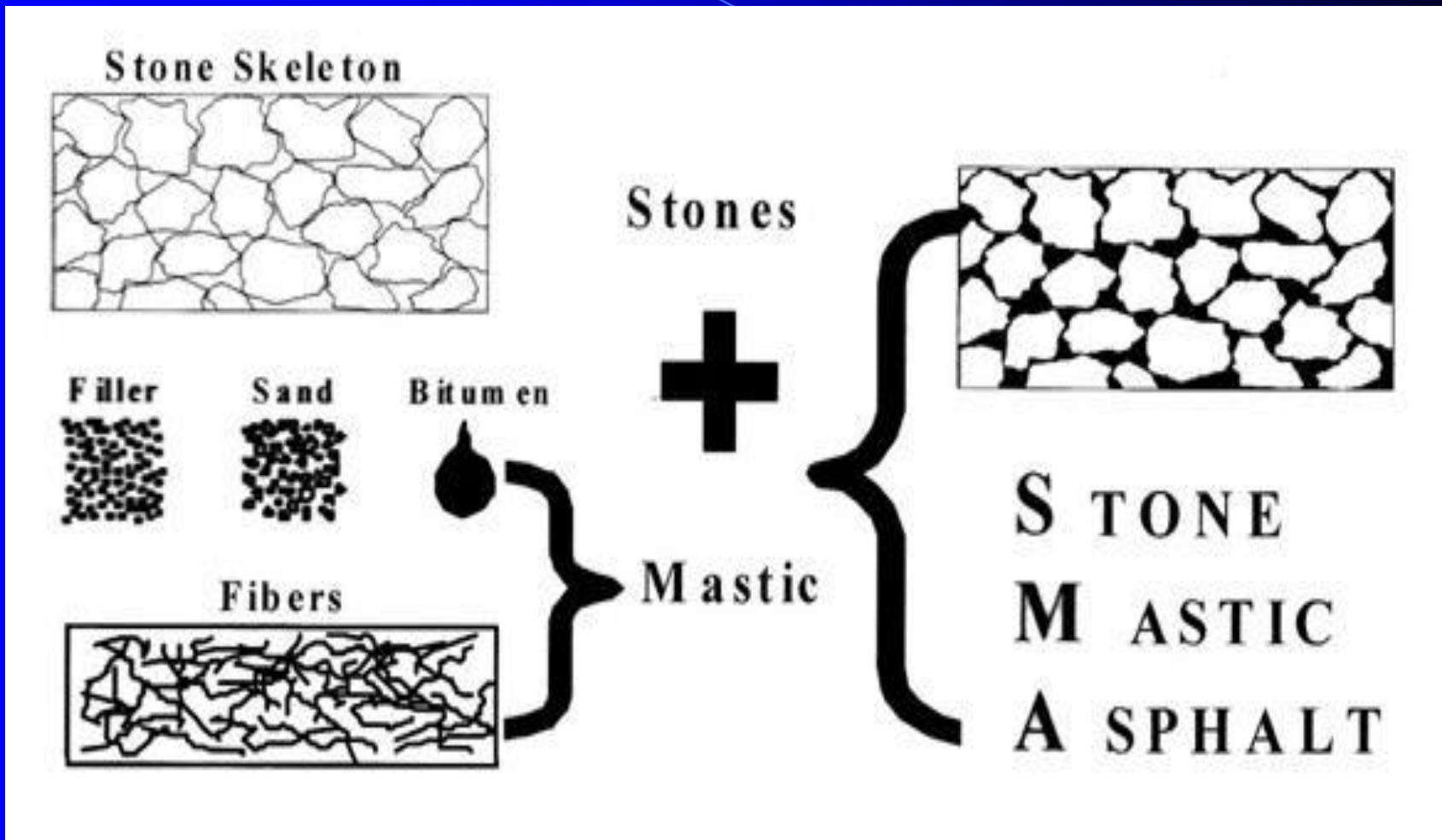


A close-up photograph of a stone mastic asphalt surface, showing dark, irregularly shaped stones embedded in a dark, textured mastic binder. The surface has a rough, granular appearance with some small green spots of moss or algae.

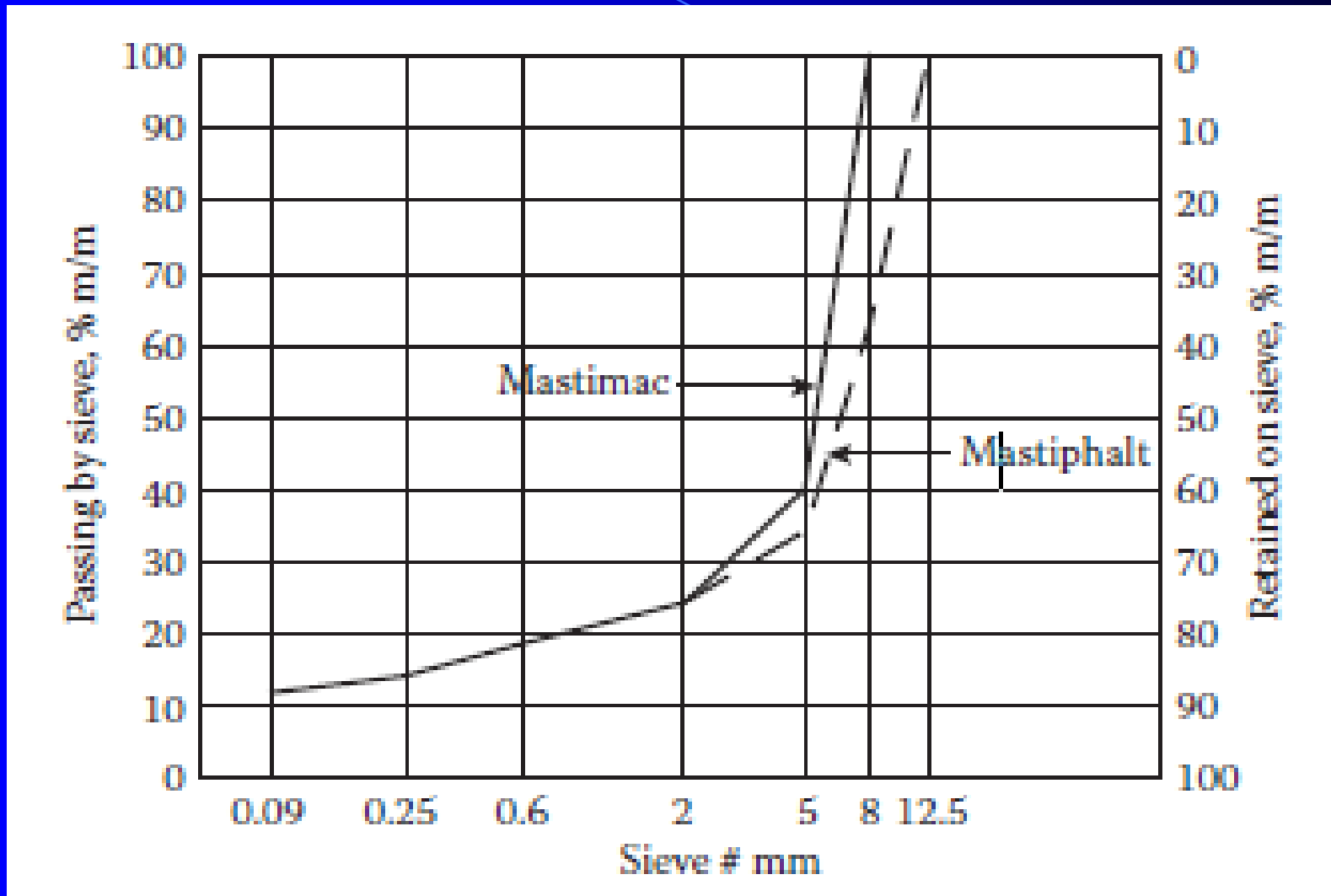
Stone Mastic Asphalt

- a temperamental Diva from Germany -

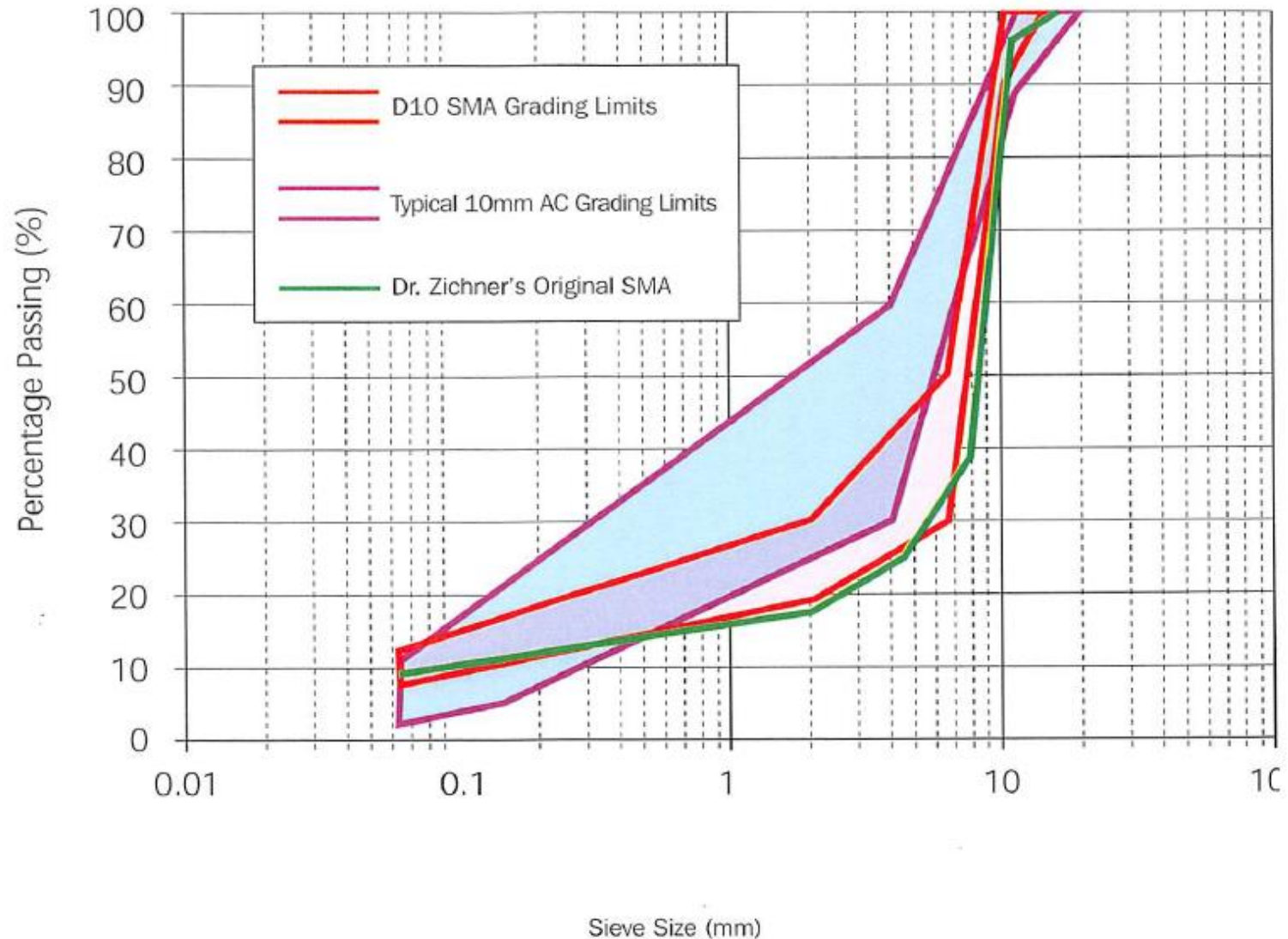
The concept of Dr. Zichners Stone Mastic Asphalt



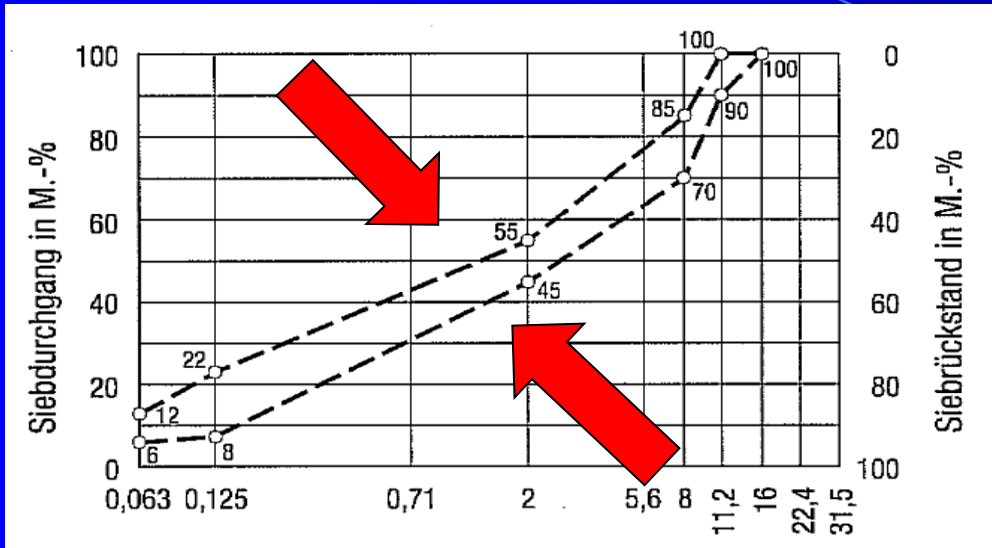
The Concept of Dr. Zichners Mastimac and Mastifalt



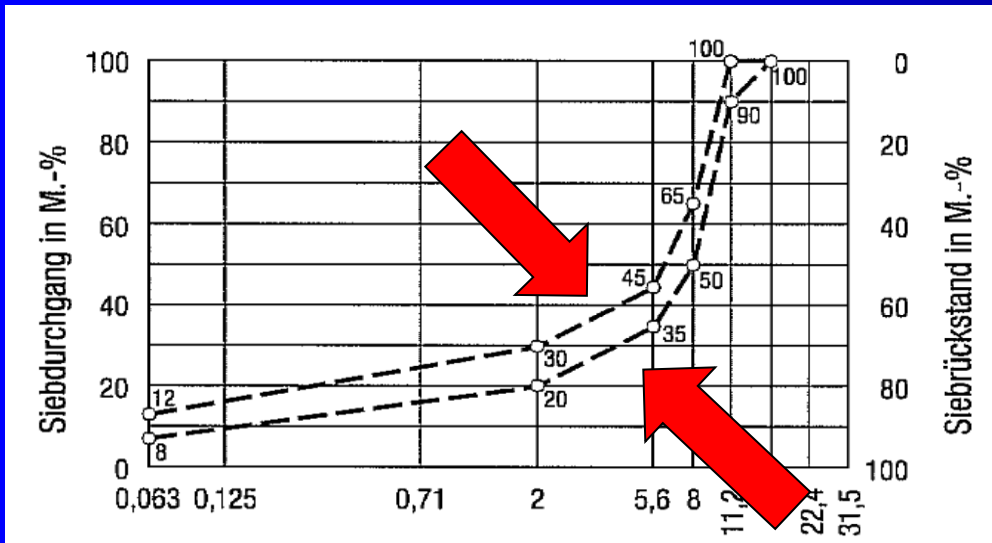
The concept of Dr. Zichners Mastimac and Mastifalt



Continuous gradation vs. gap gradation



Grading AC 11 DS
Continuous Gradation



Grading SMA 11 S
Gap Gradation

Definition of an SMA skeleton

- adequate ratios of various aggregate fractions
- all fractions > 2 mm are used
- Adjustment of the proportions to achieve the desired skeleton
- no sharp breaks in gradation curves
- German gradations are quasi-continuous gradings

Continous gradiation vs. gap gradiation

aprox. proportion for mix design

	2/5 mm	5/8 mm	8/11 mm
SMA 8	2,5 parts	4,5 parts	NA
SMA 8 S	2 parts	5,5 parts	NA
SMA 11 S	1 part	2 parts	4 parts

The arguments for SMA:

- | | |
|-----------------------|--|
| 1. Skid resistance | Aggregate Type / Design of surface texture |
| 2. Evenness / rutting | strong aggregate structure |
| 3. Noise | - 2,0 dB (A) |
| 4. Surface durability | binder-rich and voidless mortar |
| 5. Visibility | reduced reflection and spray |

In Germany SMA is used for:

Roads with heavy running traffic like motorways, industrial roads

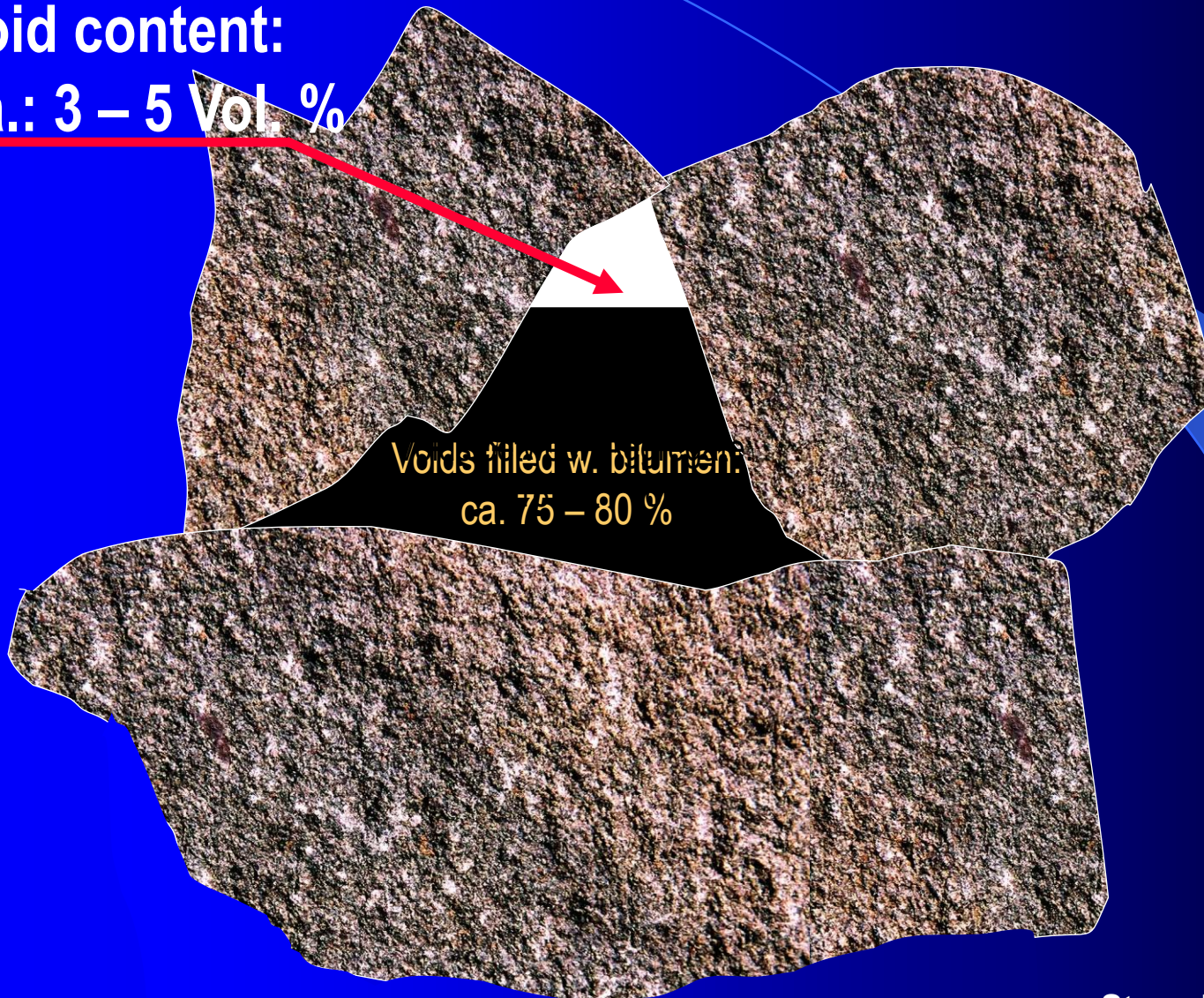
Not suitable for: - Small roads (expensive)

- Inner-city roads (difficult in laying manually)

Mix Composition: Principle SMA

Void content:

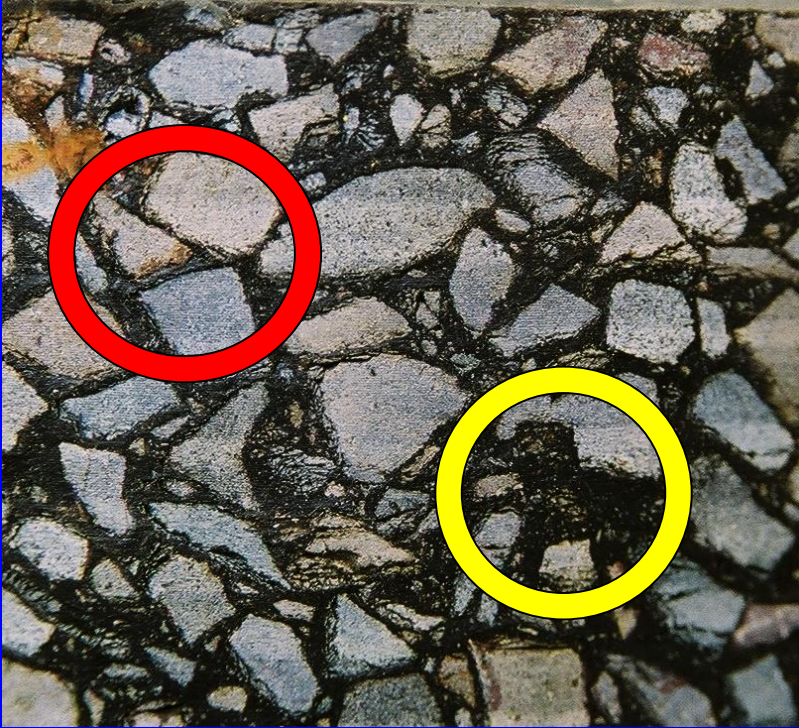
ca.: 3 – 5 Vol. %



**Voids filled w. bitumen:
ca. 75 – 80 %**

Aggregate Skeleton

Differences between SMA and AC



SMA



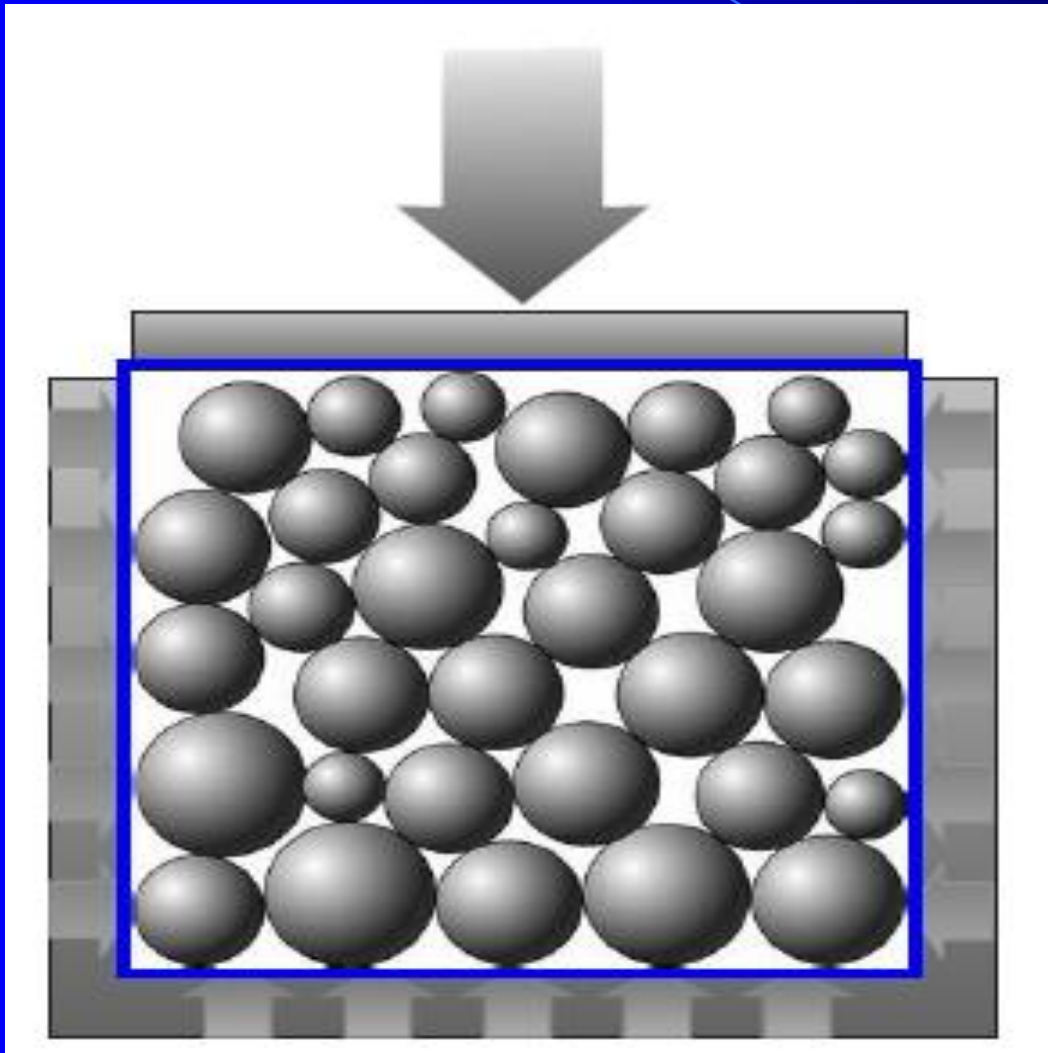
AC

- What we need:
- Grains of suitable size
 - Supporting the grains with each other
 - Hooking the grains together

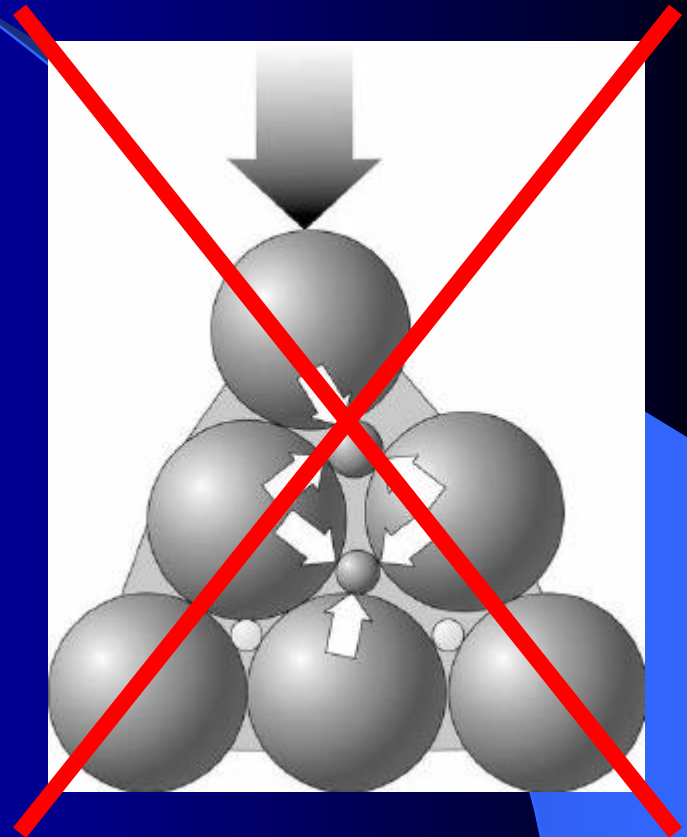
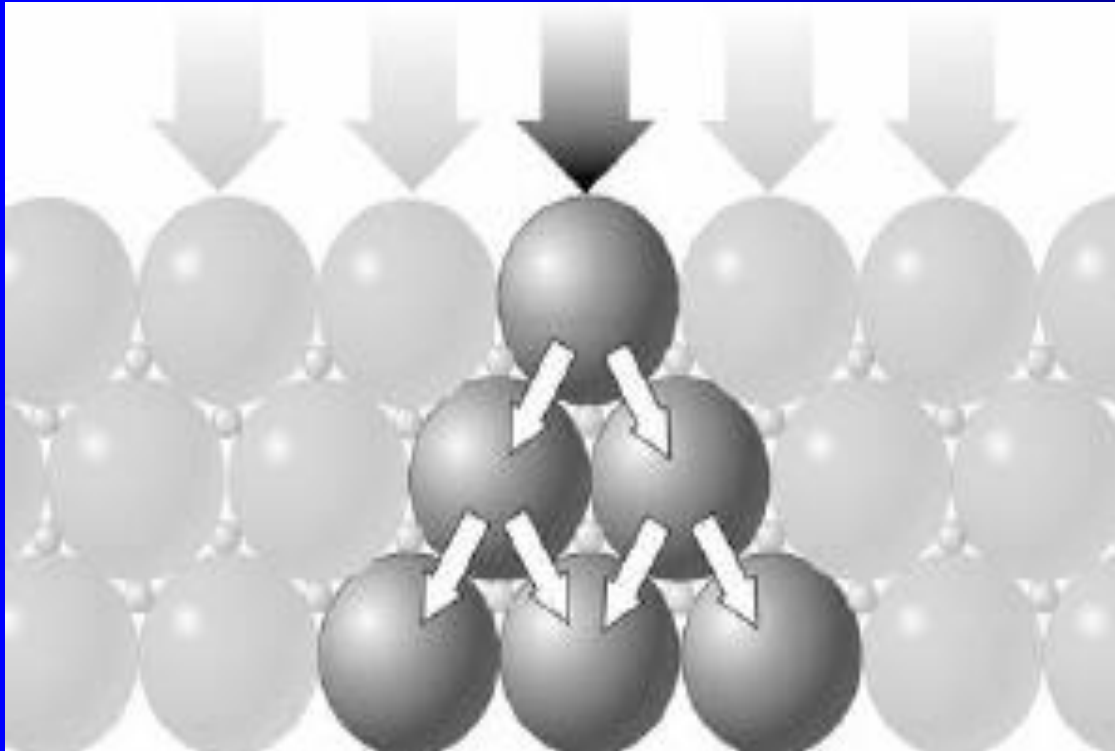


11

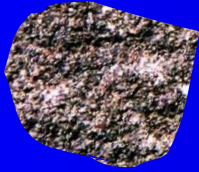
Aggregate Skeleton



Aggregate Skeleton



Aggregate Skeleton



Requirement:
good shape

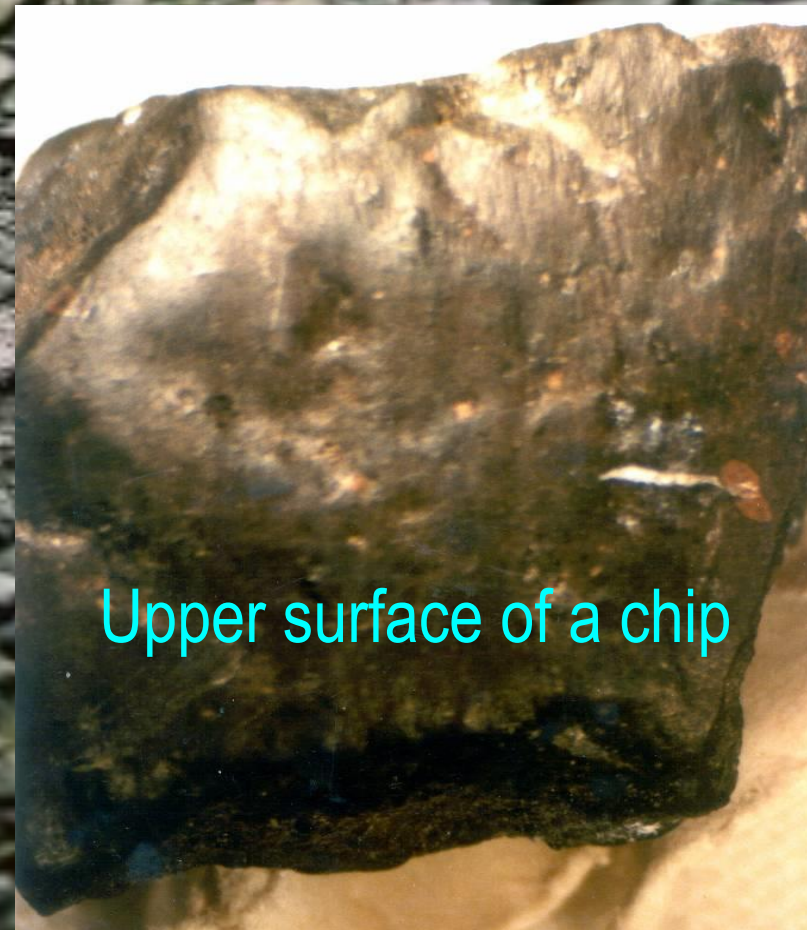
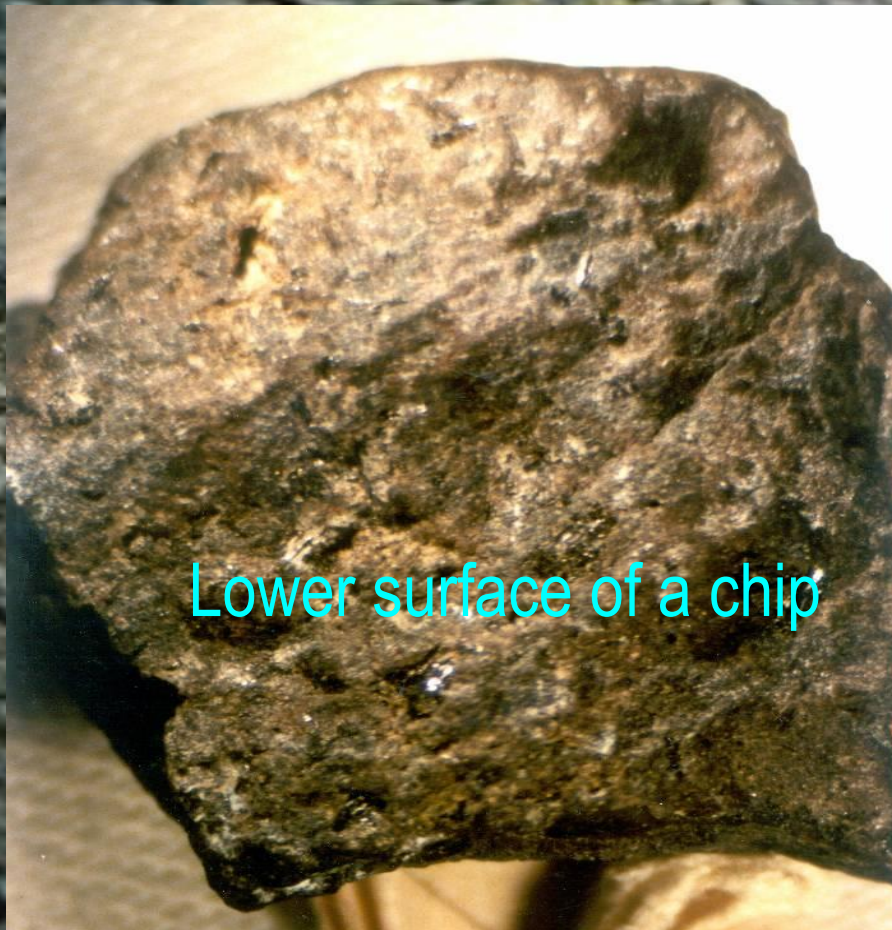


screen

Screens are a little
bit stupid !

Skid resistance / PSV

Failure: Polished within a few years !!!!!!!!!!!



Skid resistance / PSV



Necessity: Good adhesion between bitumen and aggregates:



Result of rolling bottle test : left side: good adhesion
right side: bad adhesion

By experience:

Aggregates: limestone > basalt > quarzitic porphyr > sandstone/ quarzite

Bitumen: affinity depends on resin - content

Research : Selection of suitable aggregates



Mix Composition: Selection of suitable aggregates



Wales

PSV = 68

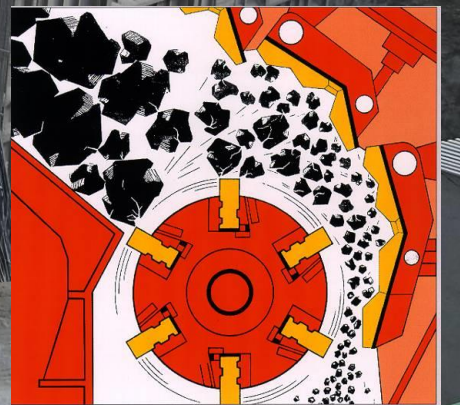
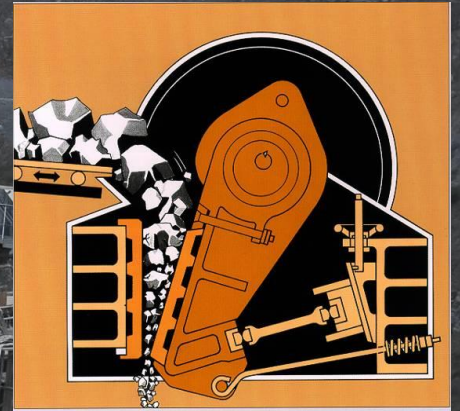
Greywackes



Research: Optimizing crushing and screening

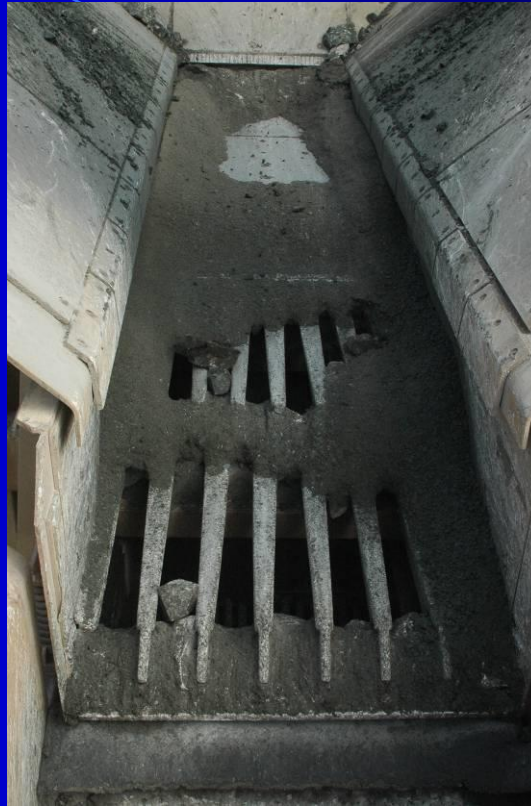
for high quality aggregates regarding strength, shape, fracti

- Shape of aggregates (reducing width of crusher)
- Distribution of sizes (additional fractions/ screens)
- Reducing dust content





**Insufficient separation during screening
Overload of pre-screening**



Do not overload the primary crusher !

Mastic:

- 1. Binding the coarse aggregate skeleton**
- 2. Lubricating the coarse grains during compaction and enabling a proper aggregate structure in a compacted surface course**
- 3. Sealing the layer, or filling the voids in the compacted aggregate structure**
- 4. Withstanding stresses caused by load and temperature**

Influence of filler on asphalt mixtures:

- 1. Very fine filler grains result in such problems as the loss of surface course stability, rutting, binder bleeding and fat spots**
- 2. Filler grains bigger than the binder film on aggregates behaves like a passive aggregate, forming mastic and take part in filling up the voids**
- 3. An excess of filler leads to mastic stiffening and the increase of cracking susceptibility**
- 4. The affinity between filler and binder influences the durability**
- 5. The appropriate ratios of binder and filler, combined with their properties, have an influence on an SMA mixture's workability and influences the SMA compaction**

Fly Ashes / Baghouse Filler / Added Filler

- 1. The use of fly ash is not permitted**
- 2. Difficult to define properties of baghouse fines**
- 3. Only added fillers can be used accurately**

Hydrated Lime

- Reduction of swelling → higher moisture resistance
- Higher tensile strength → higher durability / resilience
- Delayed aging of bitumen → higher durability
- Significant increase in deformation → lower ruts
- Added amount → 1 – 2.5 %

Bitumen

In Germany we usually use
polymer modified bitumen like:

PmB 25/55-55

Penetration: 25 - 55 mm/10

Softening Point: $\geq 55^{\circ} \text{C}$

Unmodified Bitumen like 50/70

Penetration: 50 - 70 mm/10

Softening Point: 46 - 54 $^{\circ} \text{C}$



**Stone Mastix Asphalt
German Solutions**

Stabilizers / Fibres



Loose fibres



Fiber Pellets

Purpose: Avoiding drainage of bitumen out of hot mix

High quality mixing plants are needed for SMA Dosing equipment



Automatic



Manual

and

Dosing of Cellulose Fibers at the plant

High quality mixing plants are needed for SMA Usually: Batch plants



Reducing Production Risks

Proper stockpiling and roofing of the aggregates



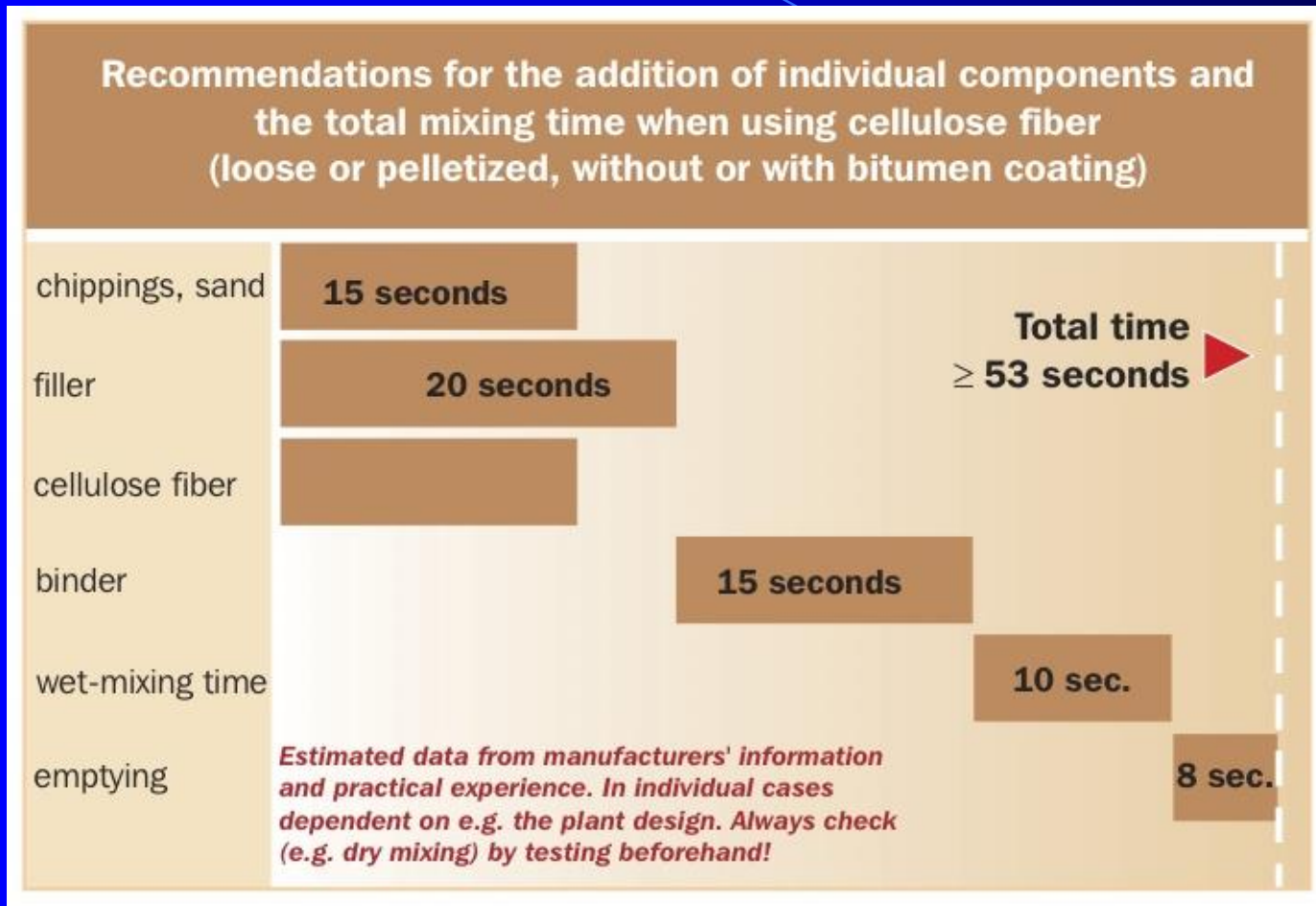
Stone Mastix Asphalt
German Solutions

Reducing Production Risks: Storing



Avoid storing of SMA hot mix for avoiding drainage of bitumen

Reducing Production Risks:



SMA Mixing temperature: $\leq 170^{\circ}$ C (PmB)

Compaction



Use modern steel drum rollers

No tire rollers on SMA !

Start compacting dynamically as soon as possible

Requirements:

Degree of compaction: $\geq 98 \%$

Void content: 2 – 5.5 %-vol

Darmstadt Scuffing Device (DSD)

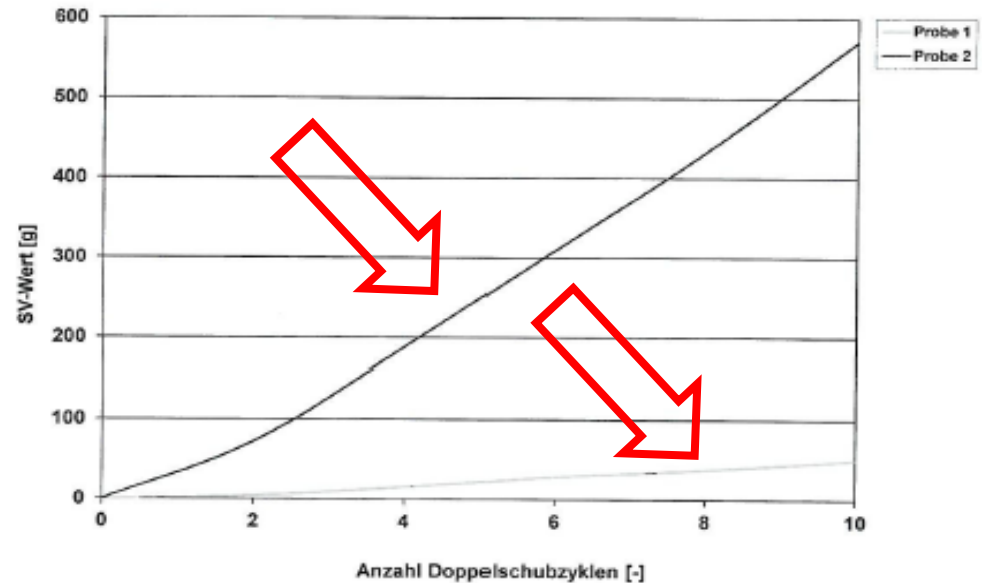
4 Untersuchungsergebnisse

4.1 Datum der Untersuchungen : 17.08.2015

4.2 Ergebnis der Untersuchung des Oberflächenverschleißes

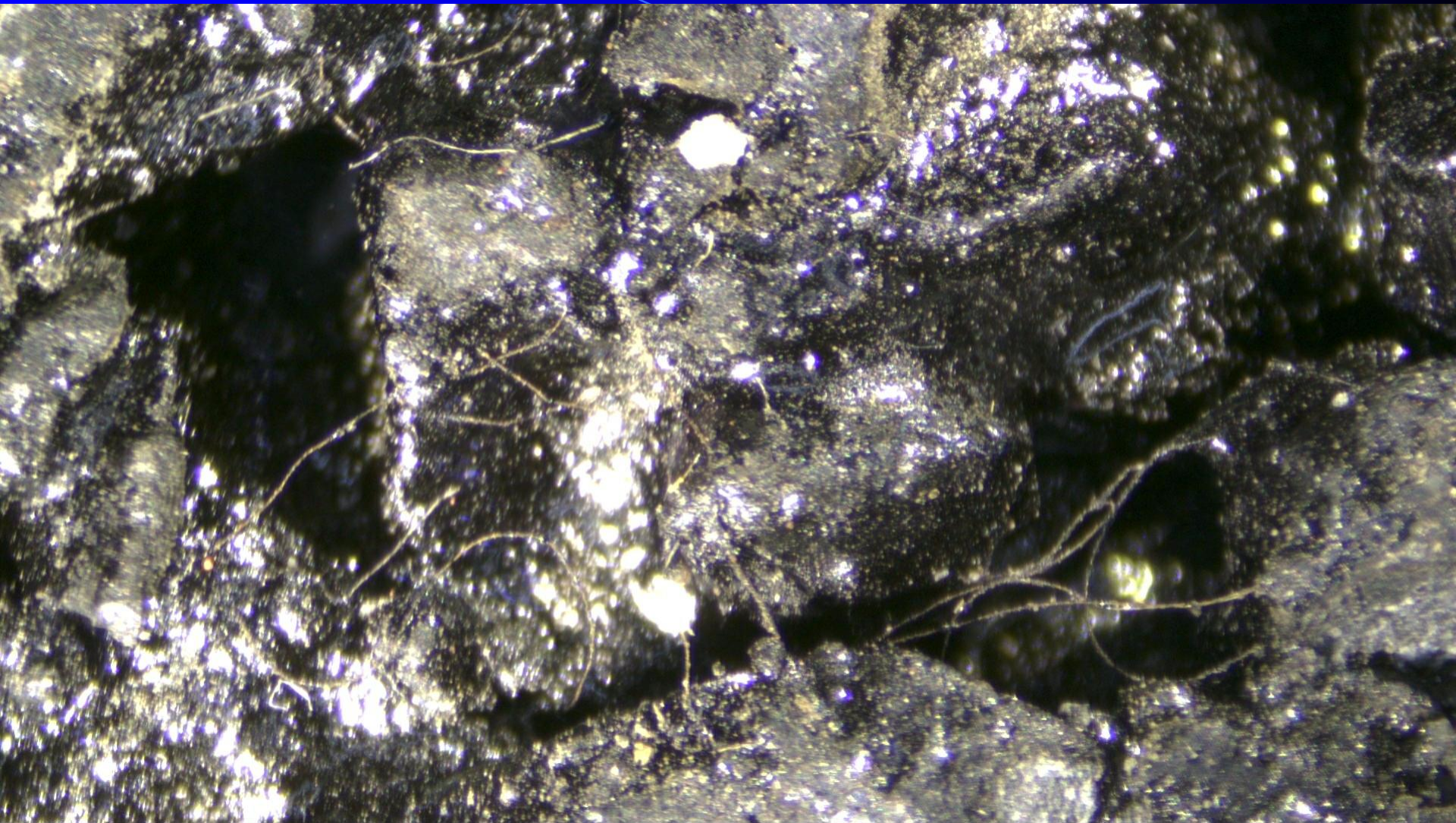
	Probe 1	Probe 2
Masse der Probeplatte vor Versuchsbeginn $M_{0,1}$:	4.783,6 g	4.735,5 g
Masse der Probeplatte nach Versuchsende $M_{1,1}$:	4.733,5 g	4.152,5 g
SV-Wert:	50,1 g	583,0 g

4.3 Grafische Darstellung des Substanzverlustes

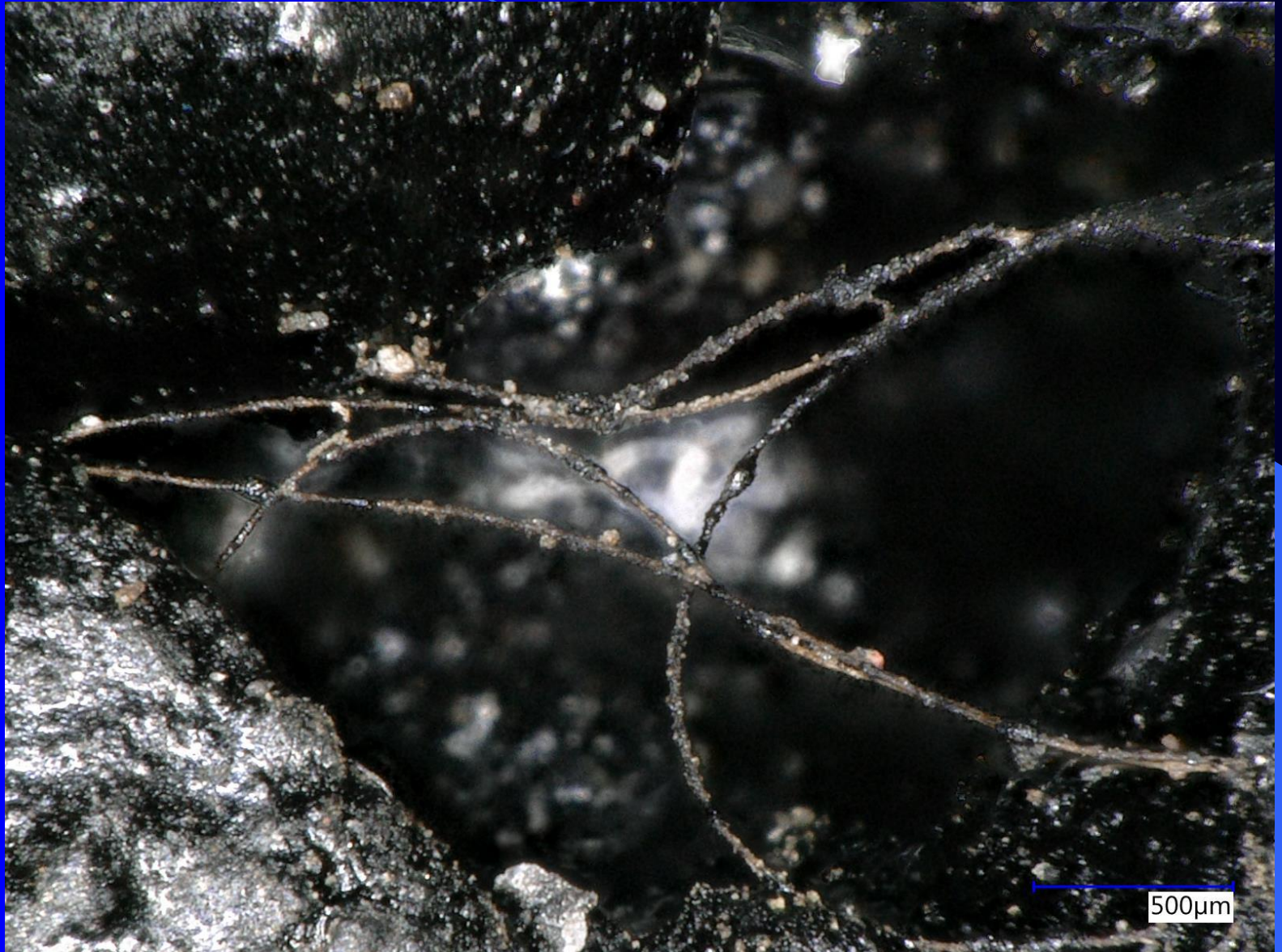



Dr.-Ing. Plamena Plachkova-Dzhurova

Forta-Fi[®] Fiber

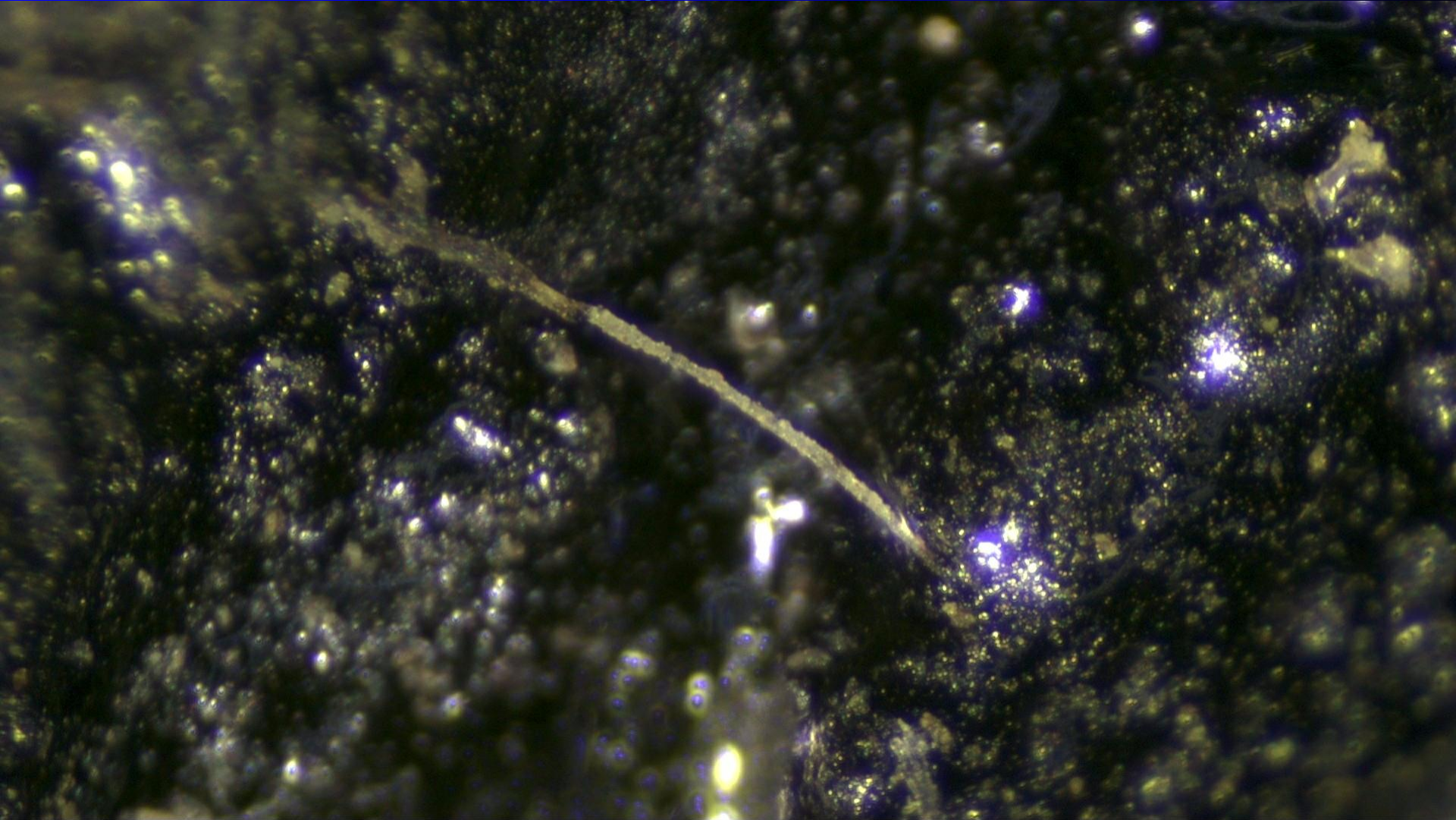


Forta-Fi[®] Fiber



500µm

Forta-Fi[®] Fiber



Hamburg Wheel Tracker





Thank you for listening

Dr. Martín Haberl