

Determination of Latex and Starch Penetration via Serial Sectioning in Combination with Fluorescence Microscopy

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Presentation Overview

- Binder Penetration/Migration
- Establishment of a New Method to Analyze Binder Penetration
 - **Serial Sectioning** in combination with **Fluorescence Microscopy (SSFM)**
- Results
 - The Influence of ***Base Paper Properties*** on ***Latex Penetration***
 - The Influence of ***Solids Content*** on ***Starch Penetration***
 - Double-staining to localize ***Starch*** and ***Latex***
- Evaluation of SSFM via CLSM
- Conclusion and Outlook

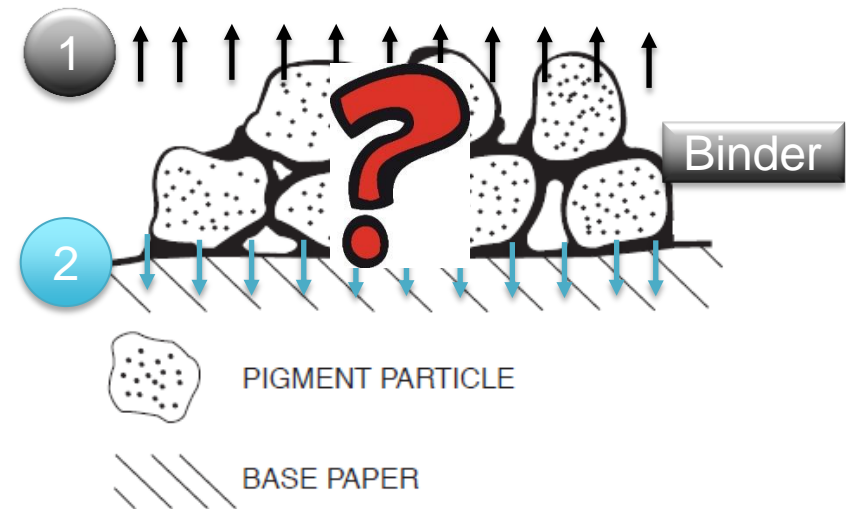
Binder Penetration/Migration

Binder migration

- Binder follows the evaporated water phase to the surface

Binder penetration

- Binder follows the water into the paper substrate



Localization of Binder after the Coating Process

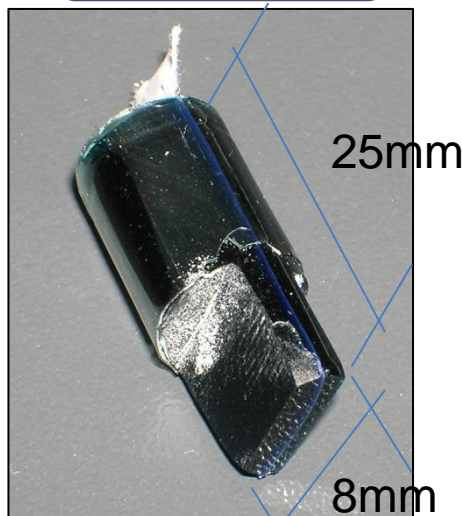
Whalen-Shaw, 1993

Establishment of a New Method to analyze Binder Penetration

Staining the binder

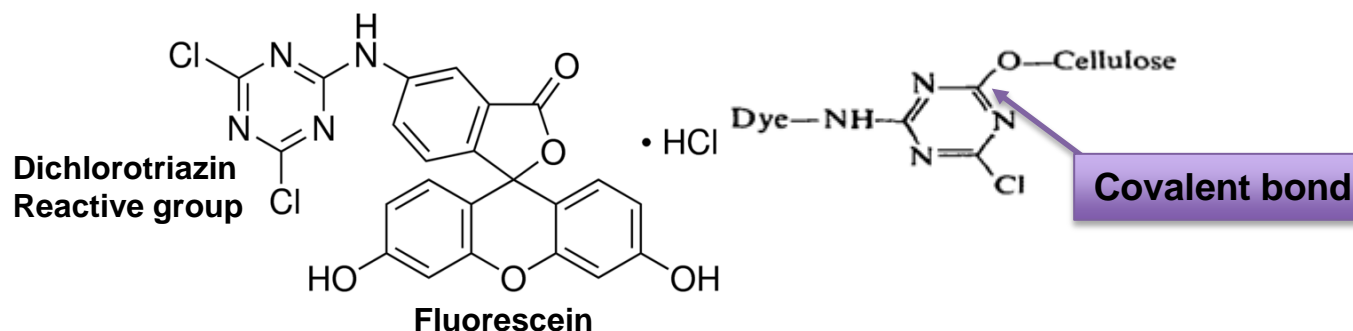
Coating

Embedding



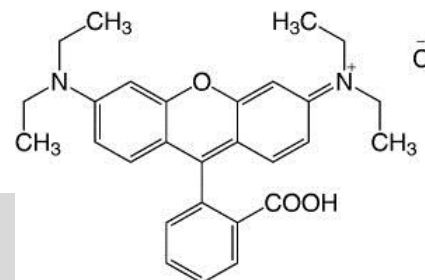
Starch

- Reactive staining with 5-([4,6-Dichlorotriazin-2-yl]amino)fluorescein



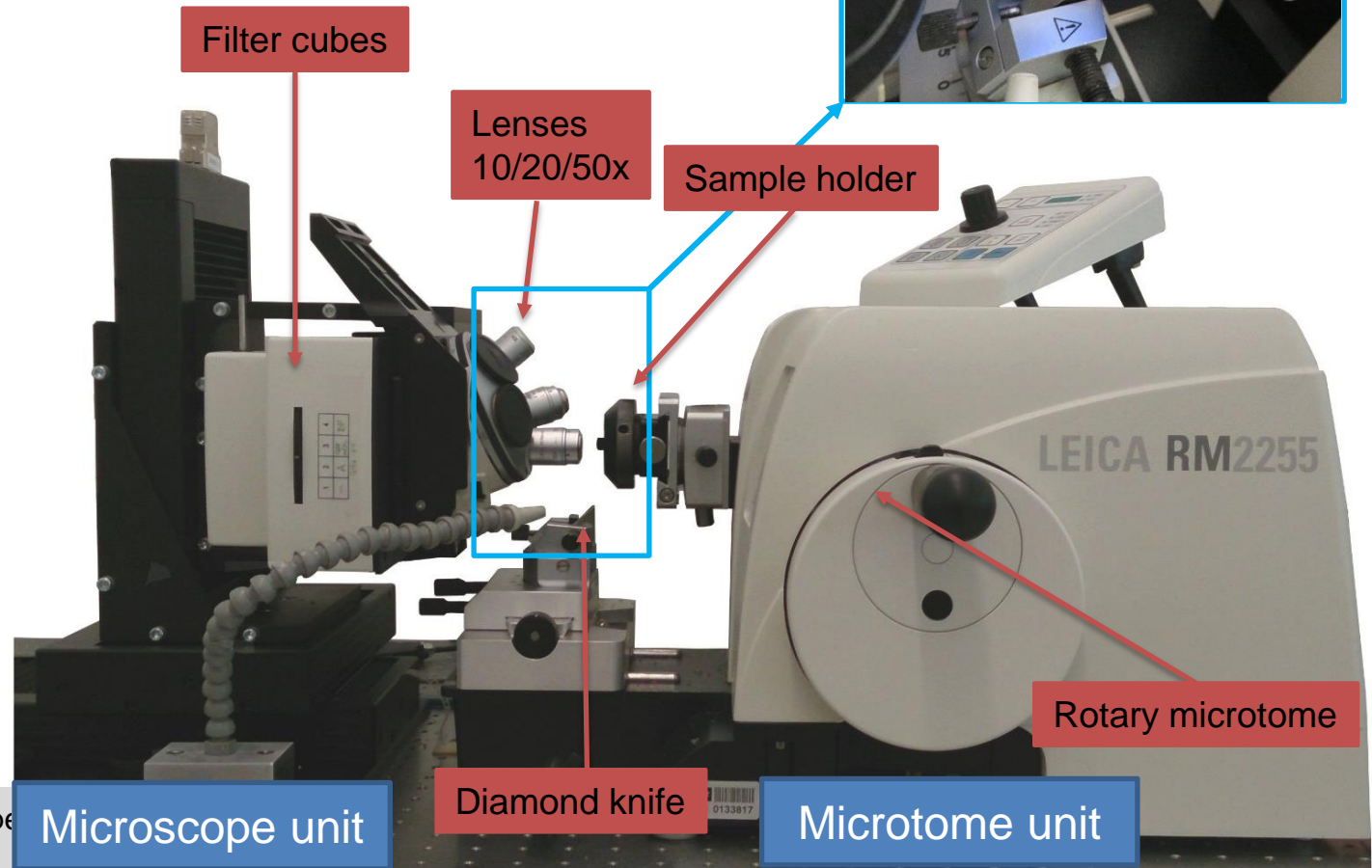
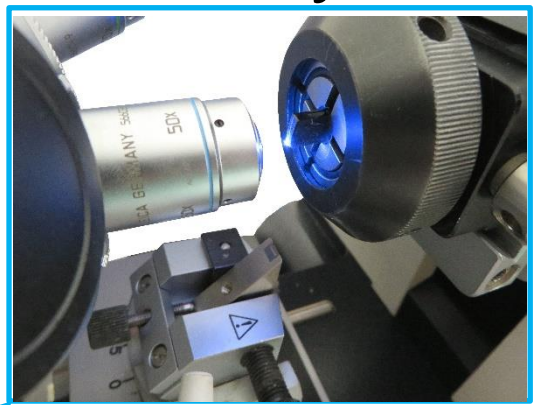
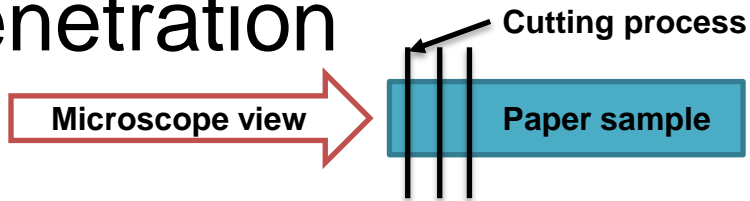
Latex

- Staining by adsorption into the latex particle with Rhodamine B



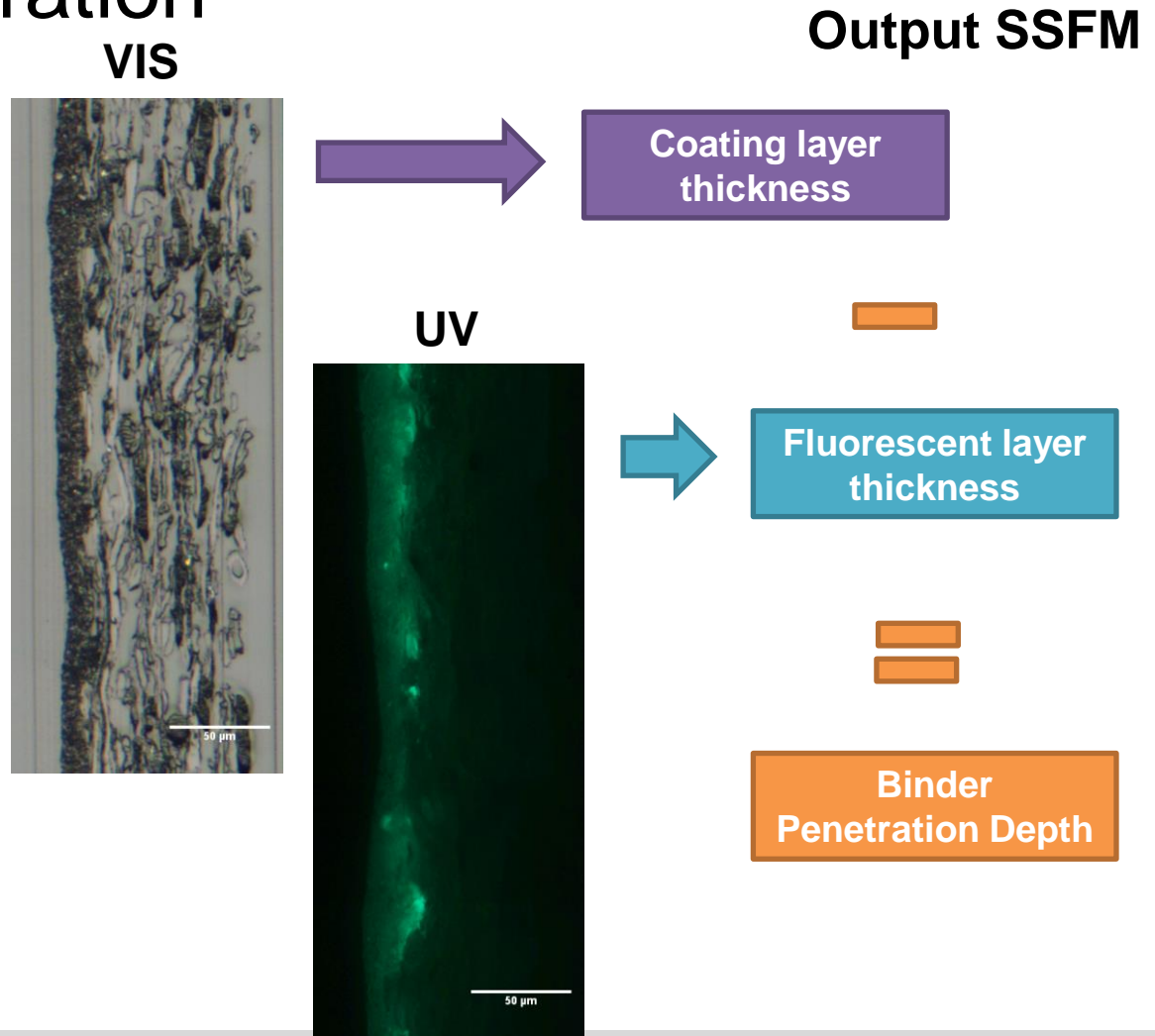
Establishment of a New Method to analyze Binder Penetration

- Staining the binder
- Coating
- Embedding
- Serial Sectioning
- Image Processing
- 3D Data Calculations



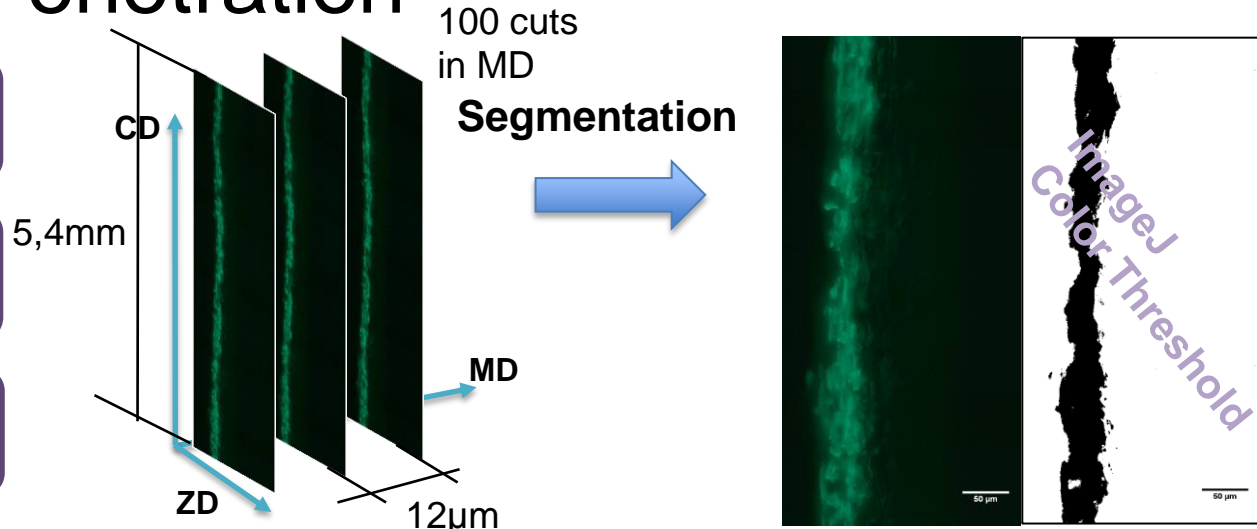
Establishment of a New Method to analyze Binder Penetration

- Staining the binder
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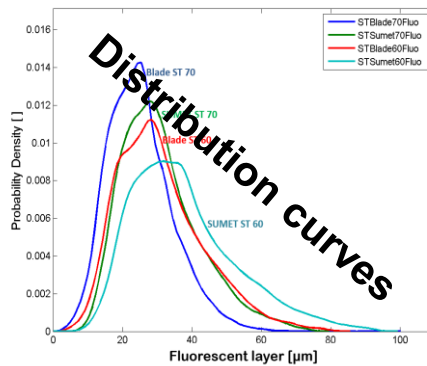


Establishment of a New Method to analyze Binder Penetration

- Staining the binder
- Coating
- Embedding
- Serial Sectioning
- Image Processing
- 3D Data Calculations



3D data evaluation



RESULTS



The Influence of *Base Paper Properties* on *Latex Penetration*

Coating Formulation

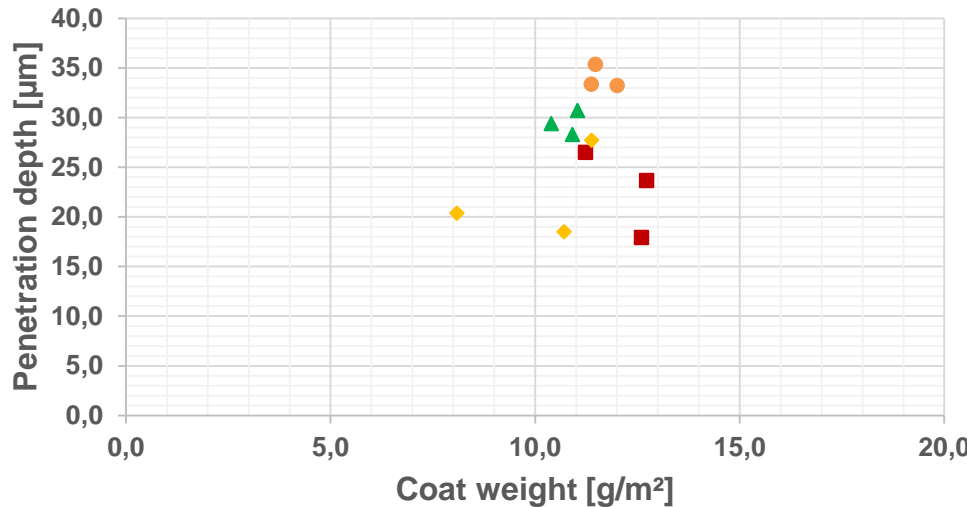
Recipe [%]	I	II	III
CaCO ₃	100	100	100
Latex stained	8	16	6
Starch			4
NaOH	set pH to 8,5	set pH to 8,5	set pH to 8,5
Target solids content	65	65	65

Base Paper Type

Base paper type	Pulp	Refining	Additive
A	Eucalyptus bleached	2000 PFI	-
B	Eucalyptus bleached	6000 PFI	-
C	Eucalyptus bleached	2000 PFI	20% filler (CaCO ₃) + Retention agent (Percol 8383)
D	Eucalyptus bleached	2000 PFI	Pre-Calendering – once each side per sheet (2000daN, room temperature)

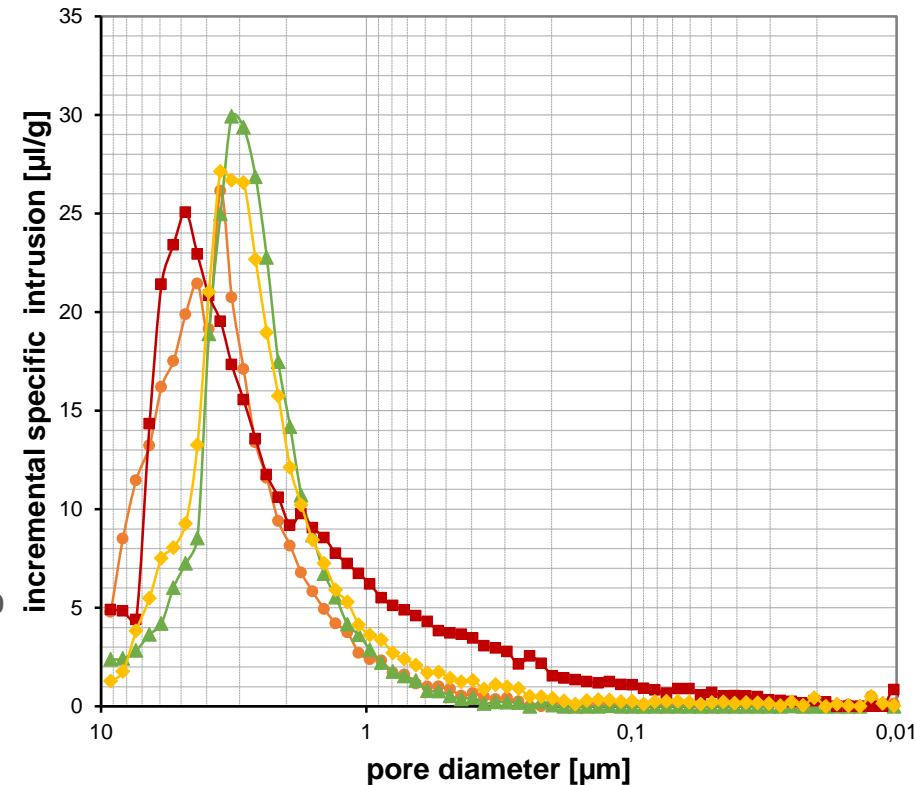
The Influence of *Base Paper Properties* on *Latex Penetration*

Results of SSFM



- Base Paper A ▲ Base Paper B ■ Base Paper C ◆ Base Paper D
- 2000rpm PFI ▲ 6000rpm PFI ■ 2000rpm PFI + filler ◆ 2000rpm PFI calendered

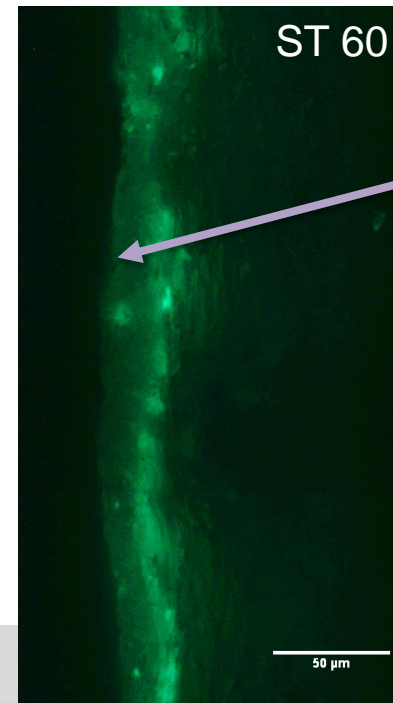
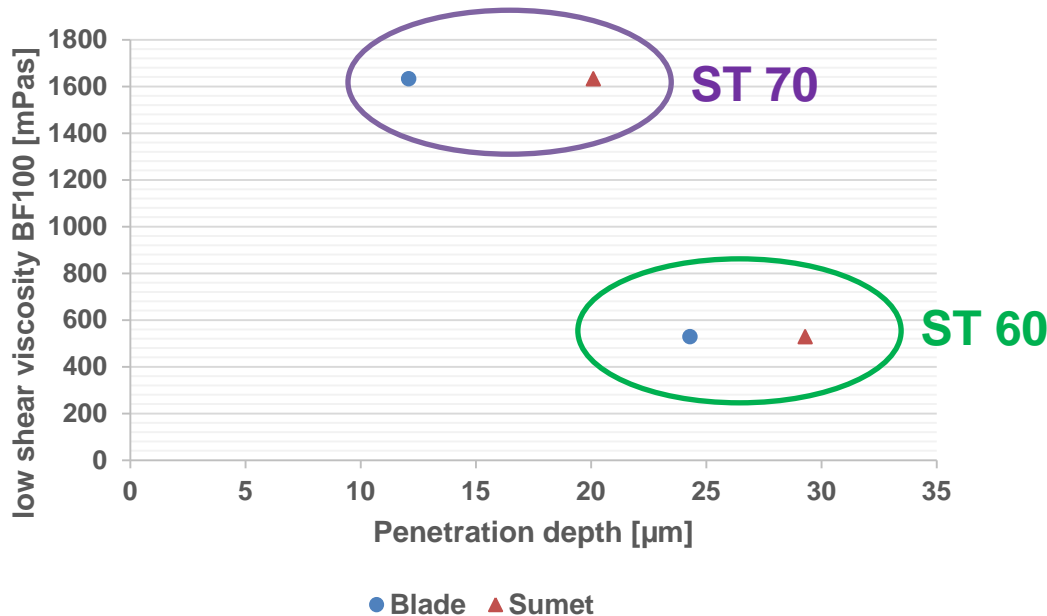
Mercury Porosimetry base paper



The Influence of *Solids Content* on *Starch* Penetration

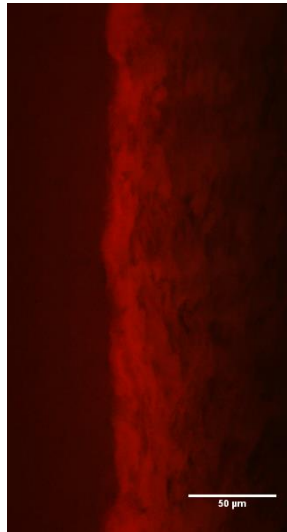
Coating Formulation

Recipe [%]	ST 70	ST 60
CaCO ₃	100	100
Latex	6	6
Starch	4	4
Thickener	0,1	0,1
NaOH	set pH to 8,5	set pH to 8,5
Target solids content	70	60

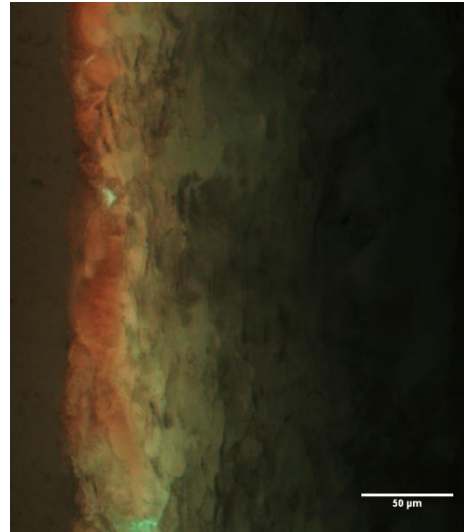


Depletion of starch at the coating surface

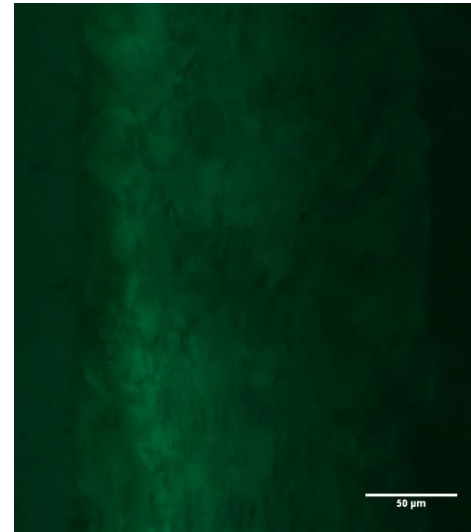
Double staining to localize *Latex* and *Starch*



Latex

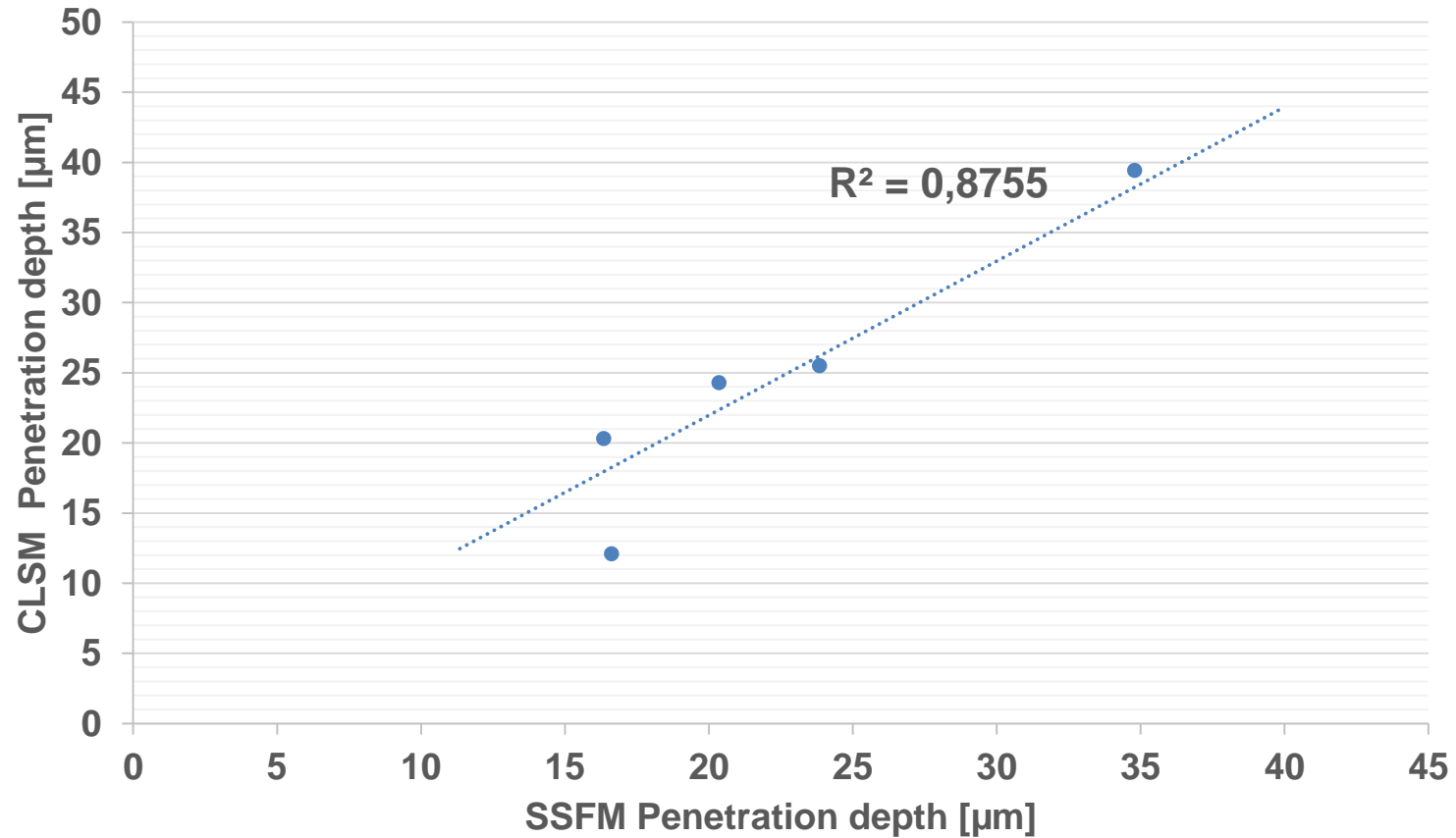


Latex + Starch



Starch

Evaluation of SSFM via CLSM



Conclusion and Outlook

- SSFM is an appropriate method to localize the binder after the coating process
- 3D-data evaluation can be performed and a mean penetration depth into the base paper can be calculated
- Staining procedure for starch and latex (most common coating binders) was developed
- Good correlation with CLSM
- Further influences on binder penetration can be tested

Thanks for the support of...



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Thank you for your attention!

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