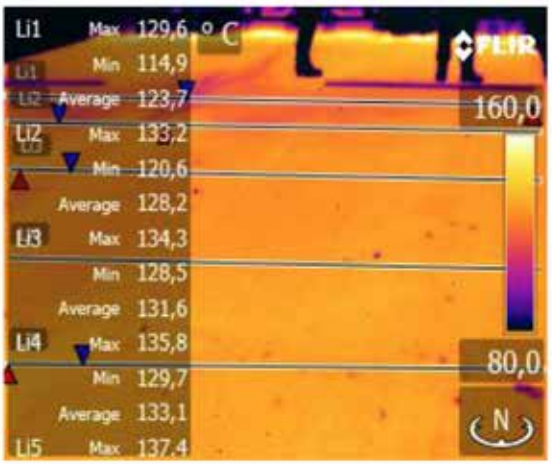

Fig. 14: Thermal image and analysis diagram of a batch from a thermally insulated dumper, incl. pusher system without feeder

Evaluation of more than 220 thermal images A3 Study

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In addition, measuring lines were drawn transversely to the direction of installation / road axis for the statistical evaluation of the thermal images. A temperature range across the installation width was generated in this way to exclude a falsification of the measurement results due to the different laying times of the asphalt layers.

"It was also found that the continuous mixing during the process of unloading meant that the differences in the temperature of the asphalt mix were significantly lower with vehicles using push-off technology"

Homogeneity / temperature distribution A3 Study

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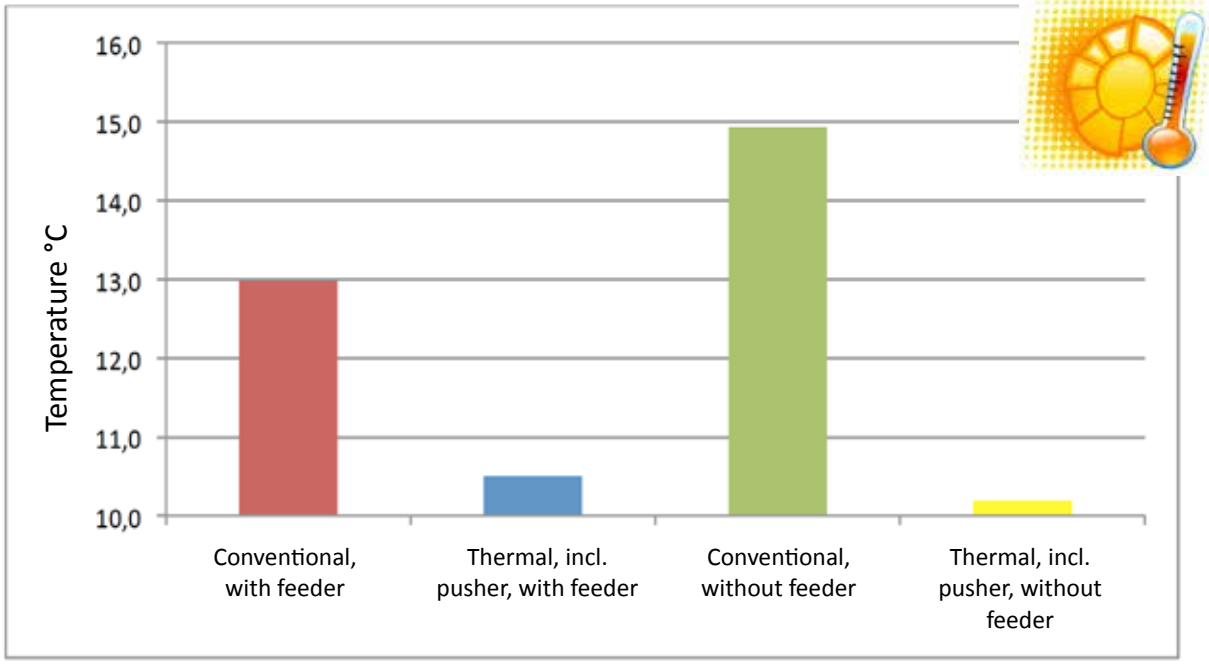

Ø temperature range of the asphalt surface

Homogeneity / temperature distribution A3 Study

The differences demonstrated here are significantly larger in "normal" installation conditions in autumn

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The standard deviation is a measured value for the deviation from the arithmetic mean/average value of a quantity.
As the difference is multiplied by the square of the average value, the effect is an average or large deviation
SIGNIFICANTLY larger than small deviations (Heinold&Gaede, P92)

It reflects very well the importance of homogeneity in asphalt construction

Homogeneity / temperature distribution A3 Study

The differences demonstrated here are significantly larger in "normal" installation conditions in autumn

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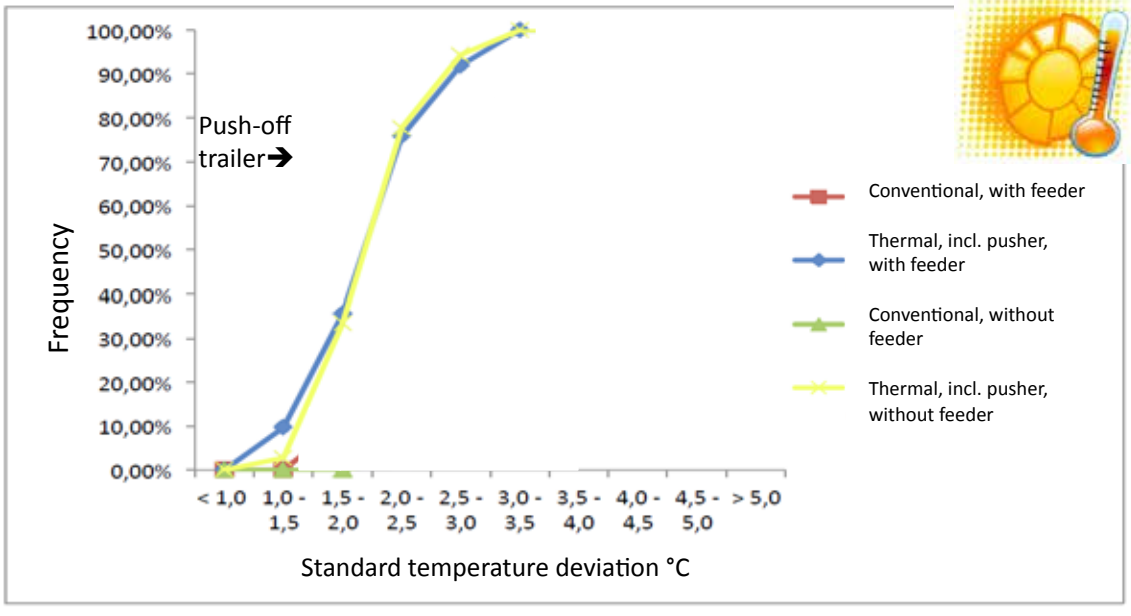

Fig. 18: Standard temperature deviation

Homogeneity / temperature distribution

A3 Study

The differences demonstrated here are significantly larger in "normal" installation conditions in autumn

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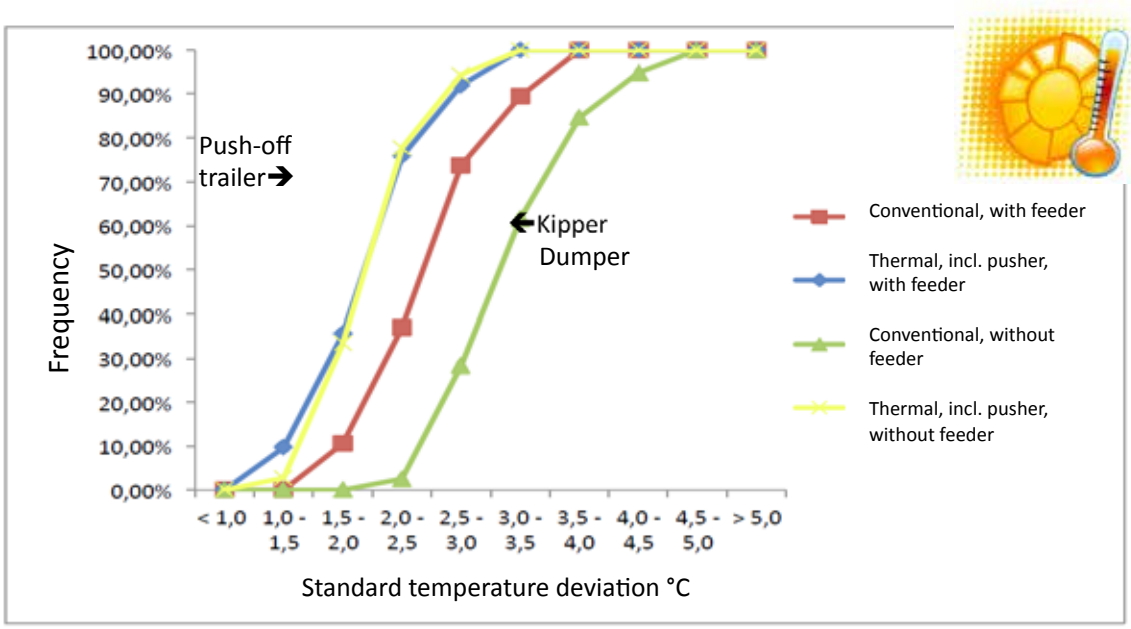
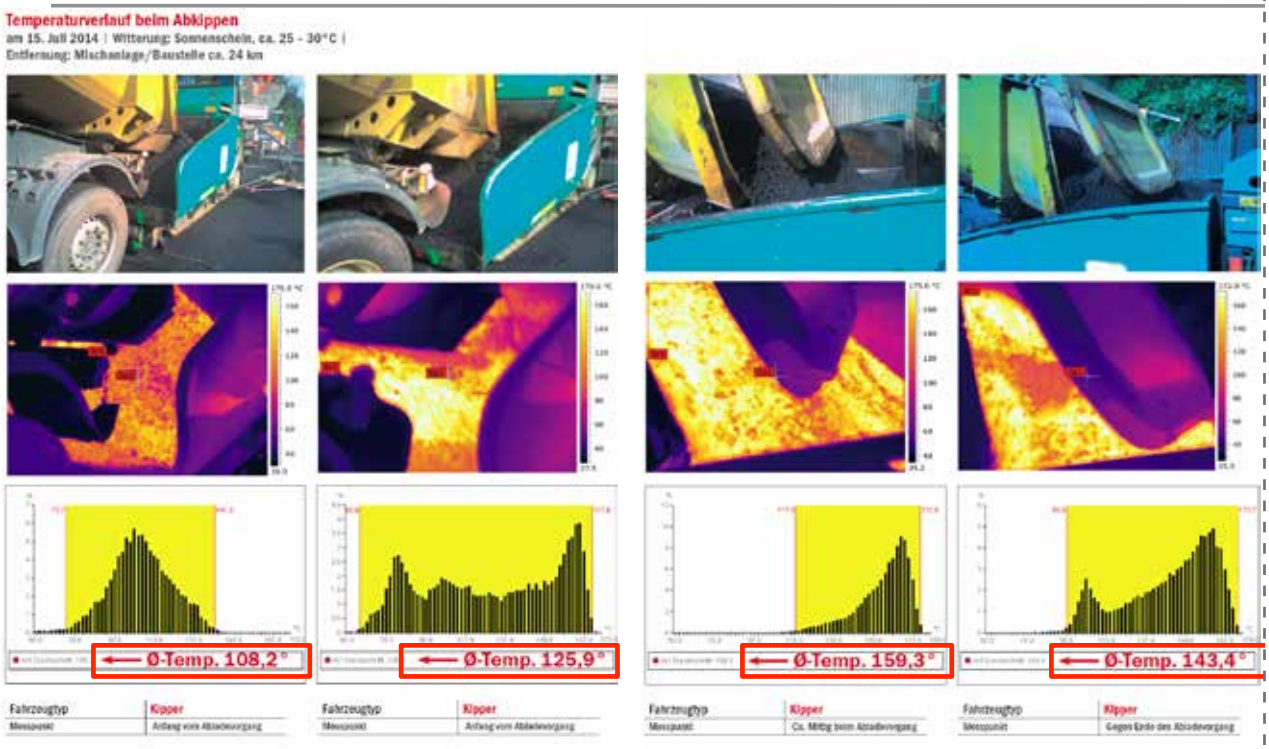


Fig. 18: Standard temperature deviation

Course of the temperature during tipping

A3 Study

TECHNISCHE UNIVERSITÄT DARMSTADT



All images correspond to one unloading process

Very high temperature fluctuations during unloading

Temperature distribution with an installation WITH feeder and conventional transport technology A3 Study

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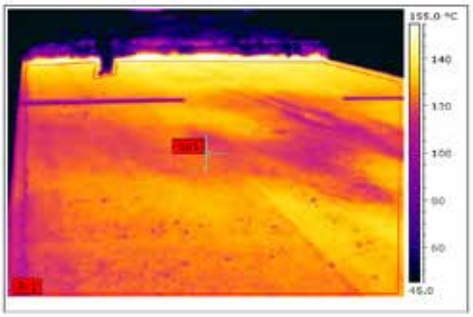


Bild Dateiname IR_1671-K.jpg

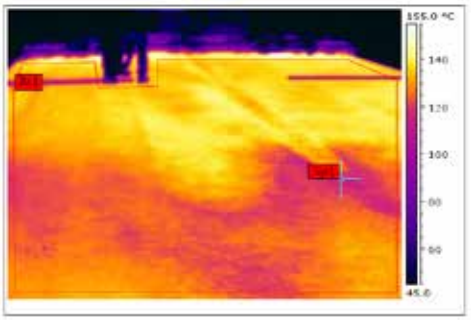
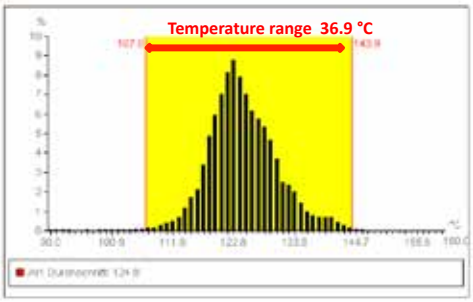
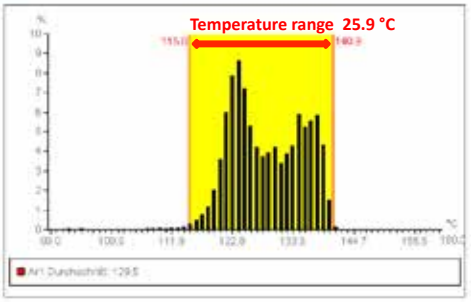


Bild Dateiname IR_1501-K.jpg

In midsummer





Fahrzeugtyp	Kipper
Location - Lfdm	366,0
Messpunkt	20.1
Temp. SP1	
W 4598 54	MZ-G 8021

Fahrzeugtyp	Kipper
Location - Lfdm	52,5
Messpunkt	3.1
Temp. SP1	115,3°C
W 4598 52	MZ-G 8039

Temperature distribution during installation WITH feeder and push-off body

A3 st

TECHNISCHE UNIVERSITÄT DARMSTADT

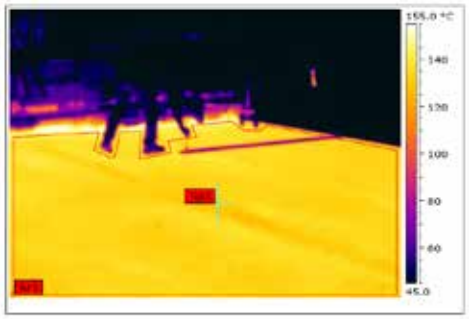


Bild.Dateiname IR_1559.jpg

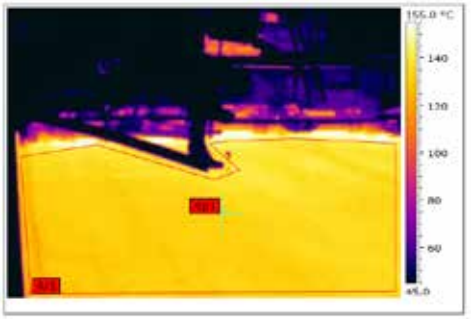
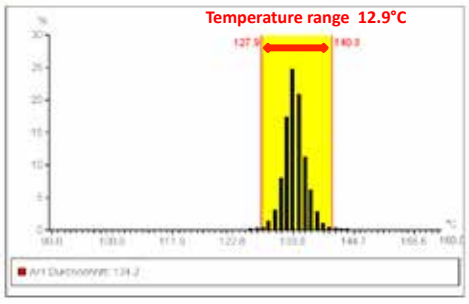
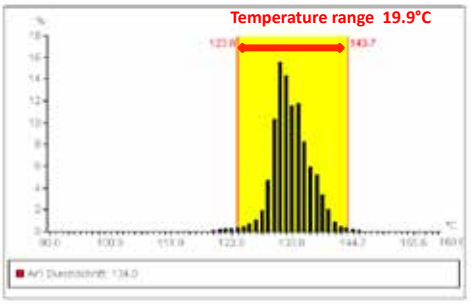


Bild.Dateiname IR_1557.jpg





Fahrzeugtyp	Abschieber
Location - Lfdm	169,5
Messpunkt	8.2
Temp. SP1	131,3°C
W 4598 49	RT-BZ 289

Fahrzeugtyp	Abschieber
Location - Lfdm	165,0
Messpunkt	8.1
Temp. SP1	133,4°C
W 4598 49	RT-BZ 289

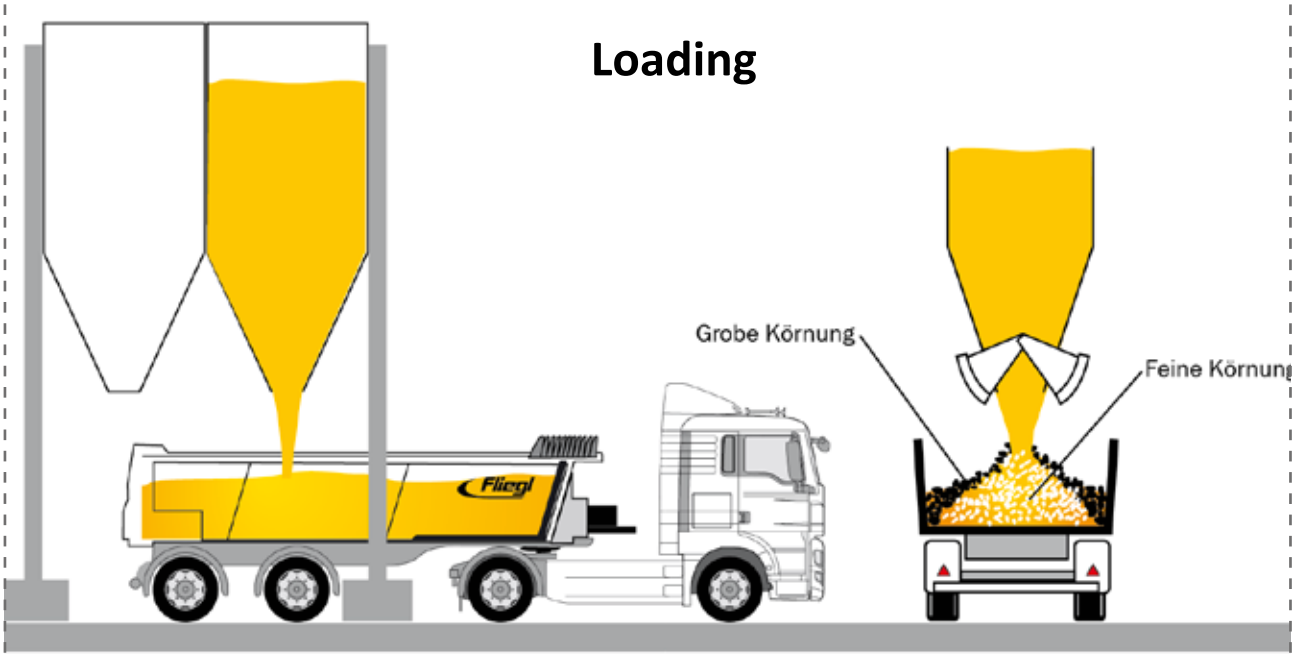
Transport solution with push-off technology

CONTINUOUS mixing throughout the unloading process
(of temperature and grain-size distribution as well as bitumen and binder-agent proportions)

– NO mix residues

Homogeneity

A3 Study



TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

bi.IVWS
Fakultät für Bauingenieurwesen
Institut für Verkehrswissenschaften
Forschungsbereich Straßenwesen

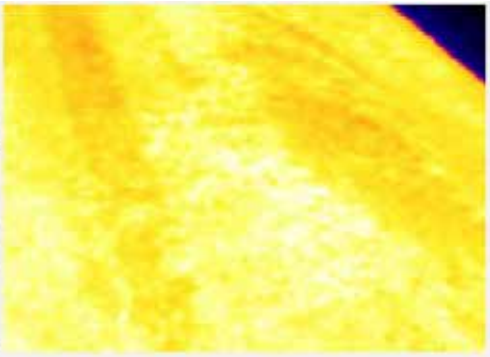
Asphalt temperature from mixing plant to installation

Temperature measurements taken during construction and asphalt technology studies

Project number D230 0615 4003 / 15406

86

TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology



Im Auftrag des

Magistrats der Stadt Wien
Magistratsabteilung 28
Straßenbau und Straßenverwaltung
Lienfeldergasse 96
1171 Wien

straßenwien
StoDt Wien

Wien, im Dezember 2015

2.1 Construction project / task

TECHNISCHE UNIVERSITÄT WIEN Vienna University of Technology

MA 28 installed a new road surface along a section of approx. 465 metres on Pausingergasse in 1140 Vienna in March / April 2015.

The following structure was realised:

- **3 cm AC11 surface, PmB 45/80-65, A2, G1**
- **8 cm AC22 binder agent, PmB 25/55-65, H1, G4**
- **9 cm AC32 base, 50/70, T1, G4**
- **20 cm non-bonded top base layer, U1, 0/63**

**The difference between two types of delivery,
one with conventional dumpers (KK truck)
and one with push-off trailers (TA truck), are to be compared
and their effect on the installation temperature quantified.**

Construction fields

TECHNISCHE UNIVERSITÄT WIEN Vienna University of Technology

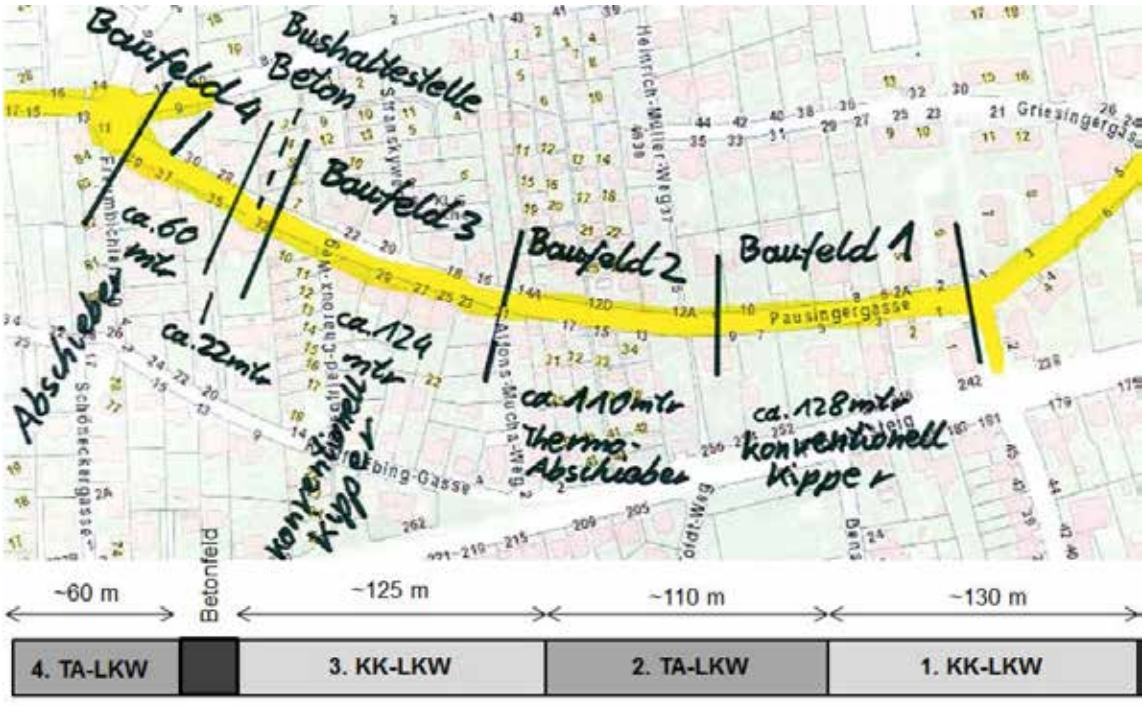


Fig. 1: Layout of the four construction plots

Temperature measurement ON the trucks

TECHNISCHE UNIVERSITÄT WIEN Vienna University of Technology

2.2.1 Temperature measurement within the load of a truck at the mixing plant

2.2.2 Temperature measurement within the load of a truck at the construction site

The temperature of the mix was documented on every truck at 8 measuring points (see Fig. 3) down to a depth of approx. 15 cm **using a piercing thermometer.**
The measurements were taken in four areas, each at 10 cm and 20 cm from the side wall.

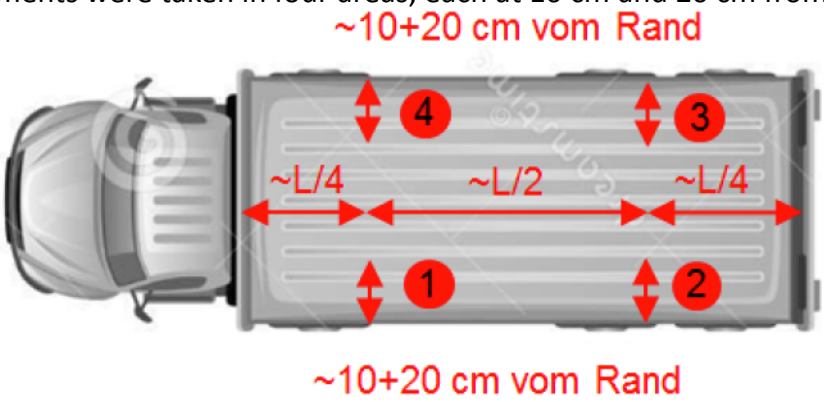


Fig. 3: Diagram of the points measured with piercing thermometer on the trucks

Temperature measurements taken from the installed material

TECHNISCHE UNIVERSITÄT WIEN Vienna University of Technology

In order to enable the homogeneity of the installation temperature to be assessed, the asphalt surface was imaged using a thermal imaging camera by members of staff from the Institut für Verkehrswissenschaften (Institute for Traffic Sciences).

The asphalt temperature was measured from the paver directly behind the paving screed. Two images (left / right) were taken **for each 5 m subsection.**

At least 30 images were taken for each construction field and layer within a measured section of 75 to 80 metres.

Fig. 4:
Thermal imaging for each 5 m section,
Laying time approx. 1 min

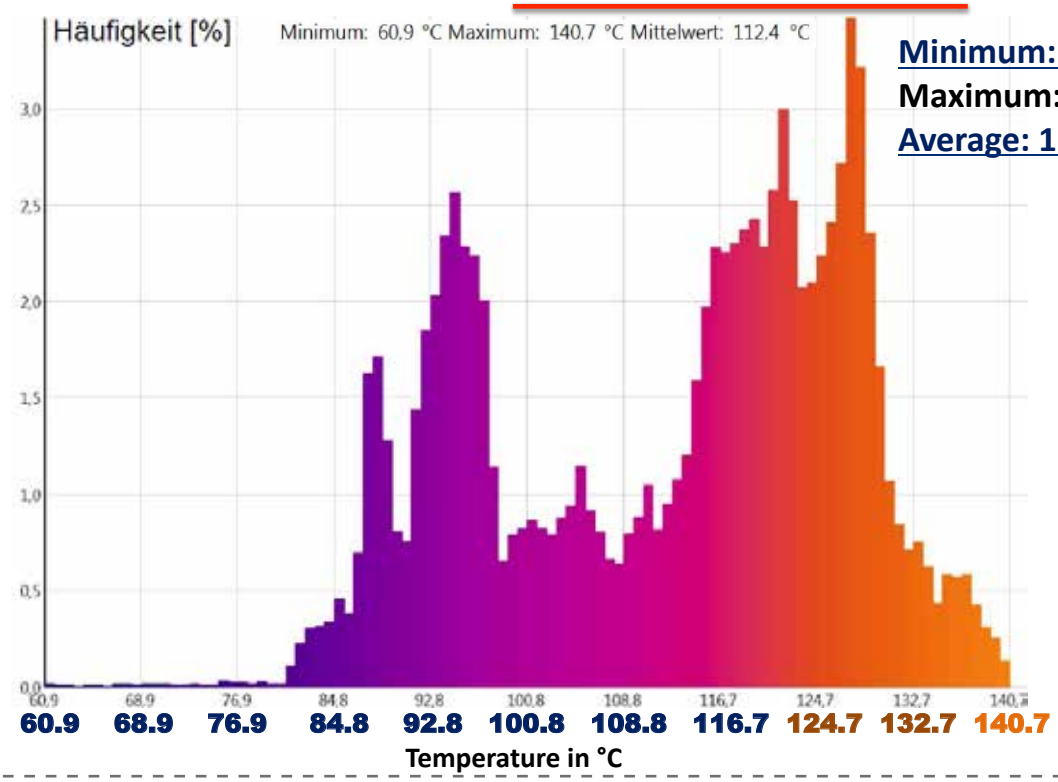
Temperature measurements using thermal imaging camera

The thermal images were analysed using the testo IRSoft Version 3.6 software. **The software makes it possible** to show the minimum value, maximum value and average value and indicate **the distribution of the individual values (per pixel) in a single histogram for selected areas.**

Fig. 7 shows an example of the temperature distributions over the asphalt surface for an inhomogeneously cool and homogeneously warm area.

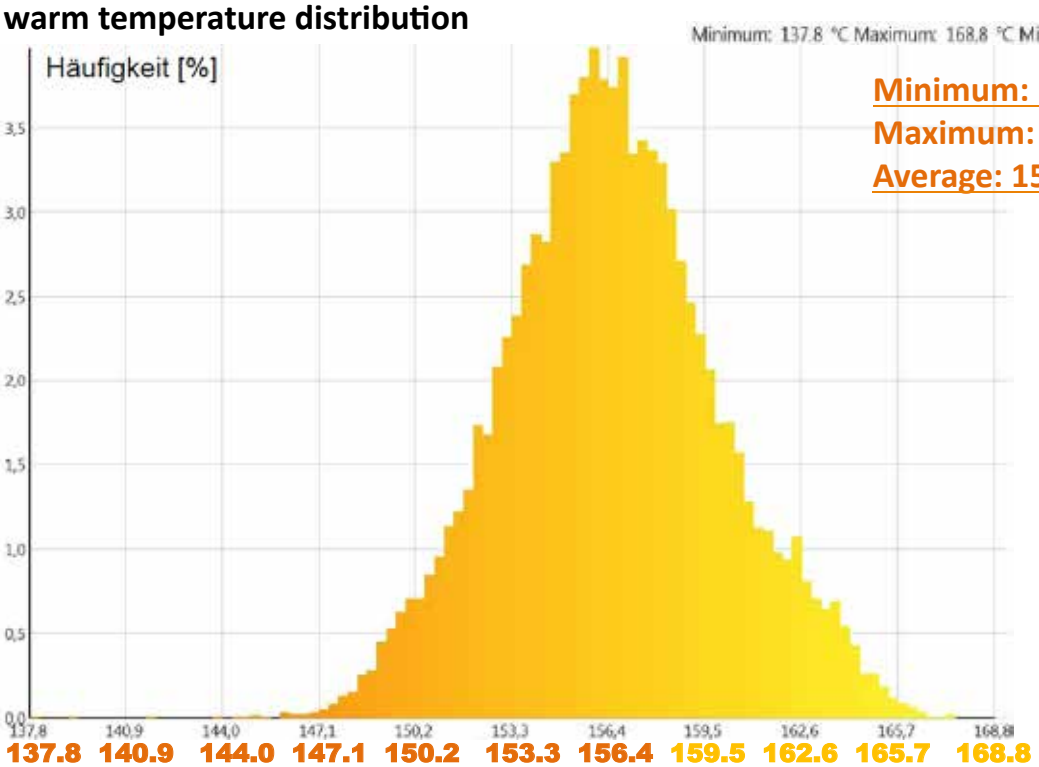
From around 30 thermal images for each construction field and asphalt layer, the minimum, maximum and average values for each five-metre section were determined and analysed on the basis of the histograms.

Fig. 7.1: Example of the thermal image analysis **of a 5-m section with inhomogeneous, cool temperature distribution – frequent on (KK) truck changes**



Minimum: 60.9 °C
Maximum: 140.7 °C
Average: 112.4 °C

Fig. 7.2: Example of the thermal image analysis for **a 5-m section with homogeneous, warm temperature distribution**



3.2.4 Difference in the asphalt surface temperature with KK and TA after installation

The three asphalt layers (base, binding, surface layers) revealed sometimes large differences in the surface temperature between KK and TA trucks.

Fig. 9 below shows as an example
the average surface temperatures for each 5-m section across the entire length of Construction Fields 1 and 2
for the two versions of delivery
(KK truck / TA truck).

Average asphalt temperature per 5-m section

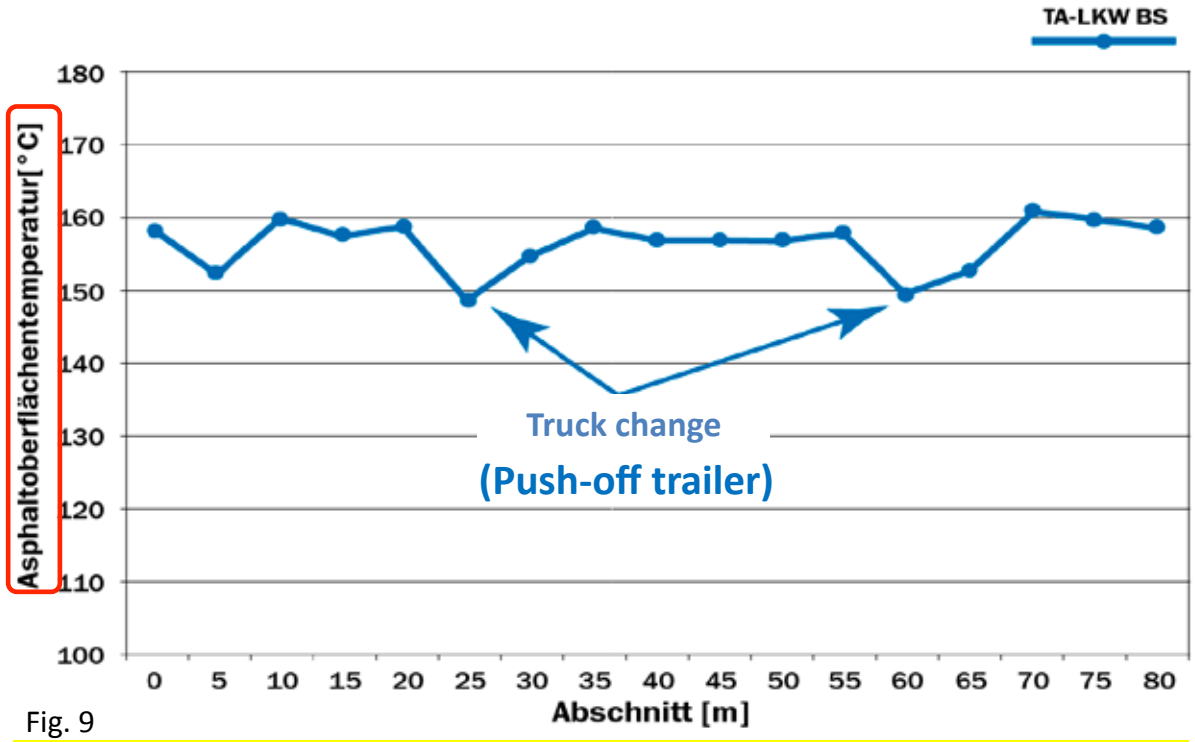


Fig. 9

Progression of the **average asphalt surface temperature** after installation for all layers (thermal image)

Average asphalt temperature per 5-m section

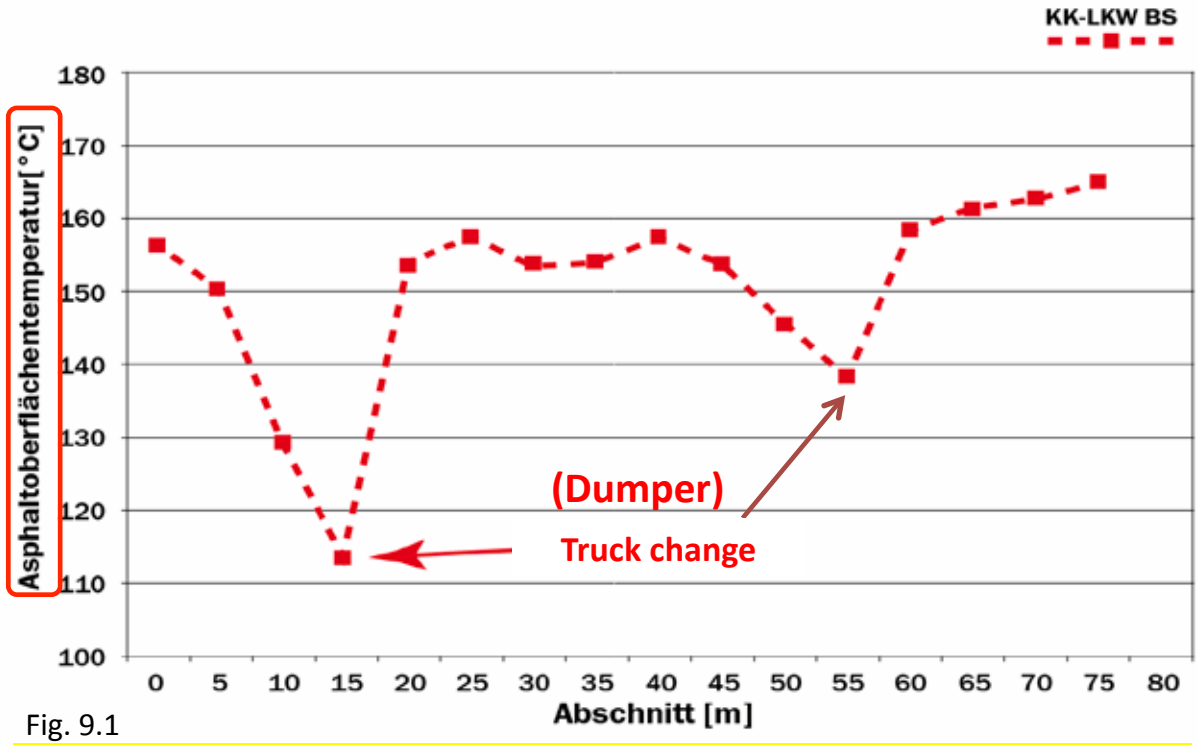


Fig. 9.1

Progression of the **average asphalt surface temperature** after installation for all layers (thermal image)

Average asphalt temperature per 5-m section

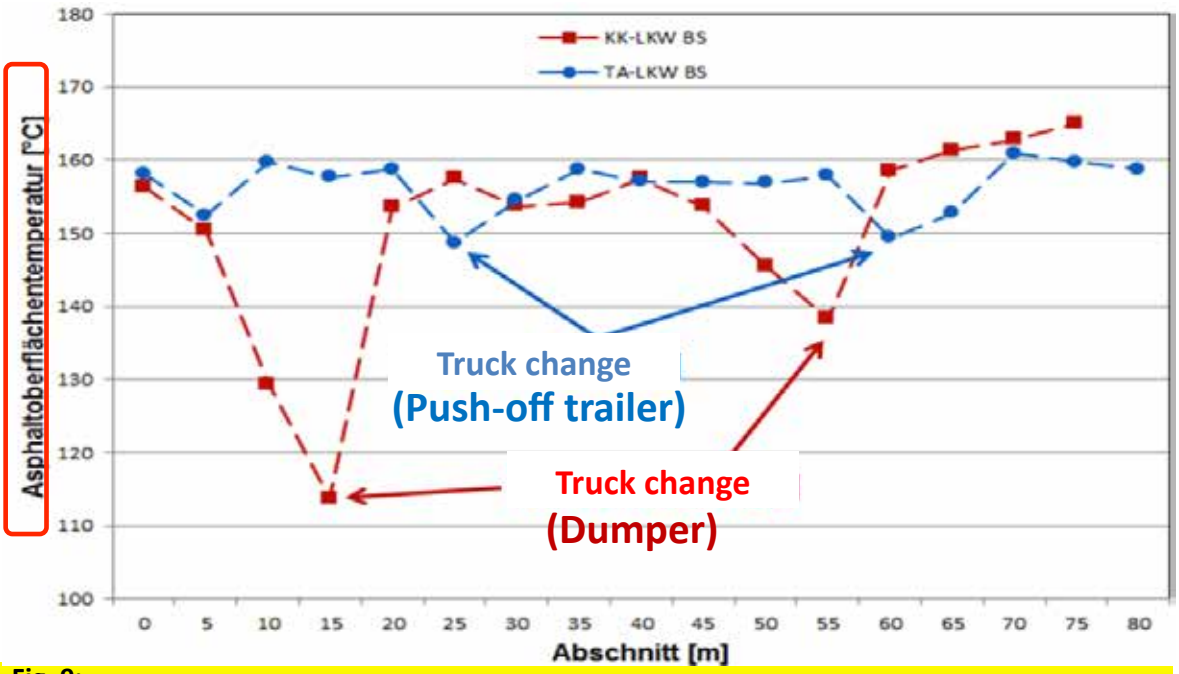


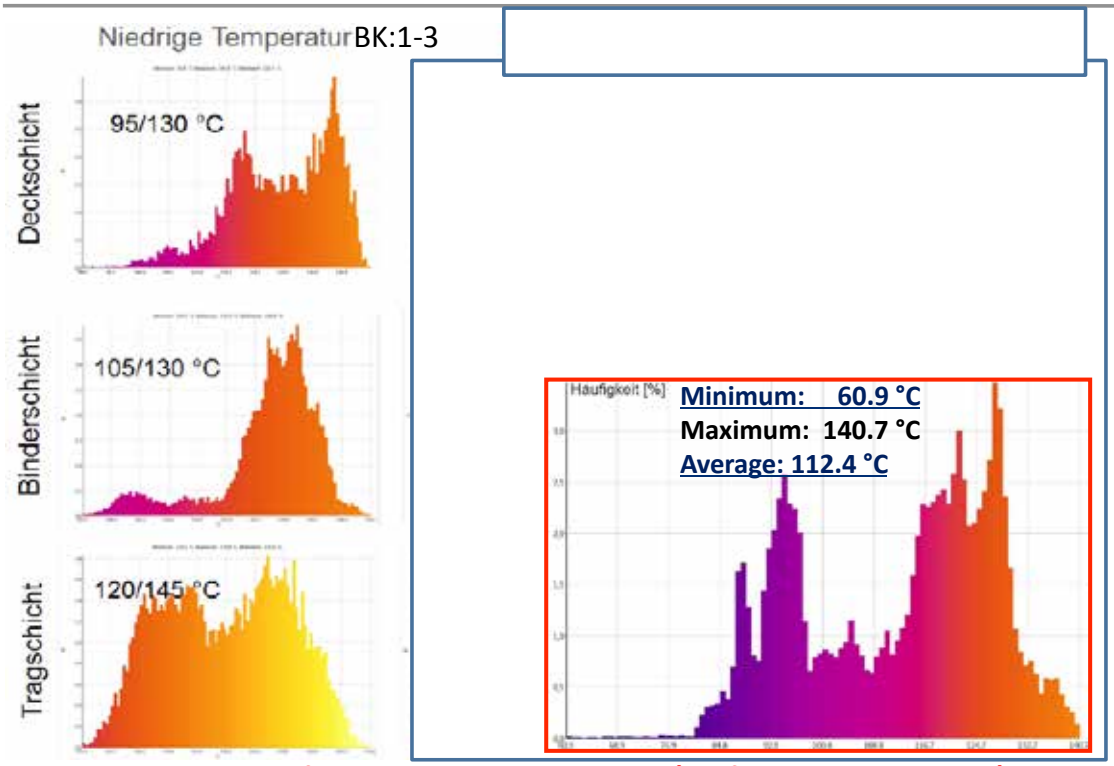
Fig. 9:
Progression of the **average asphalt surface temperature** after installation for all layers (thermal image)

3.2.4 Difference in the asphalt surface temperature with KK and TA after installation

The temperature progressions clearly reveal the sections with truck changes.

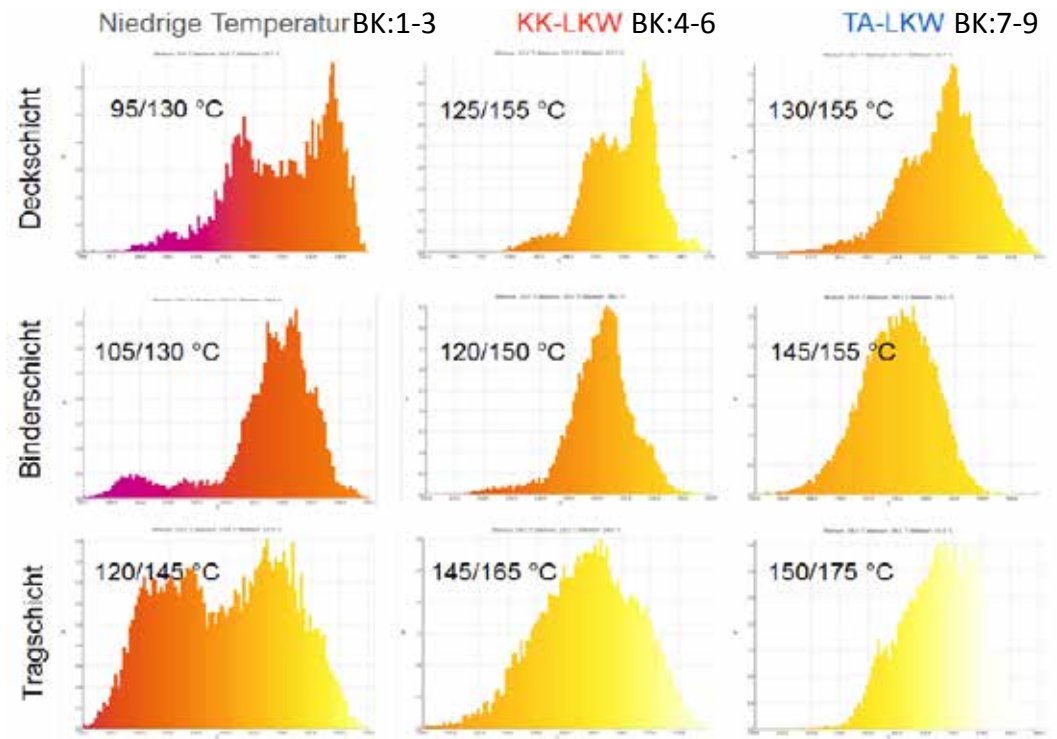
The drops in surface temperatures were considerably more apparent when conventional dumpers were used than during changes with thermally insulated push-off trailers which is due to the continuous mixing that the push-off technology permits.

3.5 Drill core extraction points



Drill cores not taken from the coldest points !! – (as, for instance, Fig. 7.1)

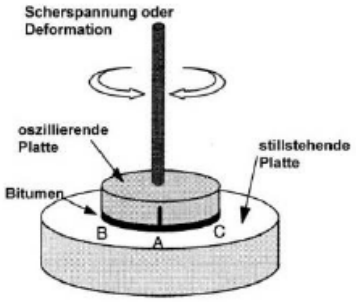
3.5 Drill core extraction points

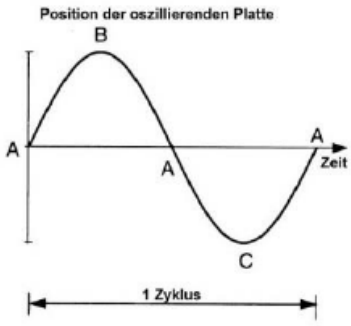


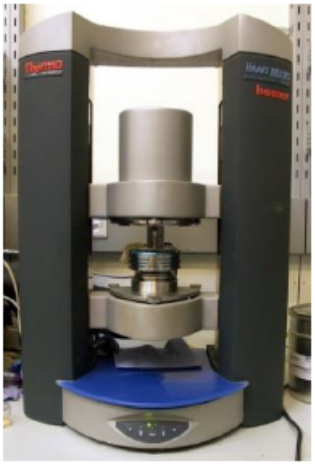
Drill cores not taken from the coldest points !! – (as, for instance, Fig. 7.1)

2.4.2 Dynamic shear modulus and phase angle

For the two delivery versions (KK truck / TA truck) and the low-temperature range, the dynamic shear modulus |G*| and phase angle ϕ of the bitumen in the binder layer were determined in the upper and lower temperature range using a dynamic shear rheometer (DSR) in accordance with ÖNORM EN 14770 on the basis of DN 100 mm drill cores from Construction Fields 1 and 2.



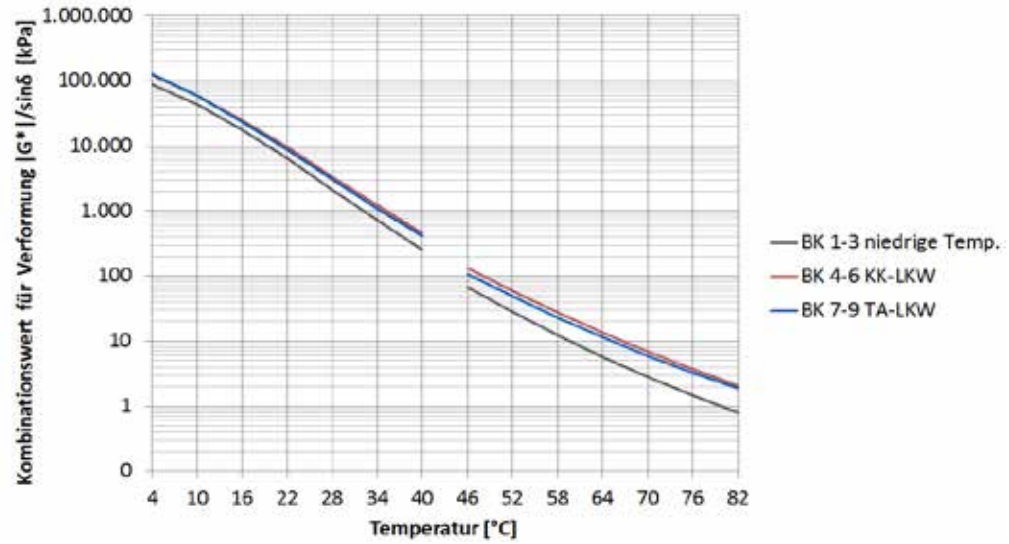




Dynamic shear rheometer (DSR)

It was not possible to determine any significant difference between the two delivery versions (KK truck / TA truck) when the temperature values were adhered to (BK4-6 and BK7-9).

A considerably lower combination value did, however, result for the deformation in the low-temperature range (BK1-3). This dropped compared with the other ranges by -30% at 4°C and by -60% at 82°C.



5. SUMMARY AND INTERPRETATION

- The technological analyses showed worse material properties for the deformation indicator of bitumen and resistance to permanent deformations in the mix for the area created with material that was too cold (binder and surface layer).
- The average surface temperatures in the examined area were below the required installation temperatures but the coldest sections have not yet been analysed here.

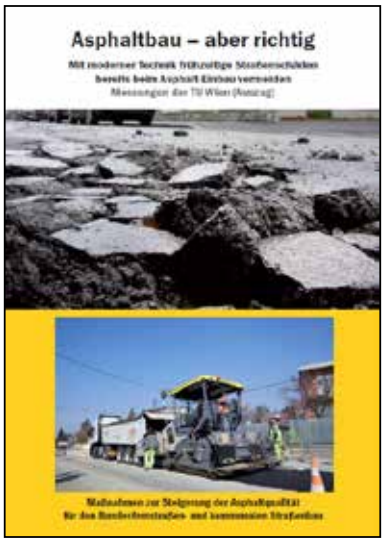
It must therefore be assumed that the material properties worsened further at the cold points with surface temperatures of less than 100°C

5. SUMMARY AND INTERPRETATION

- **The risk of cold nests occurring was reduced significantly when vehicles with push-off technology were used and a more homogeneous temperature distribution was achieved with the bit-by-bit transfer of mix to the paver.**
- Using transport vehicles with push-off technology in urban areas also reduces the risk of damage to overhead lines during unloading; they can also be used more easily in tunnels, under bridges in avenues than dumpers can.

The above presentations have been quoted from the project report prepared by the TU Vienna, which runs to around 100 pages

A 40-page summary of the thermal image analyses is also available

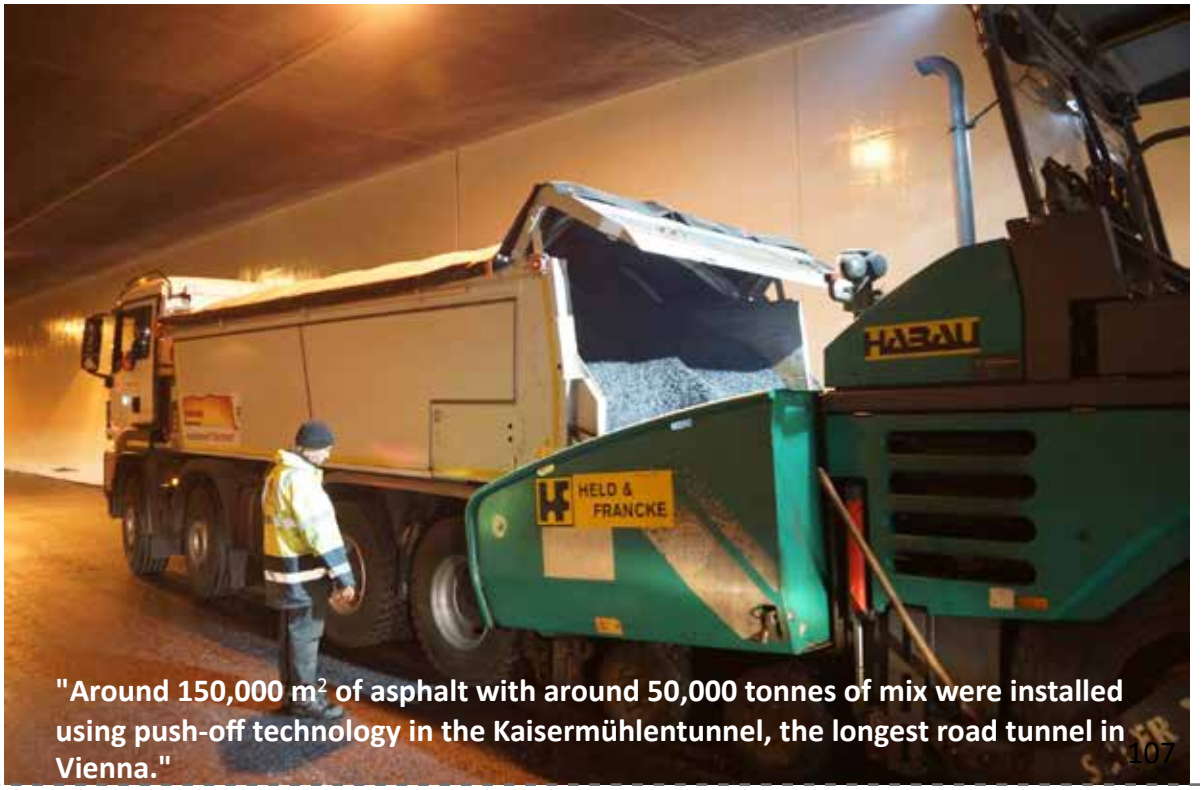


Detailed research report by the TU Darmstadt available on CD

Please ask for these free detailed reports if you are interested

Construction site report by ASFINAG:

"Tunnel rehabilitation – push-off technology secures high quality of road"



"Around 150,000 m² of asphalt with around 50,000 tonnes of mix were installed using push-off technology in the Kaisermühlentunnel, the longest road tunnel in Vienna."

Office of the Carinthian Provincial Government

Wissenschaftliche Untersuchungen im Asphaltstraßenbau

Auftraggeber/Baulastträger:
Amt der Oberösterreichischen Landesregierung,
Direktion Straßenbau und Verkehr

Begleitet von der BPS
(OÖ Boden- und Baustoffprüfstelle)

Temperaturverlauf und Qualitätsmerkmale an mehreren Pilotstrecken
Mischguttransport mit unterschiedlicher Technik

Konventionell: Kipper Asphaltmulde

Fahrzeuge mit Abschiebetechnik

Projekt 1 | Seite 5-37

L 1514 Wimbergerstraße

Baulos: „Schindlberg 2" - km 6,108 bis 6,830
Landstraße, Ausserorts, keine Einbauhindernisse
Einbau mit 1 Fertiger in voller Breite

Eingebaute Schicht: AC 22 deck 70/100, A5, G8, RA10
Mischanlage: Haselbach - Entfernung Mischanlage/ Baustelle ca. 15km / 20min
Witterung: Sonnenschein, Morgens ca. 25°C, Nachmittags ca. 35°C

Projekt 2 | Seite 39-90

L 555 Waldneukirchnerstraße

Baulos: „OÖ-Bad Hall" – ab km 0,200, 1220mm, Breite ca. 6,2mm.
Stark frequentierte Straße im städtischen Bereich,
Anzahl von Einbauten: 183 Stück Schächte und Schieber
Einbau mit 2 Fertiger heiß an heiß

Eingebaute Deckschicht: AC 11 deck PmB 45/80-65, A2, G1
Mischanlage: St. Pantaleon - Entfernung Mischanlage/ Baustelle ca. 45km
Witterung: Sonnenschein, Morgens ca. 25°C, Nachmittags ca. 33-35°C

Projekt 3 | Seite 93-130

Bundesstraße B 138 Pyrnpassstraße

Baulos: „Am Thalbach" - km 2,473 bis 3,078

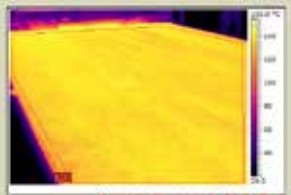
Einbau im fließenden Verkehr:
1. Tag Stadtauswärts Transport mit ASW / Teilstück mit Asphaltmulden,
2. Tag Stadteinwärts mit Asphaltmulden
Eingebaute Deckschicht: AC 8 deck PmB 45/80-65, A3, G1
Mischanlage: Gunskirchen - Entfernung Mischanlage/ Baustelle ca. 12km
Witterung: Sonnenschein, Morgens ca. 22°C, Nachmittags ca. 28°C

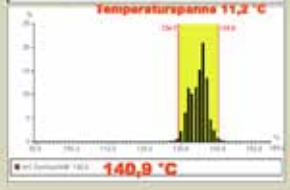
LEGENDE

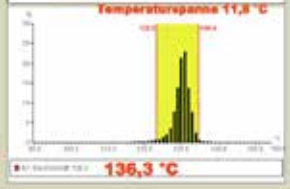
Temperaturspanne = über 20/25°C		Temperaturspanne = über 30°C	
Temperatur = unter 125°C		Temperatur = unter 120°C	
Ø Einbautemp. = unter 135°C		Ø Einbautemperatur = unter 135°C	
Temperaturspanne = über 35°C			
untere Einbautemp. = unter 110°C			
Ø Einbautemp. = unter 120°C			

Scientific studies – temperature of the crust on thermal bodies...

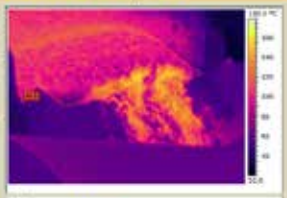
OOE_L1514_Wimbergergstr._Abschiebefzg.-BA 1
Einbau: 16.Juli, von 8.45 bis 9.30 Uhr, Witterung: Sonnenschein, windstill, ca. 25 °C Entfernung Mischanlage/ Baustelle: ca. 15 km / 20min



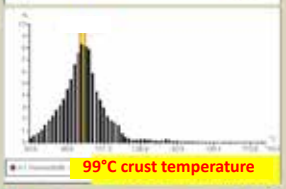




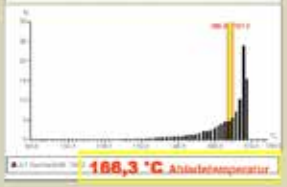
OOE_L1514_Wimbergergstr._Abschiebefzg.-BA 3.2
Einbau: 16.Juli, von 13.25 bis13.55 Uhr, Witterung: Sonnenschein, windstill, ca. 33 bis 35 °C Entfernung Mischanlage/ Baustelle: ca. 15 km / 20min



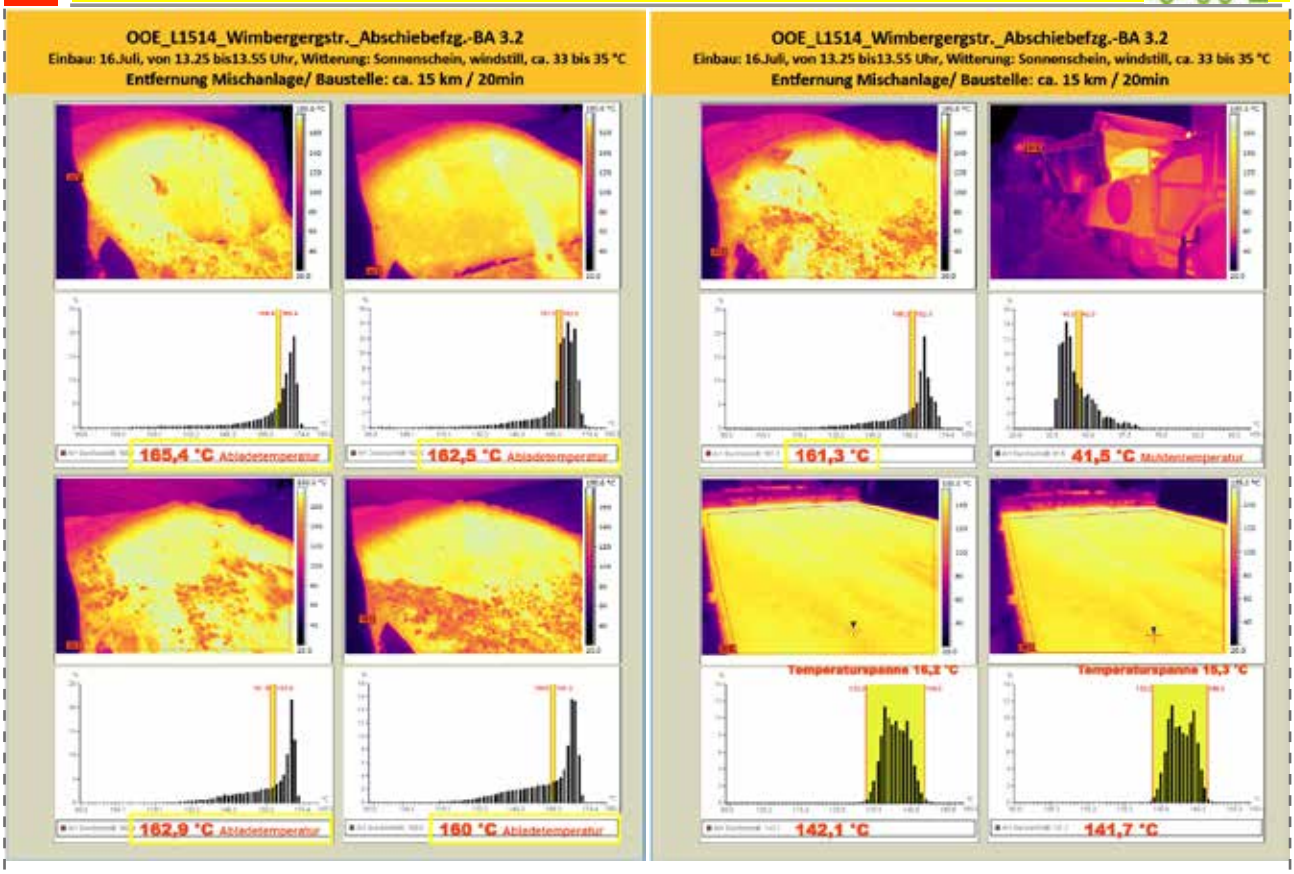
Krustenbildung bei thermoisolierten Fahrzeugen – bei konventionellen Fahrzeugen (Kipper) ein großes Problem



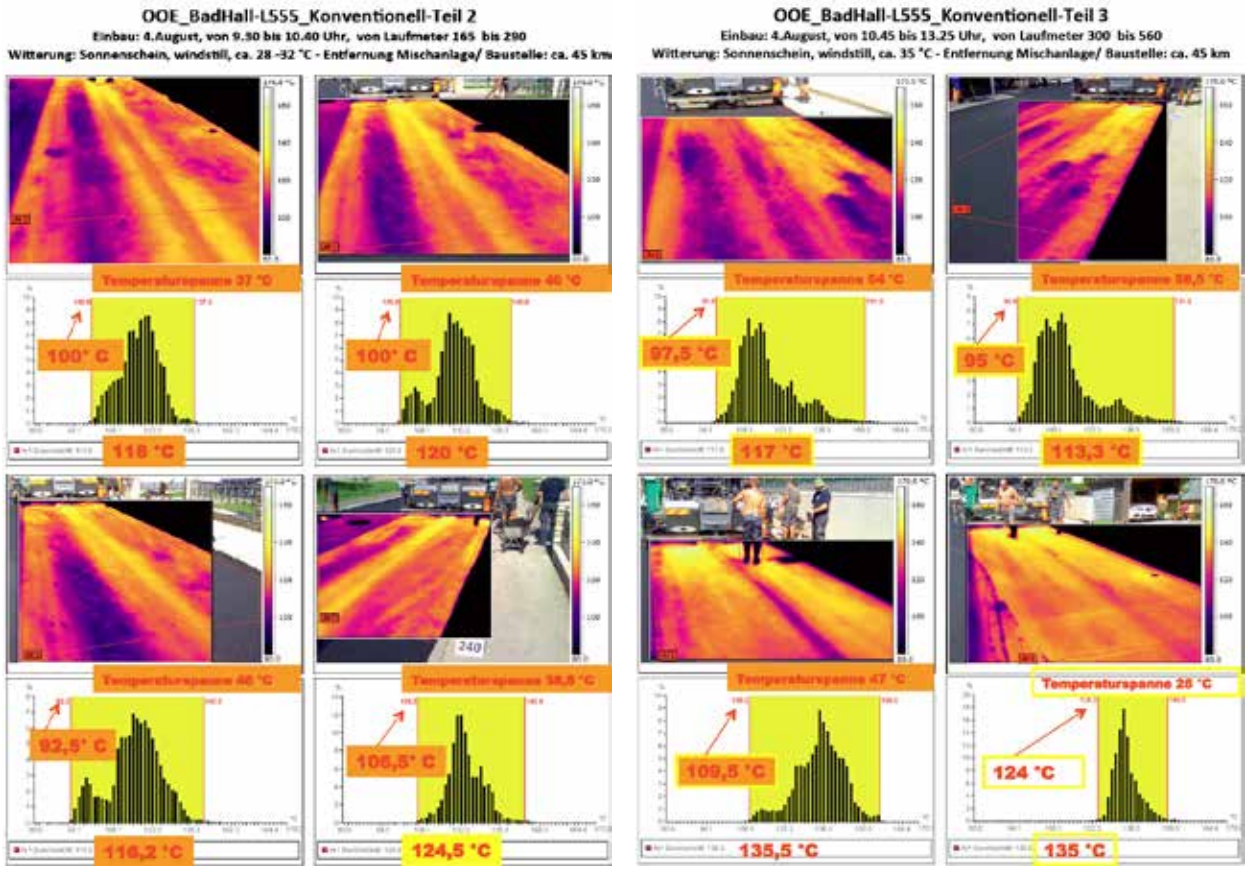
Die Folgen der Krustenbildung (Entmischung/Kalte Nester) werden mit Abschiebefahrzeugen durch laufende Durchmischung beseitigt.



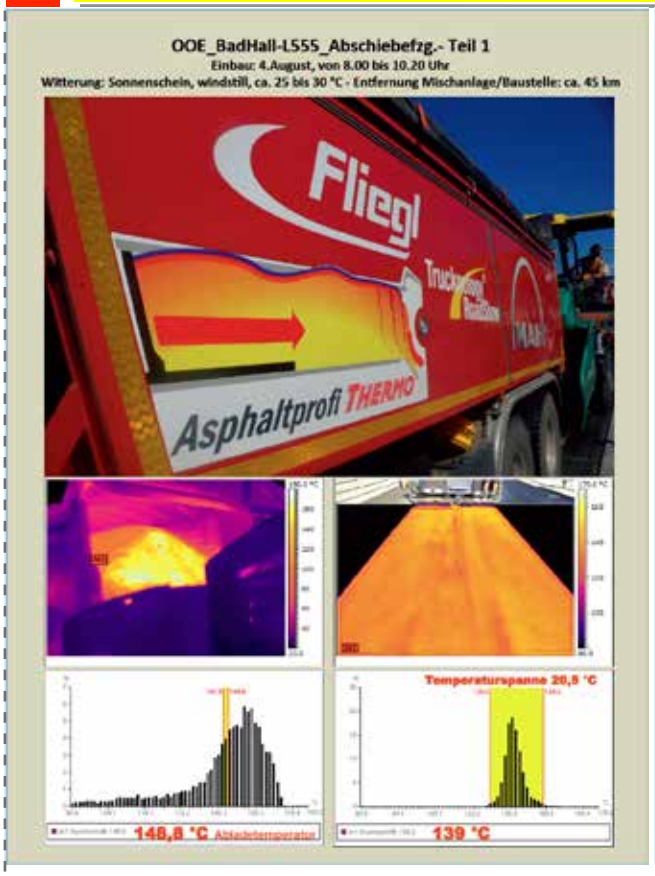
Scientific studies – temperature during unloading

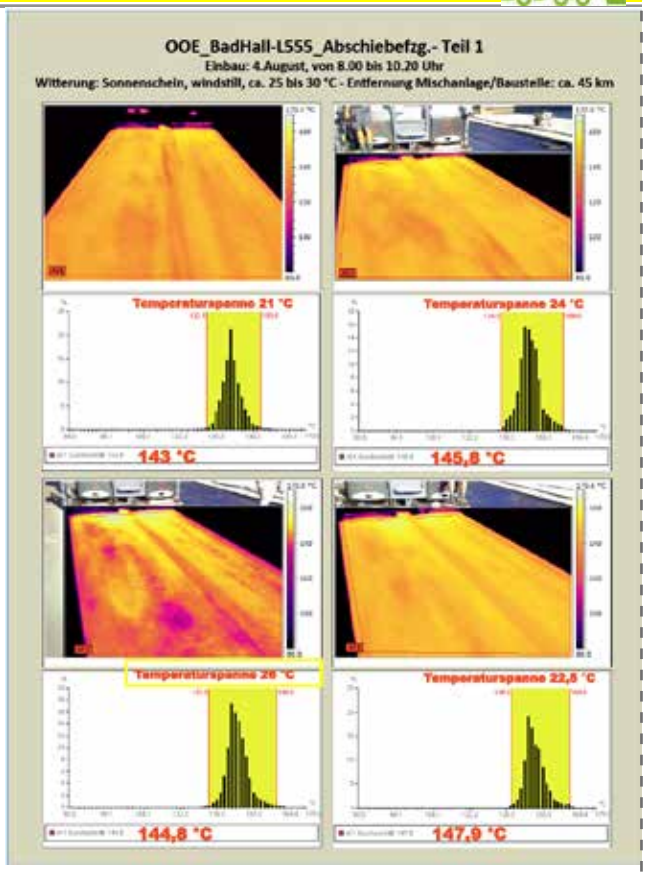


Scientific studies – Federal State Gov. OOE – Bad-Hall – asphalt bodies

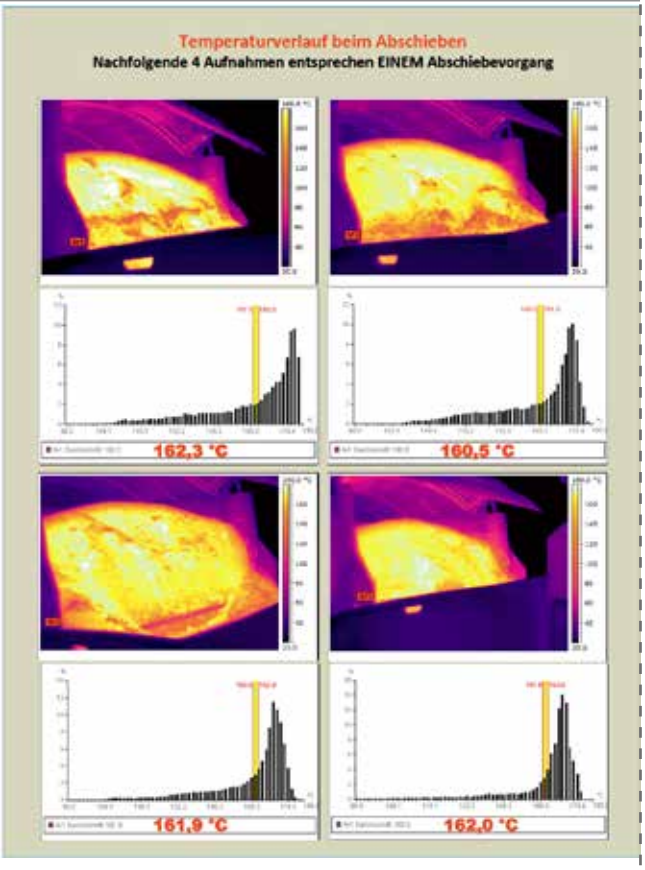


Scientific studies – Federal State Gov. OOE – Bad-Hall – push-off vehicle

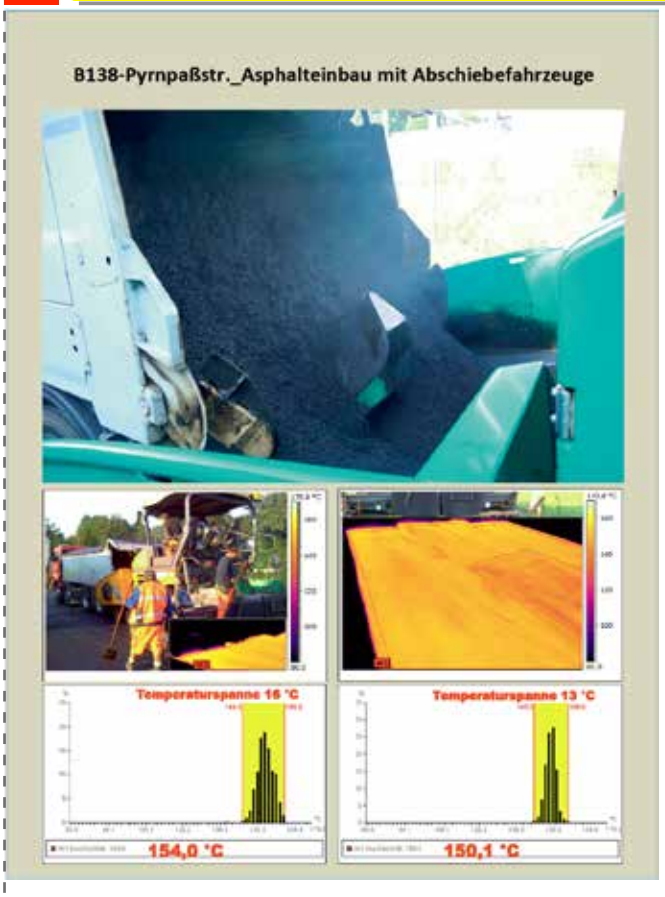


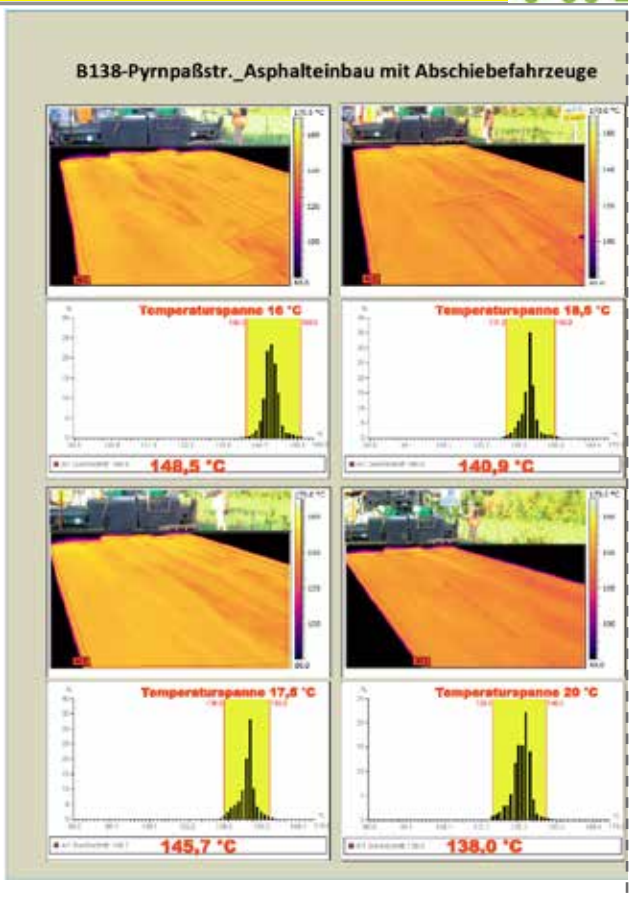


Scientific studies – B138 – asphalt bodies – push-off vehicle

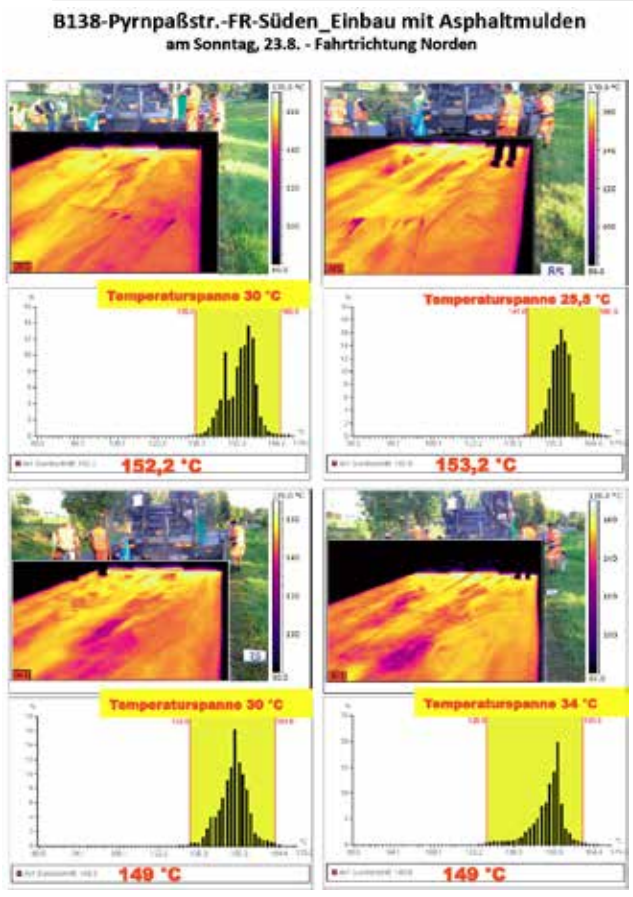


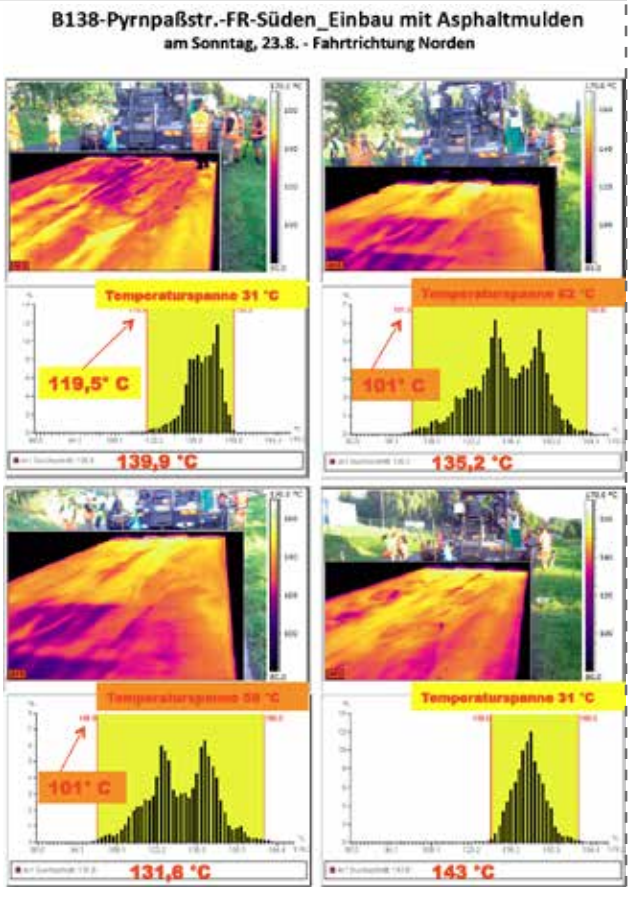
Scientific studies – Federal State Gov. OOE – B138 – push-off vehicle





Scientific studies – Federal State Gov. OOE – B138 – asphalt bodies





Temperature progression during asphalt installation

Berlin, B96 Residenzstraße

Installation with thermal bodies
(as required in the specifications)

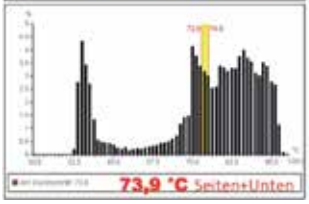
Sunshine, approx. 25 – 35°C

Binder layer:
Mix transport with thermally insulated **dumper bodies**
Installation of asphalt binder, two layers, total 10 cm
Designation: AC16 B S, rubber-modified bitumen

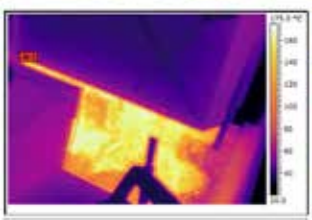
Surface layer:
Mix transport in thermally insulated **push-off vehicles**
Installation of a 2.5 cm thick noise-optimised asphalt surface layer
Designation: SMA 5 S, noise-optimised without splintering

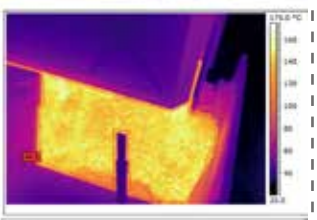
Temperature progression with thermal bodies – dumpers

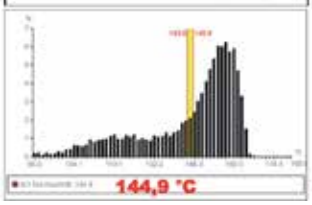
Muldentemperatur ➔ je kleiner, umso weniger Wärmeverluste
hohe Temperatur = hohe Wärmeverluste

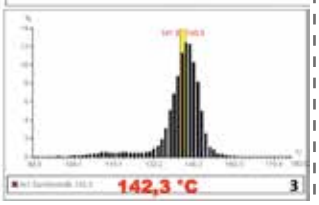


Berlin, B96-Residenzstraße_Einbau mit Thermomulden
Temperaturverlauf beim Abkippen



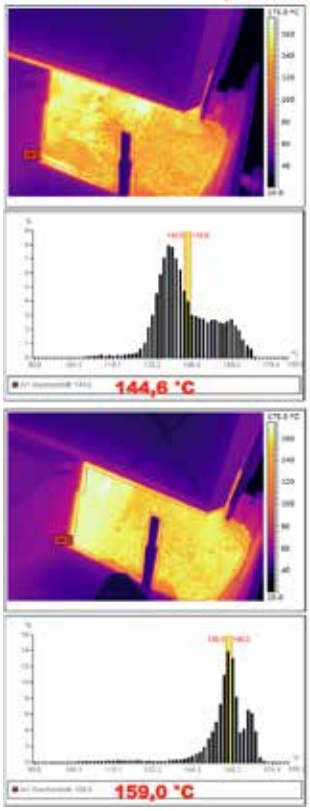




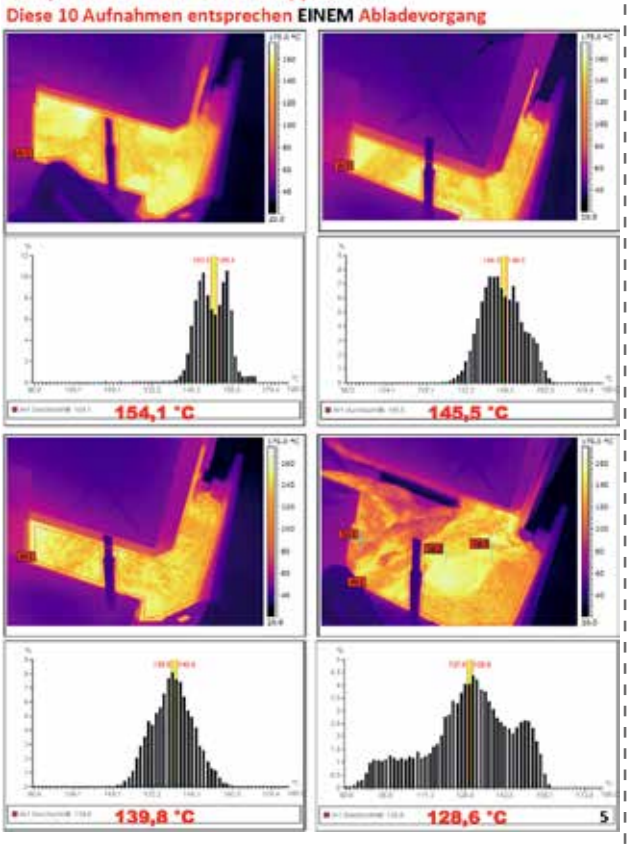


Temperature progression with thermal bodies – dumpers

Berlin, B96-Residenzstraße_Einbau mit Thermomulden
Temperaturverlauf beim Abkippen
Diese 10 Aufnahmen entsprechen **EINEM** Abladevorgang

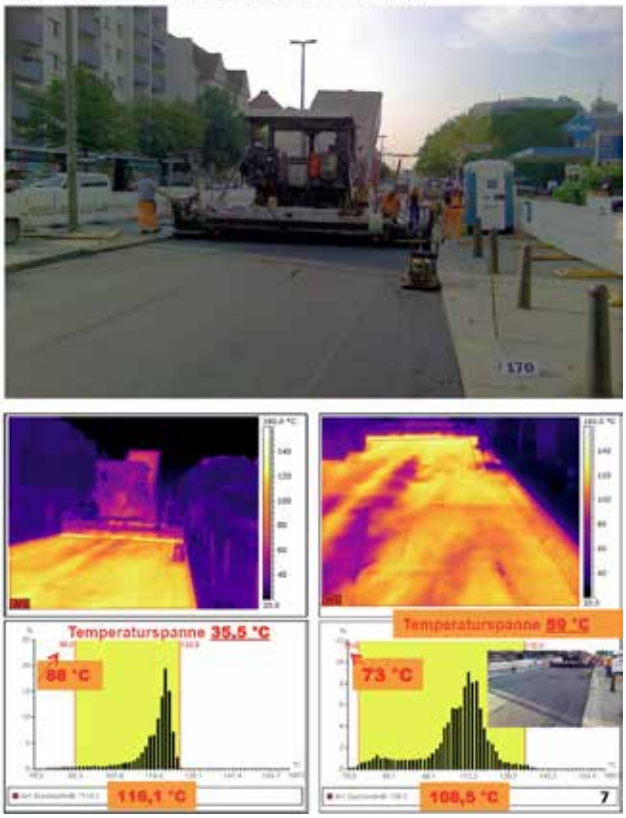


Berlin, B96-Residenzstraße_Einbau mit Thermomulden
Temperaturverlauf beim Abkippen
Diese 10 Aufnahmen entsprechen **EINEM** Abladevorgang



Temperature progression with thermal bodies – dumpers

Berlin, B96-Residenzstraße_Einbau mit Thermomulden-Teil 1
Witterung: Sonnenschein, windstill, ca. 25 -28 °C
Einbau von Binderschicht von ca. 8.30 Uhr bis 9.15 Uhr



Berlin, B96-Residenzstraße_Einbau mit Thermomulden-Teil 1
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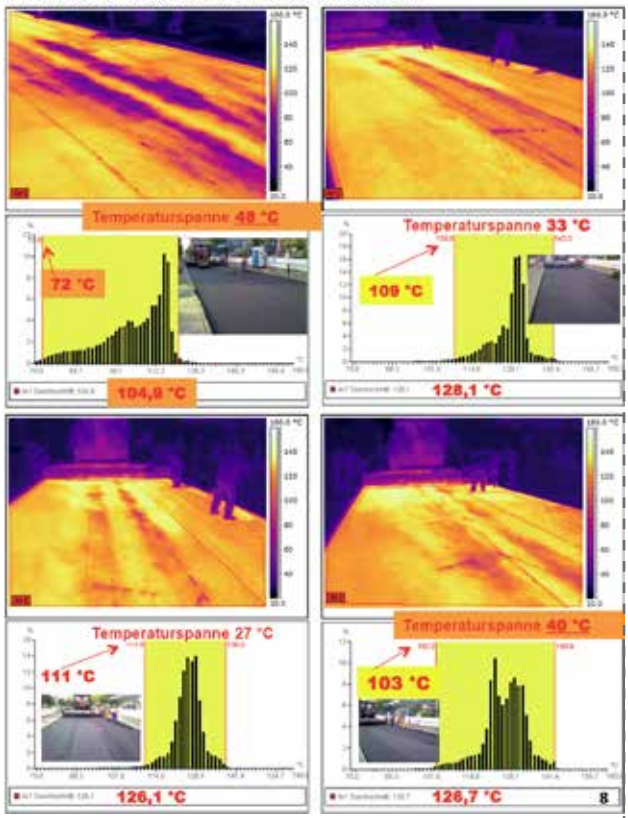
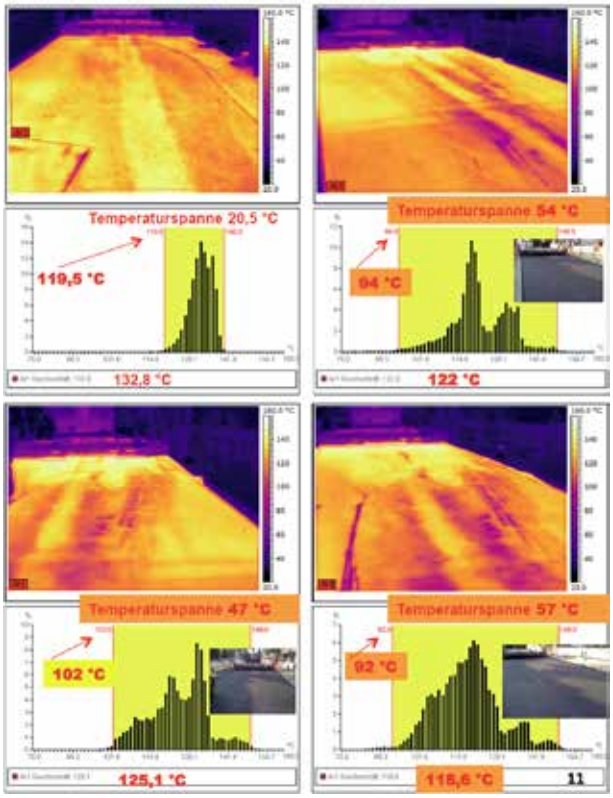
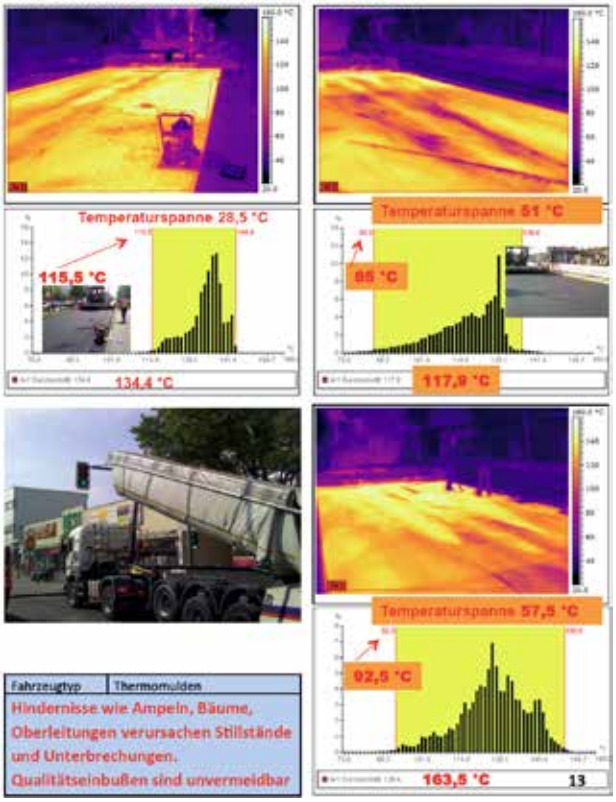


Temperature progression with thermal bodies – dumpers

Berlin, B96-Residenzstraße_Einbau mit Thermomulden-Teil 2
Witterung: Sonnenschein, windstill, ca. 28 -30 °C
Einbau von Binderschicht von ca. 9.15 Uhr bis 9.35 Uhr



Berlin, B96-Residenzstraße_Einbau mit Thermomulden-Teil 3
Witterung: Sonnenschein, windstill, ca. 30 -32 °C
Einbau von Binderschicht von ca. 9.35 Uhr bis 10.30 Uhr



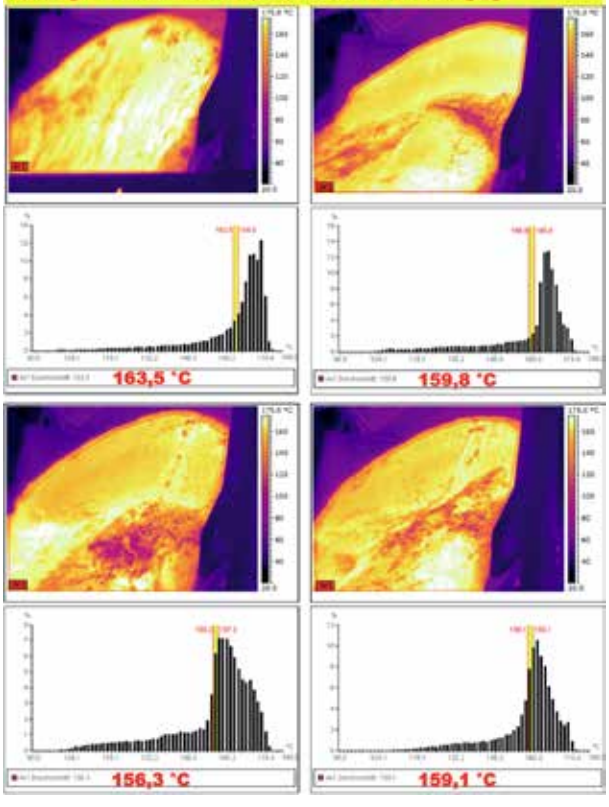
Fahrzeugtyp	Thermomulden

Hindernisse wie Ampeln, Bäume, Oberleitungen verursachen Stillstände und Unterbrechungen. Qualitätseinbußen sind unvermeidbar

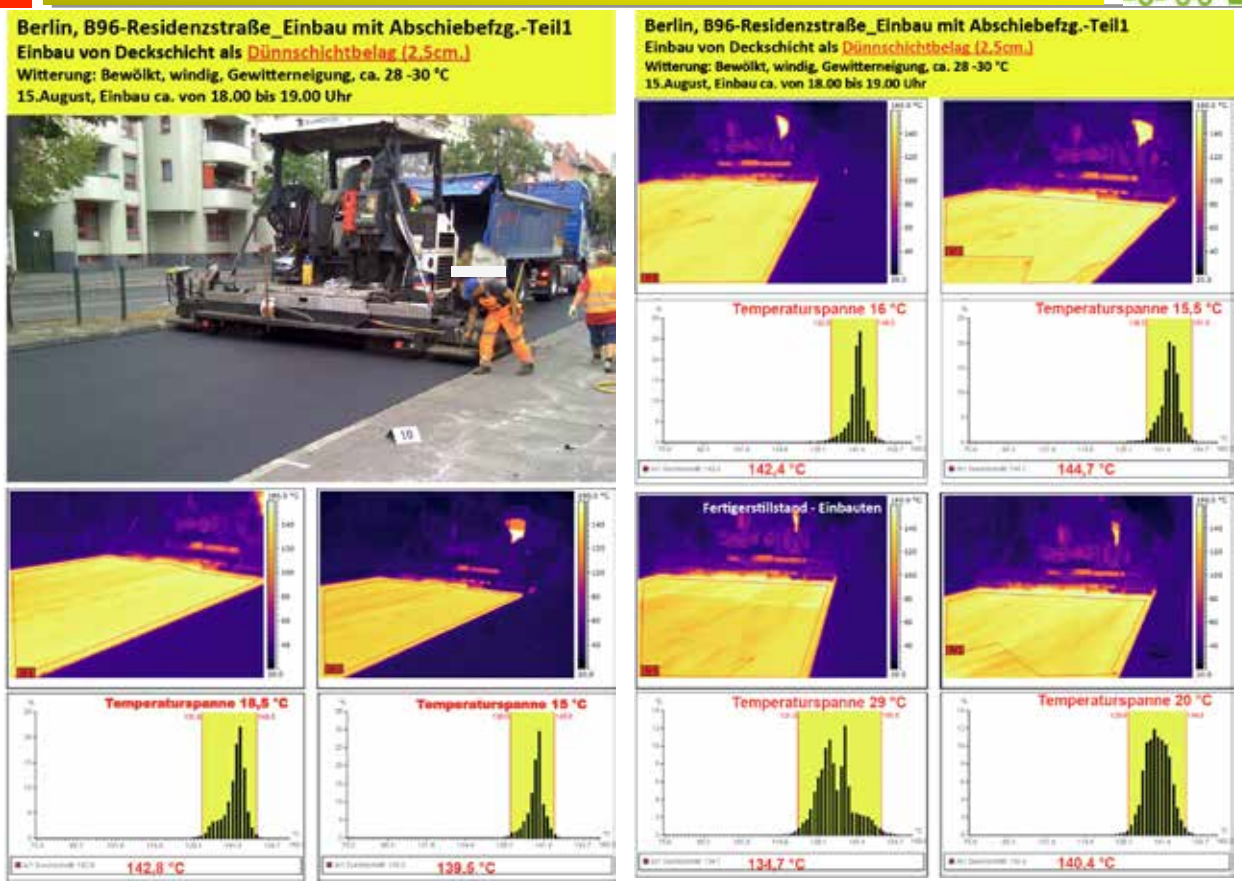
Temperature progression with thermal bodies – push-off vehicles

Berlin, B96-Residenzstraße_Einbau mit Abschiebefahrzeuge
Temperaturverlauf beim Abschieben
Nachfolgende 4 Aufnahmen entsprechen **EINEM** Abschiebevorgang

Berlin, B96-Residenzstraße_Einbau mit Abschiebefzg.-
Temperaturverlauf beim Abschieben
Nachfolgende 4 Aufnahmen entsprechen **EINEM** Abschiebevorgang

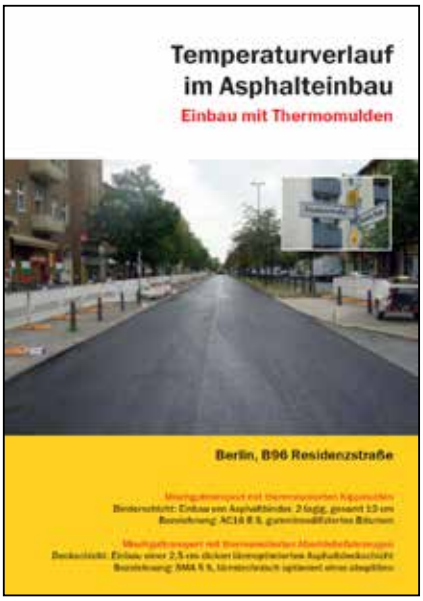


Temperature progression with thermal bodies – push-off vehicles



The above presentations have been quoted from the 132-page analysis report prepared by the Austrian Provincial Government in cooperation with BPS Linz

The above presentations have been quoted from the 32-page construction-site report prepared by Berlin Reinickendorf Building Authority



Please ask for a free detailed report if you are interested

Fliegl

Transport solution with push-off technology

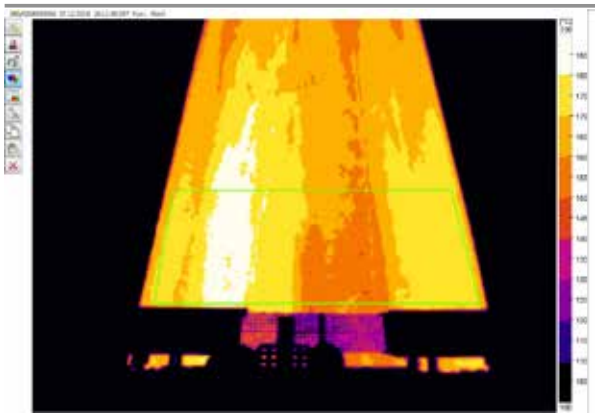
CONTINUOUS mixing throughout the unloading process
(of temperature and grain-size distribution as well as bitumen and binder-agent proportions)

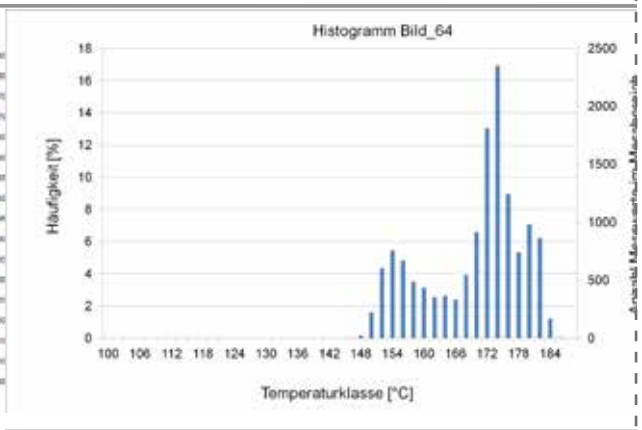
– NO mix residues

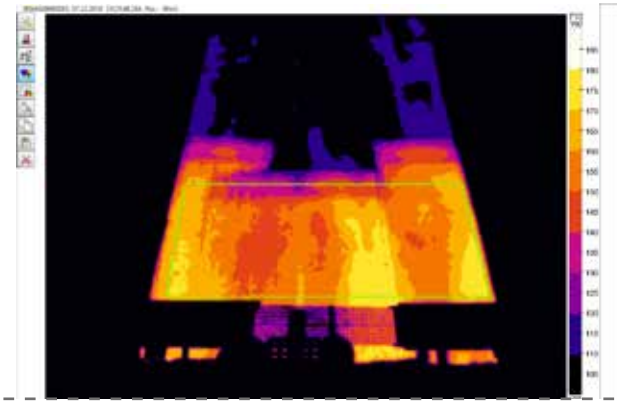
Thermal imaging systems:

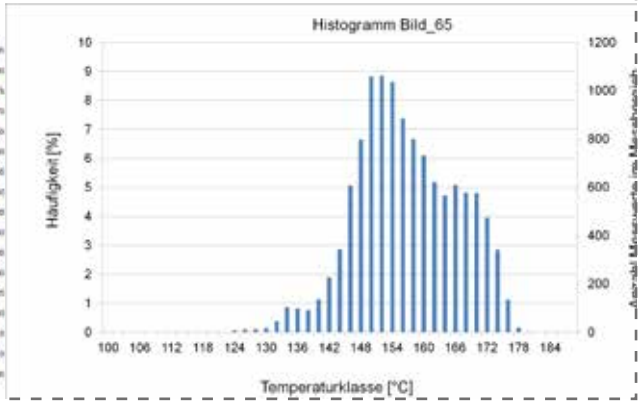
Ready-to-use measuring system

Research by TU Brunswick on behalf of Asfinag: Temperature progression with thermal bodies

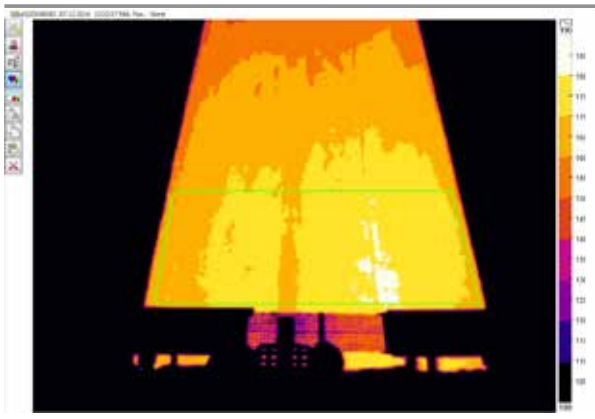


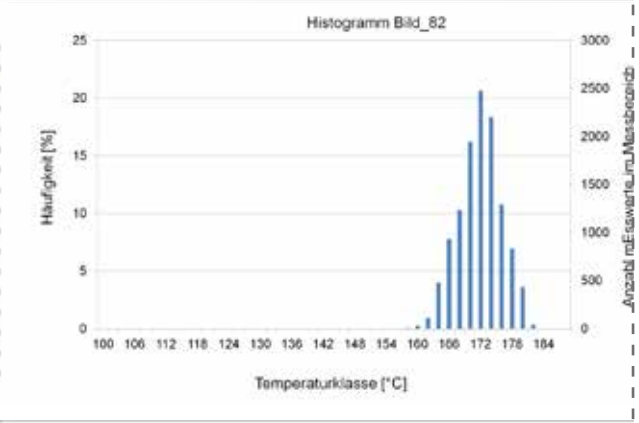


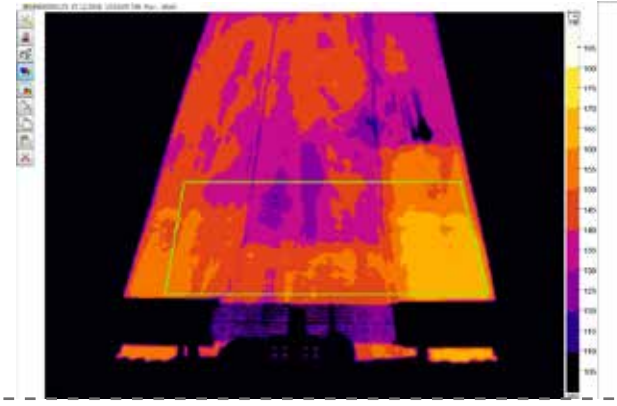


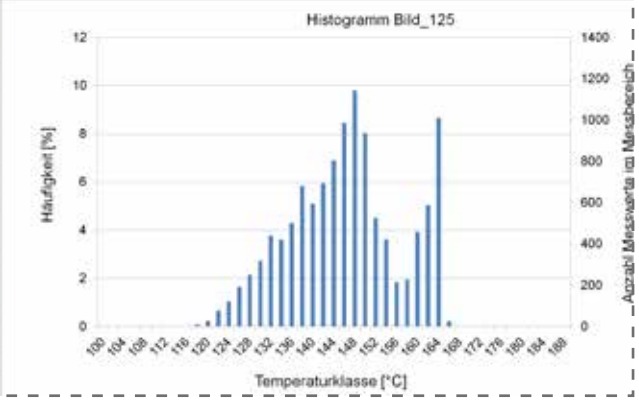


Research by TU Brunswick on behalf of Asfinag: Temperature progression with thermal bodies



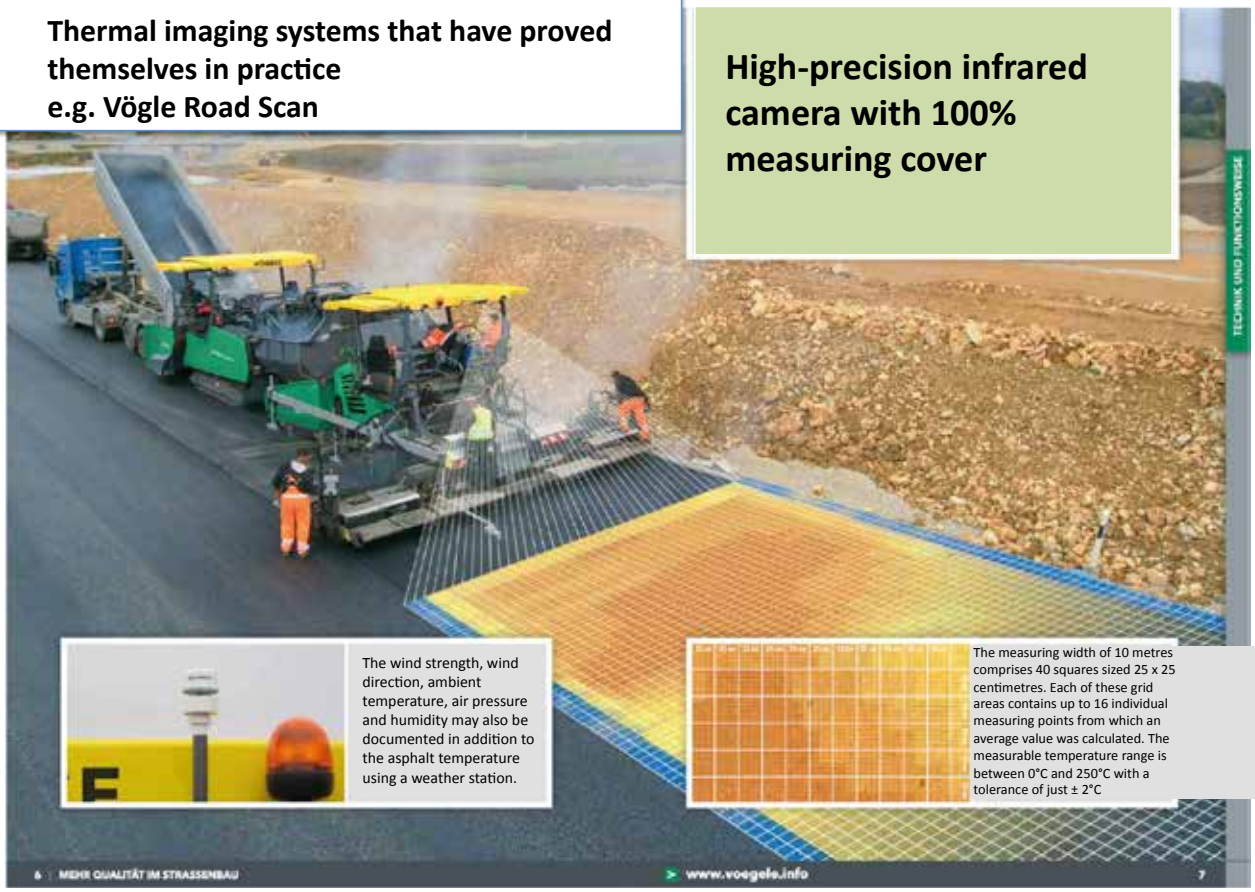




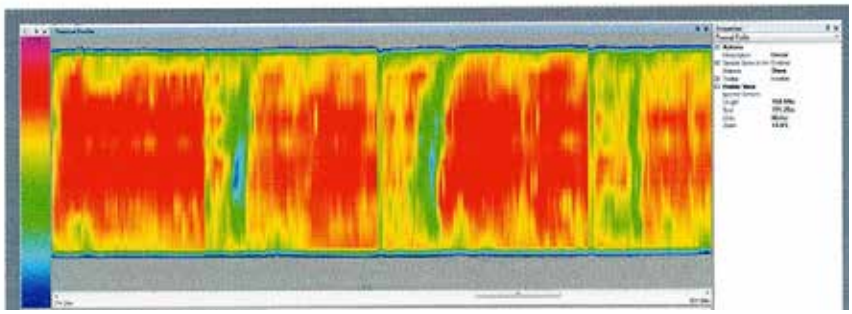


Thermal imaging systems that have proved themselves in practice
e.g. Vögle Road Scan

High-precision infrared camera with 100% measuring cover



Thermal imaging systems that have proved themselves in practice
e.g. Moba Pave – IR Scan



"Truck changes are often the cause of temperature differences in the mix and may be quickly identified as a clear cold point."

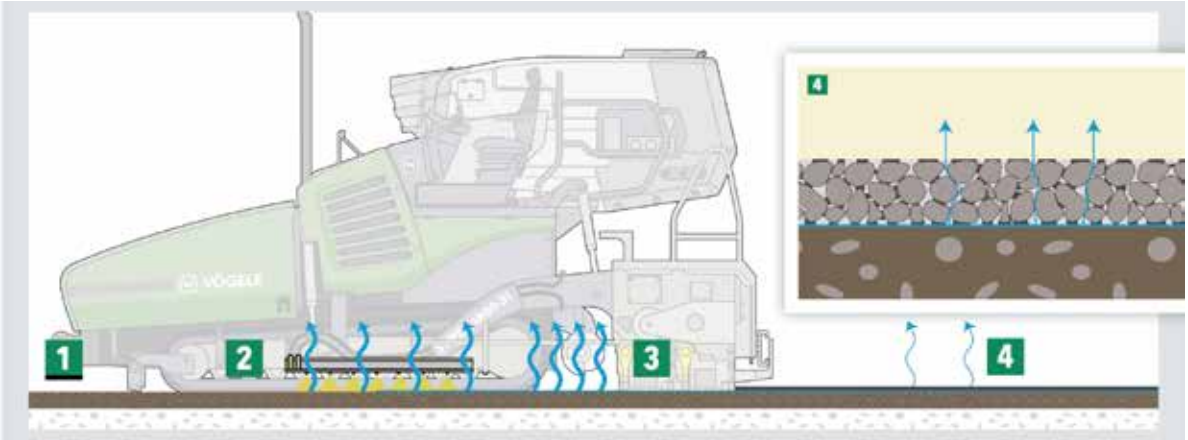
Vögele Spray Jet

Application of primer and asphalt installation in a single operation

Reduces soiling➔ improves bonding between layers

Vögele Spray Jet

The water already begins to evaporate when the bitumen emulsion that has been preheated to between 70 and 80°C is sprayed on. The remaining water content evaporates spontaneously when the emulsion then comes into contact with the hot mix that has been heated to a temperature exceeding 100°C. This is how the so-called 'breaking of the emulsion' is achieved when VÖGELE SprayJet technology is used.

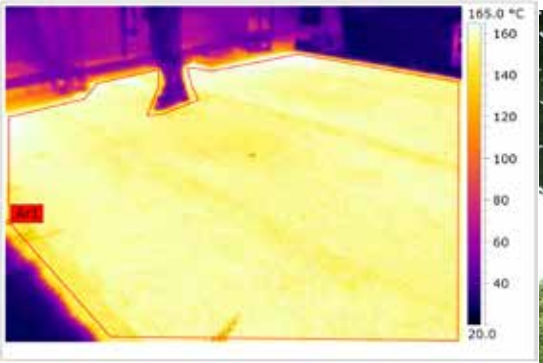


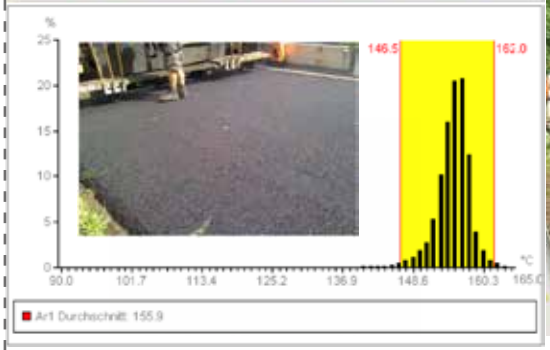
1. Prepared base: milled surface or newly installed binder layer.
2. Application of the hot bitumen emulsion that possesses temperatures ranging between 70 and 80°C using the spray paver.
3. Installation of a surface or binder layer. The bitumen emulsion 'breaks' immediately because the hot asphalt mix causes the water to evaporate. A firmly adhering bitumen film remains.
4. Any remaining water from the bitumen emulsion evaporates through the 'open pores'

Use in Austria

Push-off technology – use in municipal road construction

Heidelberg, Wieblinger Bypass: Binder- and surface-layer installation, mix transport using push-off vehicles was already required in the specifications.





Location - Lfdm	Binderschicht
Durchschn. Einbautemp.	**155,9 °C**
Temperatur Delta	**15,5 °C**

Installation on the A7

Midsummer temperatures / short travel distance

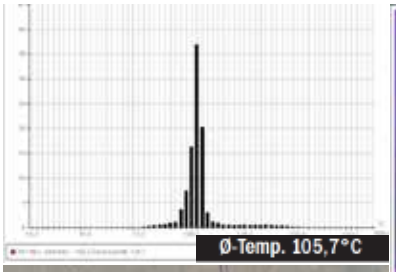
Segregation / crust formation:
The occurrence of "cold nests" is quite normal due to lots of cold mix from the "crust"

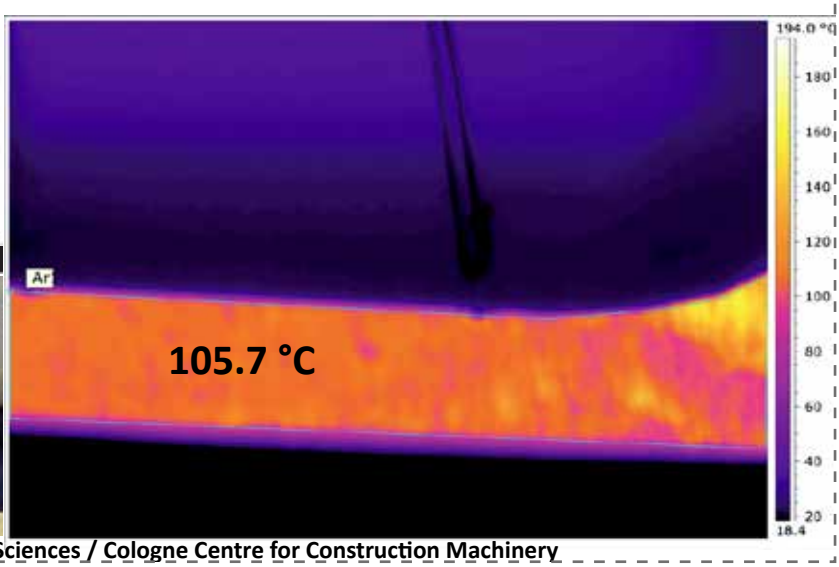
Cold material from the top layer (crust formation) is the first to slide into the paver –
Very often strong segregation when unloading with conventional transport technology (dumpers)

Transfer from dumper to bunker

with an average temperature of **ONLY 105.7°C**
typical when starting to unload from dumper vehicles,
→ first cold material then hot material comes out

Construction project: Dessau, 20 November 2012
Measurements by the Technical University of Darmstadt and Cologne University of Applied Sciences
Outside temperature: approx. 7°C



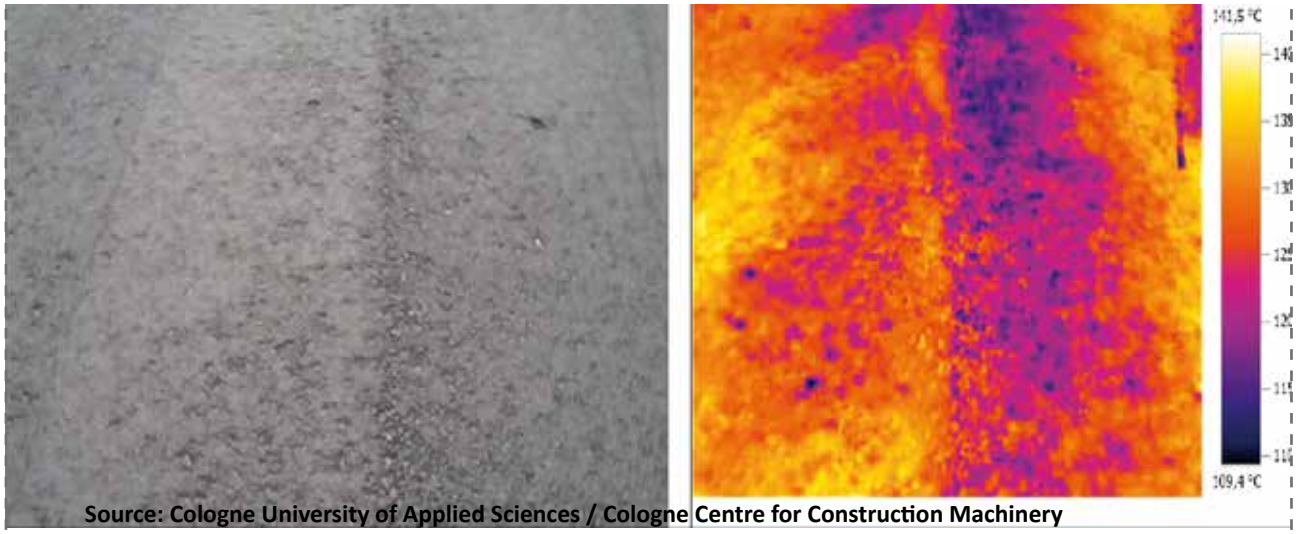


Source: Cologne University of Applied Sciences / Cologne Centre for Construction Machinery

Practice:

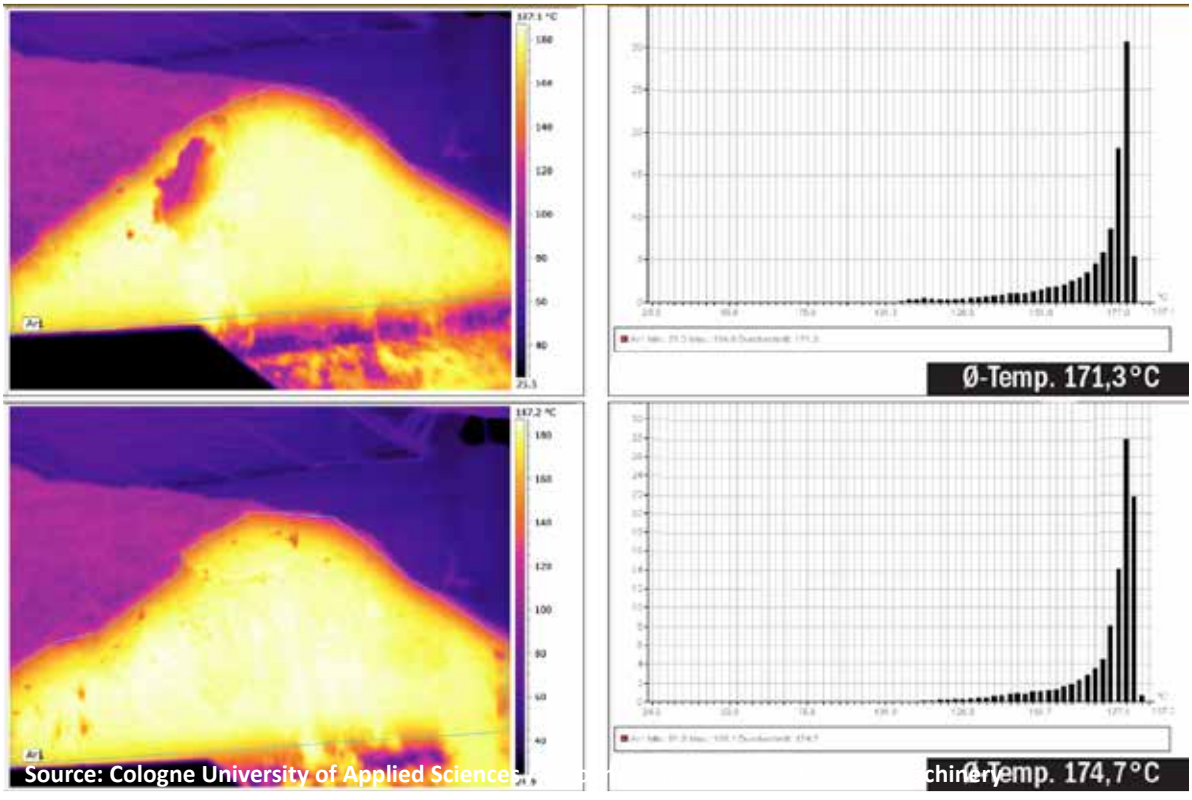
»The occurrence of "cold nests" due to the non-uniform feed of mix leads to considerable quality defects.«

Construction project: Dessau, 20 November 2012
Measurements by the Technical University of Darmstadt and Cologne University of Applied Sciences
Outside temperature: approx. 7°C



Source: Cologne University of Applied Sciences / Cologne Centre for Construction Machinery

After docking on, the "bit by bit" transfer commences IMMEDIATELY...



Source: Cologne University of Applied Sciences / Cologne Centre for Construction Machinery

Measurement results from other construction sites in Germany

➢Installation of "OPA" Porous Asphalt (PA) (PRACTICE)

Noise protection with OPA
PA – Porous Asphalt

- Low-noise asphalt surface layer
- **Noise reduction approx. 5 dB(A) at more than 60 km/h**
- **Significantly reduced risk of aquaplaning**
- **Improved view during rain – hardly any plume formation**
- Less dazzling in the dark and wet
- Very high void content min. 22%
- Sealing of base
- Water removal and noise reduction at the highest level
- Installation temperature: **min. 150°C**
- High-polymer or rubber-modified binder agent required
- Recommended for the creation of a trial section
- **Homogeneity extremely important**
- Problems during transport with conventional vehicles:
  Very high residues of mix

Mix temperature at the start of unloading
in the paver bucket ???

Does it still make sense to install PA here??



Mix temperature at the start of unloading
much too cold in the paver bucket!!

Does it still make sense to install PA here??
Or should an asphalt milling machine be ordered here at the same time?

Mix temperature in the paver bucket

T2 = 104.8°C peripheral zone **T1 = 124.8°C centre (with extractor chain)**
T2 = 104.5°C peripheral zone **T1 = 111.3°C centre (with extractor chain)**



Mix temperatures with the Asphaltprofi Thermo ?

Mix temperature **in the paver bucket**
with the Asphaltprofi Thermo: Material is homogeneous and hot

Optimum prerequisite for good quality

Mix temperature in the paver bucket

T1 = 173.3°C centre **T2 = 161.2°C peripheral zone**

Tipping not possible!
Very often a problem in municipal applications!

Lots of mix residues, long waiting times
Costs for excavators, trucks and mix!!

Not a problem for the ASW Asphaltprofi Thermo

Installation of PA on a very busy autobahn.
Customer required push-off technology in the specifications.

Surface layer made of noise-reducing NOA 5 D 50/70

Construction project: Essen

Installation of asphalt base layer AC 22 TS 50/70
and highly stable asphalt binder AC 16 B-HSF 10/40-65

Noise protection

Construction site in Altendorf Hauptstrasse in Essen with lots of obstructions: the following in just 750 metres

Over 80 gate valves, manholes, hydrants.... and overhead cables

Not planned, but it happened:

A collision with a tram delayed the continuation of work for four hours –

What can be done with the mix that had already been loaded on to the many trucks after such a long waiting time?? - Discard and dispose of it ??

Ideal for municipal applications !

Not planned, but it happened:

A collision with a tram delayed the continuation of work for four hours

The building inspector from the city of Essen and the site manager from Heinrich Walter Bau GmbH from Borken could hardly believe it:

The asphalt temperatures were still ABOVE 160°C, even in the peripheral zones !!

Noise protection with
PMA – Porous Mastix Asphalt

- Low-noise surface layer
- **Noise reduction approx. 4-5 dB(A) at 80 km/h**
- **Significantly reduced risk of aquaplaning**
- **Improved view during rain – hardly any plume formation**
- Reduced dazzling in the dark and rain
- Mastic asphalt with open-pore surface
- Void content in the surface layer min. 20%
- Void content in the sublayer 0%
- Mastic mass precipitates and creates chasms and clods in the surface
- Installation temperature: 180-190°C
- Installation with normal road paver, but with special setting
  (minimum performance of first compaction = tamper setting)
- No subsequent compaction
- Recommendation for the creation of a trial field
- **Homogeneity extremely important**
- Problems during transport with conventional vehicles:
  heavy segregation and binder-agent run-off

Noise protection with
PMA – porous mastic asphalt

Transport solution with push-off technology

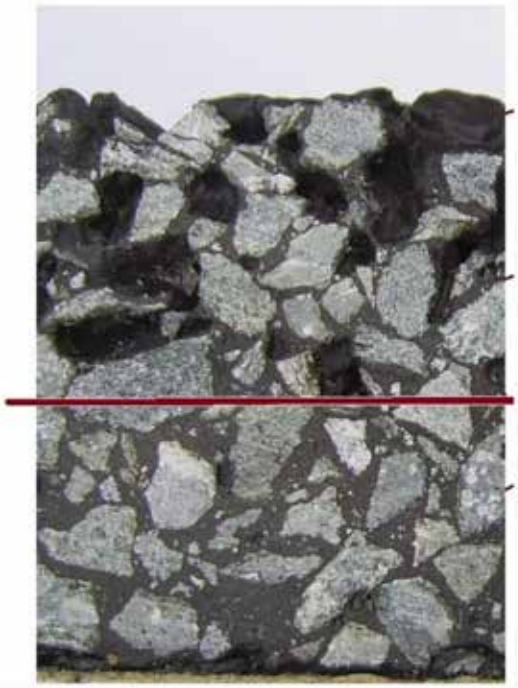
CONTINUOUS mixing throughout the unloading process
(of temperature and bitumen and binder proportions)

➔important when waiting with bitumen and binder agent (mastic mass) during transport

– very often the case with PMA!!

Asphalting work on the A 100, the busiest road in Europe with around 186,000 vehicles / day.

Installation of porous mastic asphalt (PMA)



PMA Struktur:

Obere Schicht
- offen

untere Schicht
- dicht

Noise protection

Asphalting work on the A 100, the busiest road in Europe with around 186,000 vehicles / day.

Elevated junction at AVUS (radio tower) in Berlin –

<u>The push-off technology was also already specified here</u>

Asphalting work on a tunnel section of the A66 motorway in Fulda:

4 lanes with temperature-reduced mix with a total of 6,000 t of asphalt binder layers and 2,500 t of split mastic asphalt

Laying asphalt in city centres with lots of obstructions Not a problem with the Asphaltprofi (construction project in D

Partial unloading –
Dock again after the obstruction –
and on it goes

Easy metering with the push-off trailer

Easy loading of footpath pavers

Solution to avoid accidents ?

What is the safety of your drivers worth to you? Usually not to be measured in money?

Often a deadly trap: High-voltage power lines

Greater safety!

Dangerous obstacles

ASW Stone OFFROAD in mining and underground

Water barrels in all variations – Full steam ahead

Bulk transport of the future

Winter deployment with Asphaltprofi. Transport of wet lime on arable land

Heavy-duty use in mining

Transport of blown-up aggregate in quarries
5-axle truck with payload more than 50 tonnes - ASW Stone Offroad

Asphaltprofi Thermo for hook lift unwinder

Asphalt transportation of the future

Asphalt transportation of the future

Costs / benefits for thermal bodies with push-off function

BENEFITS FOR CONTRACTING COMPANIES

ON

Benefits for contracting companies

- The average loss of temperature during transport is reduced by between 3 and 5°C when thermally insulated transport vehicles are used compared with conventional non-insulated transport of the mix.

- The average installation temperature was usually not a problem over the last few decades! !

- But one of the main problems in asphalt road construction
  – SEGREGATION –
  has not been solved in the transport of mix
  in conventional thermally insulated (dumper) vehicles!!

Benefits for contracting companies

- The contracting construction companies are usually only awarded the contract when they are the **CHEAPEST** bidders.
- But it is precisely then that it is extremely important that **YOU** utilise one component in the process chain to further improve the installation quality and in this way avoid any deductions during the approval process or even complaints during the warranty period
- However, in some cases very high temperature fluctuations in the installation process are determined even with optimum installation conditions with conventional thermal bod

Costs / benefits for thermal bodies with push-off technology?

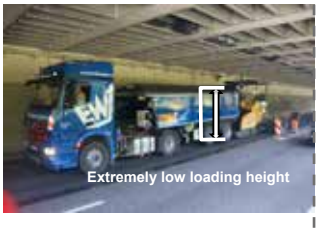
- The additional costs for the use of the Asphaltprofi Thermo with push-off technology amount to approx. 1.2 to 6 per mill
  (not percent !!) of the asphalt construction work
  or approx. € 0.50 to € 2.00 per tonne of mix
  (depending on availability, whether the transport company with push-off vehicle has been firmly incorporated into the logistics process and on the distance to the site)
- Incorporate your transport company with push-off technology **FIRMLY** into the mix-material logistics and reduce costs in this way !!
- Ask **your supplier** of mix materials to transport them using push-off vehicles and so increase **YOUR** impact and competitiveness!!!!

Costs / benefits for thermal bodies with push-off technology?

- The use of push-off technology may, however, increase the installation quality and durability of asphalt surfaces to a ***significant*** degree
- One complaint alone in a year due to segregation or the lack of an adequate compaction ratios will cost **YOU** a great deal
- It costs money to build to a good level of quality (minimum additional costs per m²!!!)
- It cost significantly more to build to a bad level of quality
- Improves process reliability in asphalt road construction

Costs / benefits for thermal bodies with push-off technology?

- Use push-off technology to avoid stop and go
- Faster and quicker installation of asphalt surfaces – **YOU** can in this way realise more running metres a day and so reduce your costs
- Significantly lower loading sill will also make loading on the construction site with small wheel loaders easier…



- Shorter circulation times as a result of significantly lower load centres on push-off vehicles (less braking ahead of bends…) and less cleaning effort even for PmB, OPA…

Costs / benefits for thermal bodies with push-off technology?

- Shorter cycle times resulting from the immediate transfer of the mix at docking (not only after 1-2 minutes)
- No residual quantities in the bodies that have to be disposed of (without separating agent in the body) even with OPA, PMA, PmB, split mastic, …
- No excavator required at the cleaning yard to scrape out the bodies

Costs / benefits for thermal bodies with push-off technology?

- Continuous asphalt installation with push-off technology
  – even in municipal road construction, avenues, underpasses, sign gantries, traffic management systems…

Costs / benefits for thermal bodies with push-off technology?

- **Partial unloading and measured unloading, e.g. 100 kg, in wheelbarrows easily possible**

Costs / benefits for thermal bodies with push-off technology?

- **"Wiesel" attachment screw makes it possible to properly close and fill trenches created for utilities (water, telecoms, Internet) without the need for excavators and while requiring considerably less manual effort**

- **Mix material can be transferred DIRECTLY from the truck to the pavement paver, fast, effectively, hot and homogeneously.**

Costs / benefits for thermal bodies with push-off technology?

Particularly for PPP projects

- Durability of the asphalt surfaces extremely important
- Reduction of rehabilitation cycles during the 30-year maintenance obligation
- Investment in greater quality and longer durability through the use of push-off technology

With push-off technology

➔ Improved homogeneity: Reduction of segregation significantly increases the lifespan of asphalt surfaces

➔ Shorter cycle times result in shorter construction times

➔ A **MILESTONE** for quality improvement in asphalt road construction

Asphalt transportation of the future

Are you ready for future requirements?

COSTS / BENEFITS FOR THE PUBLIC BODY RESPONSIBLE FOR THE CONSTRUCTION WORK

CONSORTIUM

Costs / benefits for the consortium

- The contracting construction companies are usually only awarded the work if they are the "most economic" bidders.

  in practice, this almost always means the CHEAPEST bidder!!

- The CHEAPEST bidder, however, has NO scope to implement quality-improving measures on a voluntary basis

  even if they, for instance, only cost an additional € 100.00…

- It will usually survive a warranty period of, for example, two to five years even if built using the cheapest method…

Costs / benefits for the consortium

- **ONLY if YOU provide for it in the invitation to tender, will you be able to significantly improve the durability of YOUR roads with one component in the process chain !!**
- **Many hundreds of public bodies responsible for construction work already require thermally insulated bodies with push-off function in their specifications and sometimes also require feeders and mix types in their specifications.**
- **It has long become the market's state-of-the-art**
- **No stop-and-go + improved homogeneity**
  ➔ longer durability
- **Improved smoothness ➔ Active noise protection**

Costs / benefits for the consortium

- **RVS and ASFINAG have already included push-off technology as a best-bidder criterion and are demanding it in their specifications**
- **Vehicles with push-off function**
  (recommended by the BMVI)

➔Reduced asphalt segregation in the silo
Continuous homogenisation of the material during unloading

Costs / benefits for the consortium

Long-lasting roads, in municipal road construction, avenues, underpasses, sign gantries, traffic management systems…

➔ **For such measures, it is essential to define vehicles with push-off function for transporting the mix in the specifications**

Costs / benefits for the concession company

Particularly for PPP projects

- **Durability of the asphalt surfaces extremely important**
- **Reduction of rehabilitation cycles during the 30-year maintenance obligation**
- **Investment in greater quality and longer durability through the use of push-off technology**

With push-off technology

➔ **Improved homogeneity: Reduction of segregation significantly increases the lifespan of asphalt surfaces**

➔ **Shorter cycle times result in shorter construction times**

➔ **A MILESTONE for quality improvement in asphalt road construction**

➔ **Your subcontractors will only deliver the desired quality if YOU require push-off technology in your specifications**

Costs / benefits for the consortium and for the contractor at airports

- Asphalt installation while airport operations continue without restrictions from air-traffic control's radar
- Not necessary to shut down flight operations for the rehabilitation of aprons
- Shorter cycle times permit faster construction
- Improvement of durability and quality on heavily used asphalt areas
- Fewer rehabilitation cycles

Costs / benefits for thermally insulated bodies with push-off function ??

- The additional costs for the use of thermally insulated bodies with push-off function amount to approx. 1.2 to 6 per mill –
  (not percent !!) of the asphalt construction work
  or approx. € 0.50 to € 2.00 per tonne of mix

in additional costs, e.g. for the rehabilitation of surface layers of approx. € 0.05 – € 0.20 / m²
depending on vehicle availability + supply + demand

The additional costs are VERY low
The durability of your roads will therefore be verifiably significantly improved

Costs / benefits for the consortium

- Roads and stretches of road that were built decades ago are sometimes still in use today
- The durability of some asphalt roads has deteriorated
- young stretches of road sometimes require rehabilitation after a relatively short period of use
- The reasons for this can be manifold, e.g.:
  - More traffic, more heavy-goods vehicle traffic
  - The primary materials, e.g. bitumen, filler, binder agent, have become significantly more sensitive
  - More old asphalt added (RC quota)

Costs / benefits for the consortium

- The award procedures employed in Germany where the only criterion for awarding contracts is the price (procedure where the cheapest bidder always wins)
- Many countries in Europe and many bodies in America have instituted bonus / penalty provisions, i.e. construction companies that build sustainably or meet additional quality criteria, receive additional rewards
- Higher-quality and more enduring construction methods are often technically feasible for the contractor, if the customer is prepared to pay the usually very low additional costs for certain quality components

Recommendation / solution approach:

Bitumen testing procedure

- Bitumen modifications should be better characterised, e.g. rapid bitumen standardisation procedure, (BTSV for short)
- No reliable relationships between the results from the softening point with sphere-and-ring and other rheological variables, particularly not when the bitumen has been modified. The BTSV would also allow complex binder agents, such as polymer-modified bitumen, to be sufficiently described.
- The result from the BTSV correlates, on the one hand, with the value determined using needle penetration while, on the other, providing a value for the bitumen's elasticity. This would allow the bitumen type to be assigned using the BTSV. The BTSV would also make it possible to describe how bitumen hardness changes as it ages and how the material's elastic and viscose proportions shift over time.
  The actual effect of so-called "rejuvenation agents" could be verified.

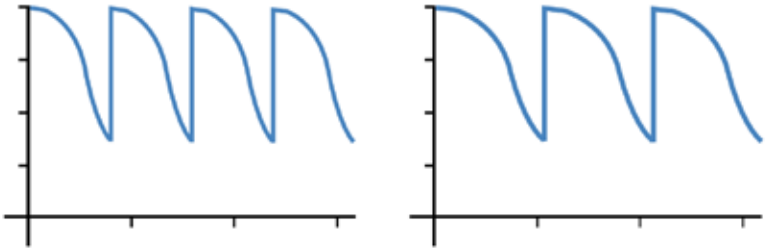
Source: Univ.-Prof. Dipl. –Ing Dr.techn. Micheal P. Wistuba (TU Brunswick)

Recommendation / solution approach:

- **Additional recognition of performance and quality parameters during the production of asphalt surfaces**
- **Broader testing, e.g. with dynamic rheometer tests**
- **This is precisely why YOU should make sure that quality is improved again by specifying additional modules.**

Costs / benefits for the consortium

- **Particularly when budgets for road maintenance and construction have been cut, it is all the more important for the measures for which tenders are being requested to last for as long as possible !!!**
- **Protect your already very tight budgets by demanding improved installation methods – that have already been state-of-the-art for a long time – and so realise longer lasting road rehabilitations.**



Reduce the necessary rehabilitation cycles

Costs / benefits for the consortium

- **<u>If you want quality, YOU will have to require it in your specifications!</u>**
  You will in this way be making an active contribution to ENVIRONMENTAL PROTECTION and will be safeguarding the value of your fixed assets
- **It costs money to build to a good level of quality** (minimum additional costs per m²!!!)
- **It costs significantly more to build to a bad level of quality ! !**

Costs / benefits for the consortium

- Push-off technology is "only" one component in the process chain but it constitutes a quantum leap in quality
- Thermally insulated dumper vehicles with push-off function are a MILESTONE in asphalt road construction and significantly improve process reliability
- What are you waiting for?
- Reduces costs for road maintenance e.g. salt storage at road-maintenance depots

Costs / benefits for the consortium

Protecting the environment by reducing CO_2 emissions during asphalt production!

Production temperatures may be reduced a little in the mixing plant

➔ **while still achieving high and homogeneous installation quality**

➔ **fewer resources** – less CO_2, less gas, oil, coal dust

Tender document for transporting mix materials

Measures to increase the asphalt installation quality

1. General

The lifetime of the road surface structure depends on various boundary conditions. These particularly also include a high-quality installation process, as well as reliable compliance with requirements from the technical regulations for asphalt building materials until completion of the bonded surface structure.

Investigation results make it clear that particularly the processing stages in the process chain from the production of the asphalt mixture, to the transport and installation of the asphalt have significant potential for assuring the quality of the asphalt mixture. Strong technical temperature and granular segregation with the delivery / handover to the producer often lead to large fluctuations in the installation quality with relevant negative impact on the durability of the newly installed asphalt base layer and cover layer.

2. Technical requirements for the transport vehicles

Thermally insulated dumper vehicles with push-off function
(reduction of segregation during the emptying process)

To ensure sufficient thermal insulation of the transport bodies, the wall / base structure including the insulating material used, must have a thermal resistance (R-value) greater than or equal to 1.65 m2K/W (at 20 °C).

The dumper vehicles must be fitted with a covering device (e.g. tarpaulins on a silicone / polyurethane basis or equivalent), which remains closed until the start of the unloading process into the road paver / feeder.

The insulating material used must have long-term temperature resistance of up to 200°.

The measurement of the asphalt mixture temperature takes place using a calibrated measuring device, which allows the temperature of the asphalt mixture to be read off in the four corner points of the transport body BEFORE unloading.

Transportation of concrete for engineering

How would you handle transportation?

'The main thing is that it's cheap??'

With dumper??

➡ Considerable segregation

with concrete mixer!

➡ Continuous mixing

'Quality has priority!!!'

Transportation of asphalt for asphalt road construction

How would you handle transportation?

'The main thing is that it's cheap??'

With dumper??

➡ Considerable segregation

With push-off function!

'Quality has priority!!!'

➡ **CONTINUOUS** mixing during the unloading process with push-off vehicle!

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Fliegl Bau- und Kommunaltechnik GmbH | Bürgermeister-Boch-Str. 1 | D-84453 Mühldorf · Germany
Tel. +49 (0)8631 307 382 | Fax: +49 (0)8631 307-553 | E-Mail: martin.fliegl@fliegl.com
www.fliegl-baukom.de