# 51st International Annual Symposium DITP

On the wings of change

*Consistency, efficiency and performance: translating Lab insights into industrial value*

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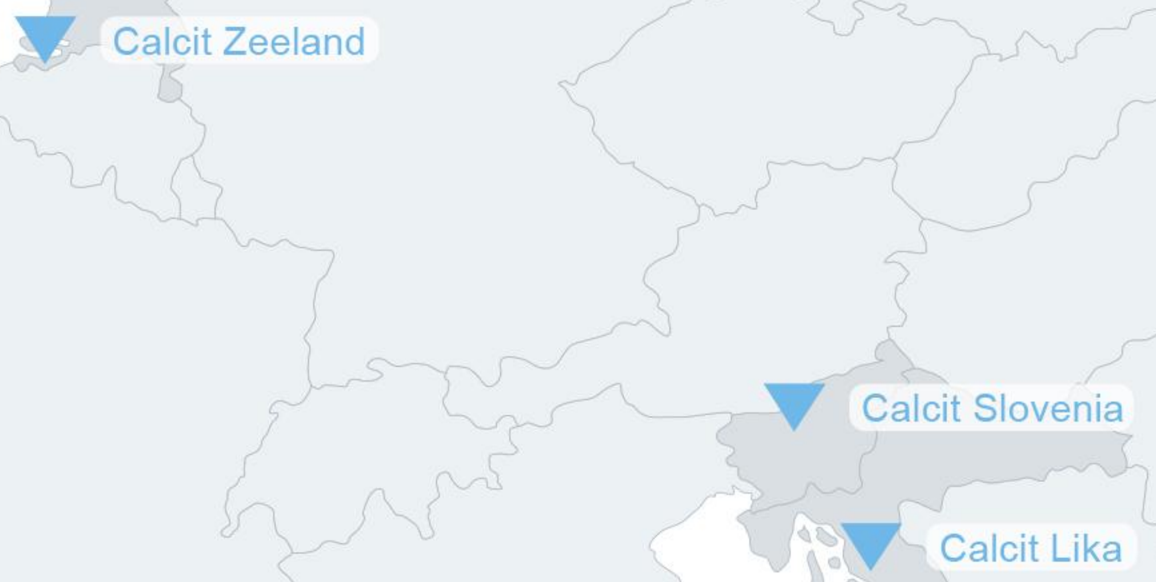
20.11.2025

CALCIT

Calcit is one of the leading producers of calcium carbonate pigments, functional additives and granulates on the European market.

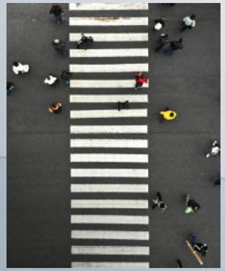
- > 300 employees
- Steady-growth and commitment
- Security of supply from 3 production sites
- Strategic position and lean concept for deliveries to central EU and Nordics




**~ 75% Paper & board**

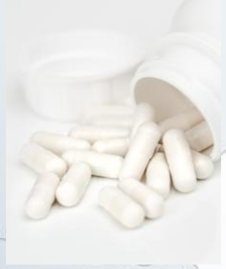
~ 18% Plastics, rubber & adhesives

Paints, coatings & plasters



Glass

Pharmacy



Construction

# **Challenges** of Central EU paper & board market

**High performance + Costs reduction**

- *High whiteness*
- *High opacity*
- *High surface coverage*
- *Lower drying costs*
- *Lower quality white fibers*
- *Reduction in grammage*

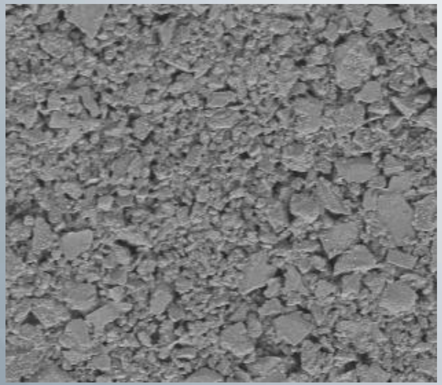
# **CoverCoat** – is a new range of calcium carbonate based mineral solutions for coated paper and boards

**Limestone with content of $CaCO_3$ > 99%**

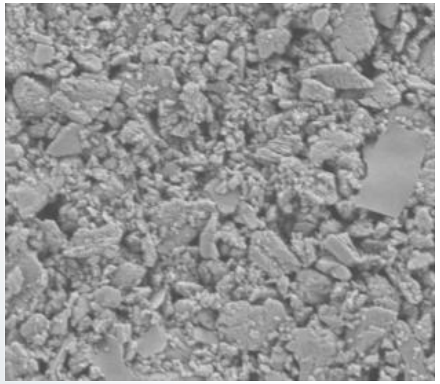
- No impurities, no graphite
- No flotation chemicals

Tailored production technology

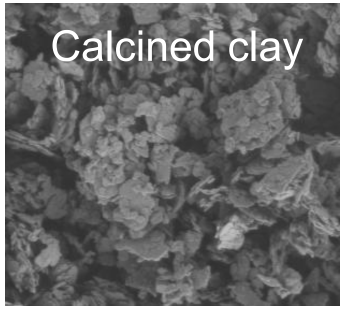
**WPSD HydroPlex**
Standard grades



**NPSD CoverPlex**
Special grades

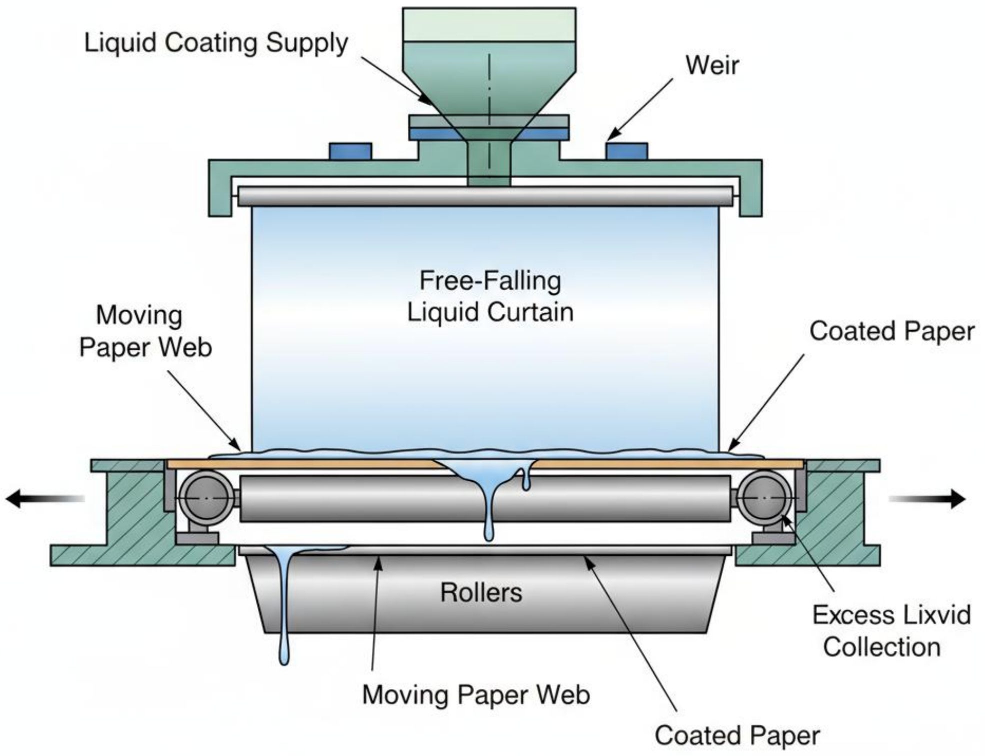


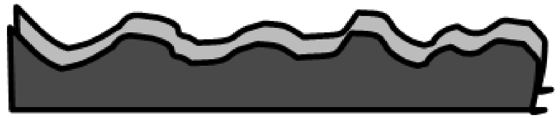
**CoverCoat**
Mineral grades
**GCC**
+

# Curtain coater process

- Non-impact and non-contact coating process
- High coating speed (100-2000 m/min)
- Contour coating → defect free coating surface
- Uniform coverage at low solids content and minimum coat weight
- Rheology and surface tension of the coating color are of great importance

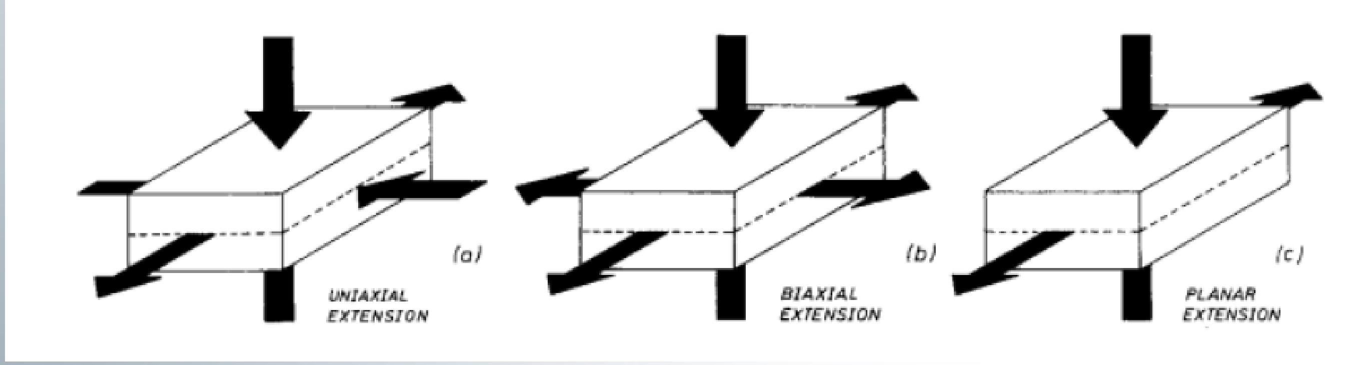


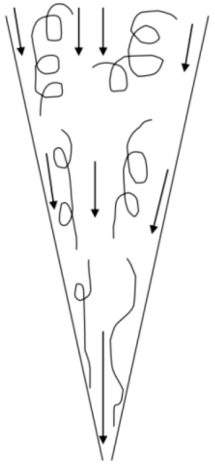



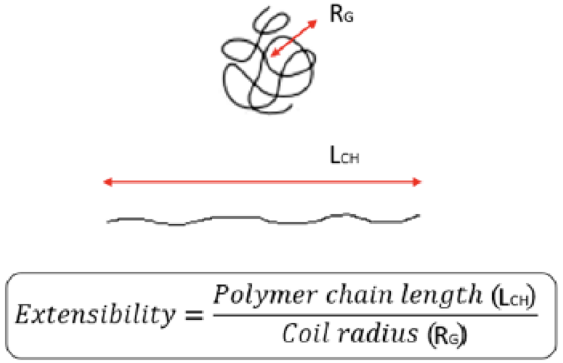
*Contour coating*

# Curtain coater process - Rheology

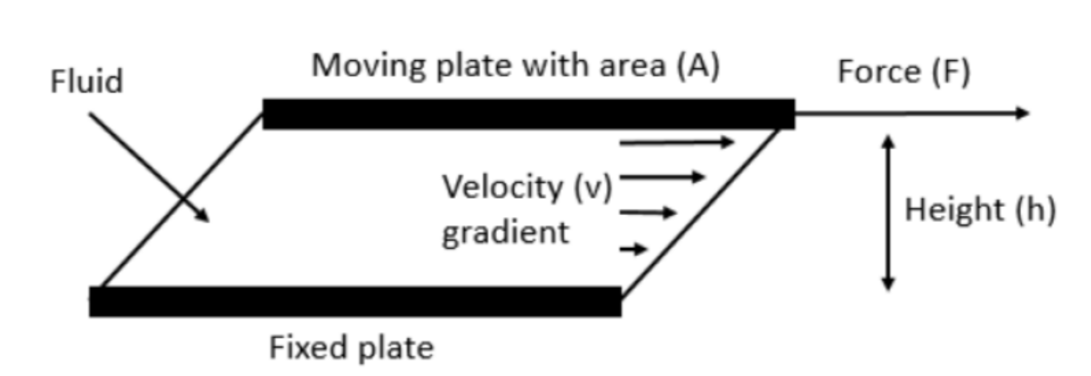
***Extensional viscosity*** - is a fluid's resistance to extension (elongation) – is caused by the uncoiling of high Mw polymers.






***Shear viscosity*** - is a fluid's resistance to motion (shear).




LEHTIMÄKI, WATTI, et al. "Measurement and control of extensional viscosity in barrier coating dispersions." *TAPPI JOURNAL* 22.11 (2023).

# Curtain coater process - Rheology

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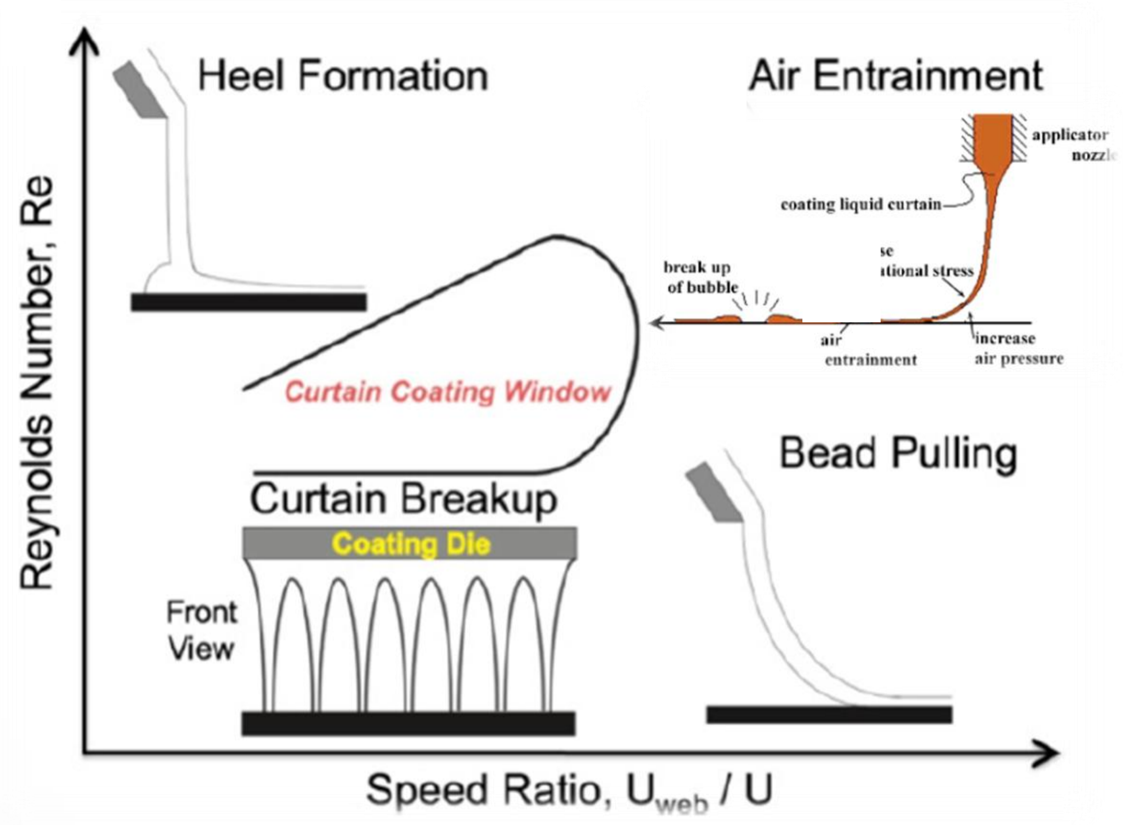
**Main issues in curtain coater process**





Schoenfelder, Samantha Leigh. "The Modification of a Curtain Coating Formulation: A Study of Rheology and Surface Tension, and Their Effect on Pitting." (2017)
Schröder, Andreas. "Extensional viscosity of curtain coating colors evaluated as Euler number." (2023).
Yang, Arthas, et al. "Role of extensional viscosity in paper coating." *Applied Rheology* 21.2 (2011): 23607.

# Curtain coater process - Rheology

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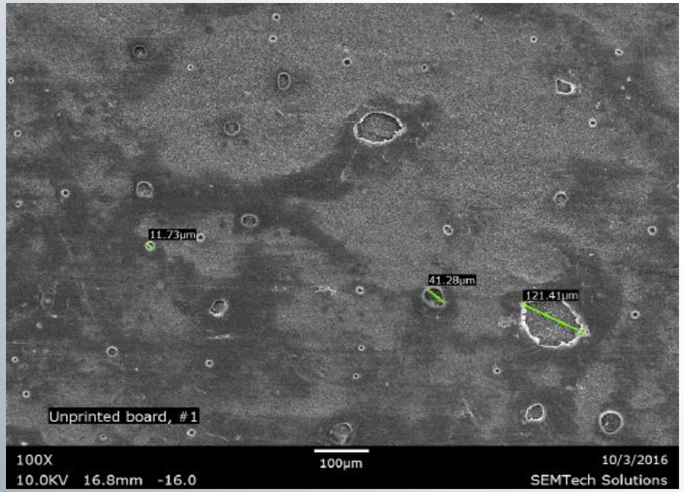
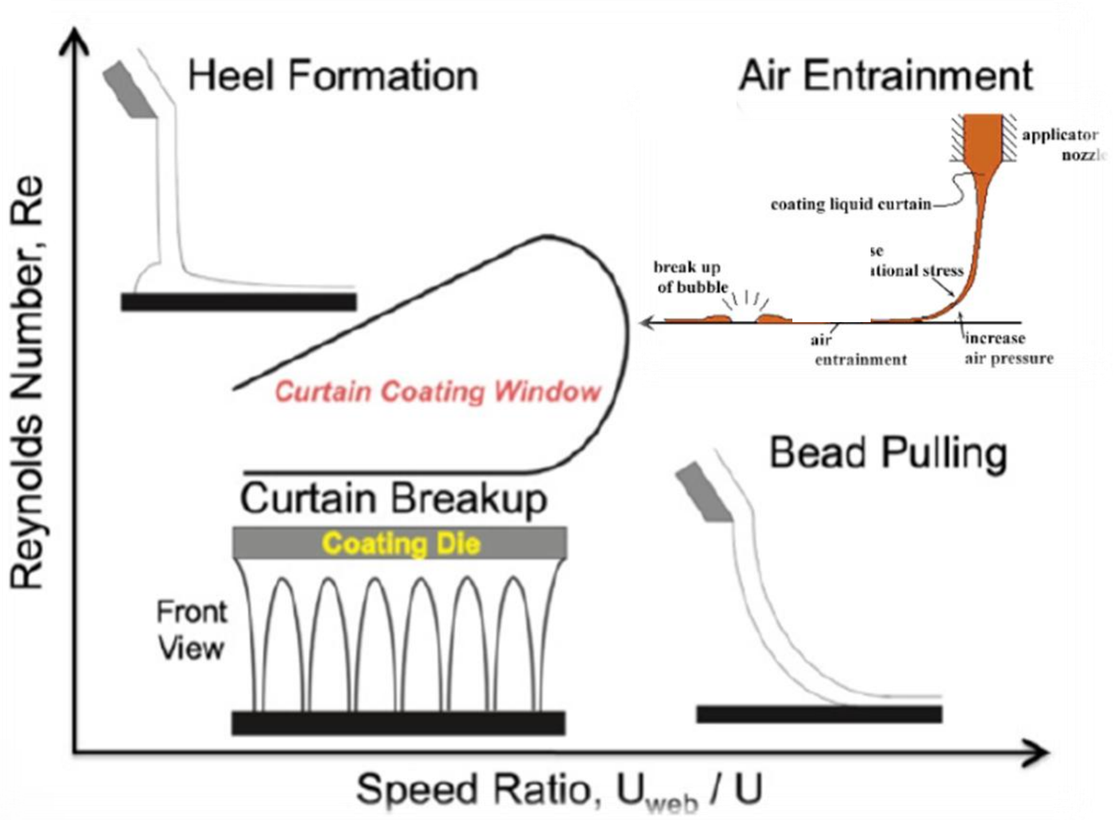
### Air entrainment




Low VE causes the air entrapment by literally pulling the air underneath the coating

### Main issues in curtain coater process

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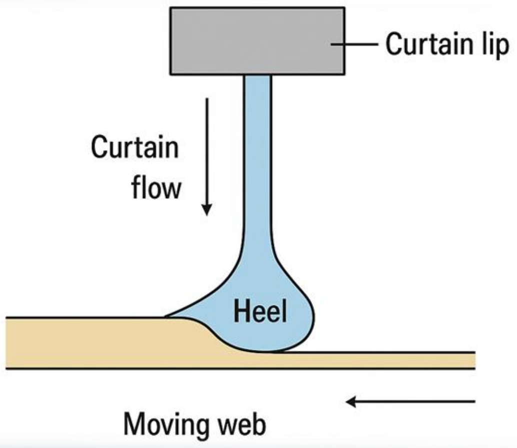
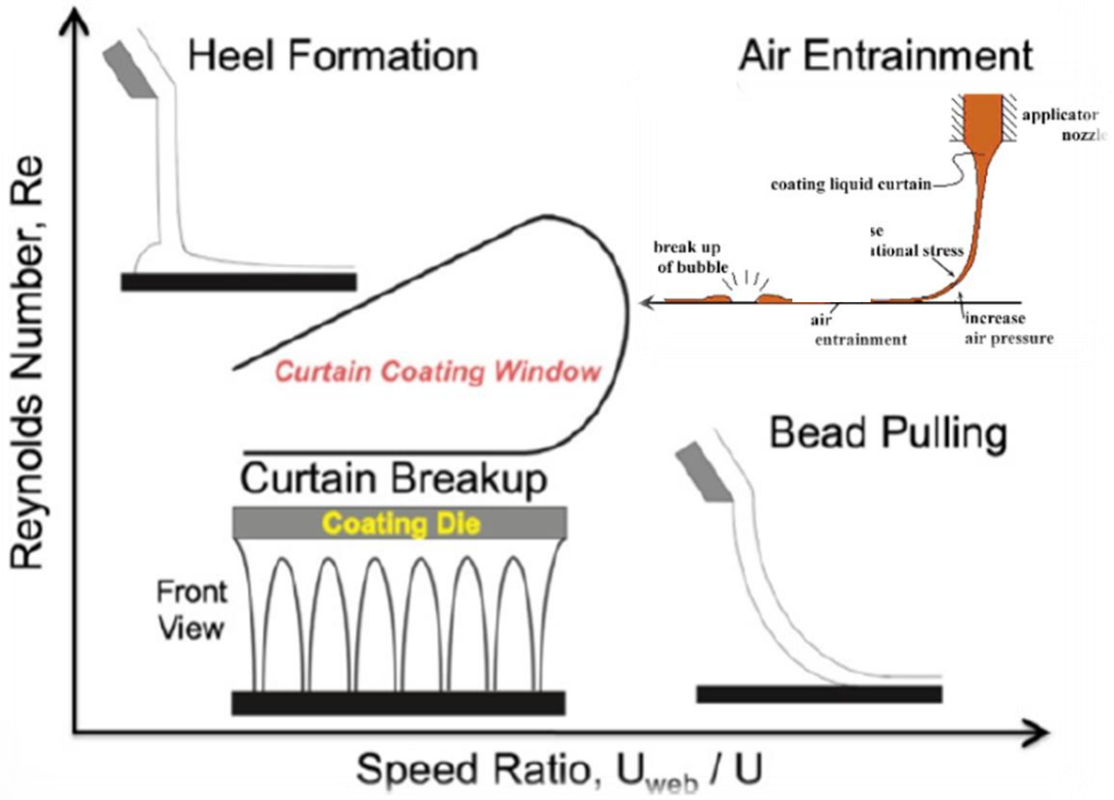
# Curtain coater process - Rheology

### Heel formation




Not proper extensional viscosity (usually too low) causes a heel formation

### Main issues in curtain coater process

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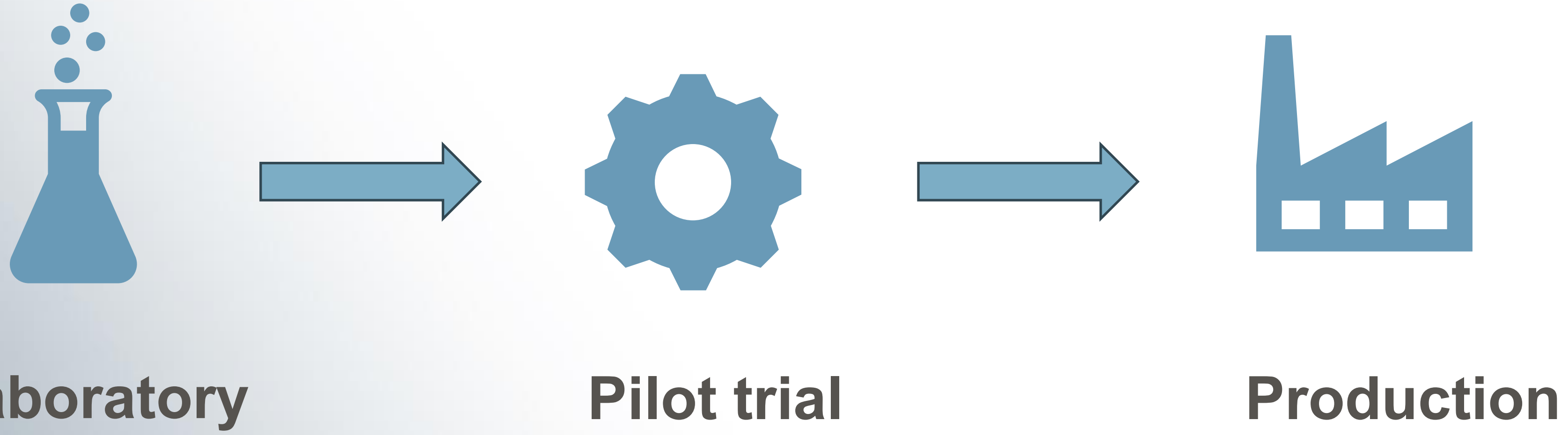
# **Calcit** approach for ensuring safe pigment implementation and process stability




*Structured approach—from laboratory testing to pilot trials and full production—ensures a reliable and risk-mitigated implementation of new pigments tailored to our customer's needs.*

Case study: Implementing the pigment in the Curtain Coater

**Laboratory scale**

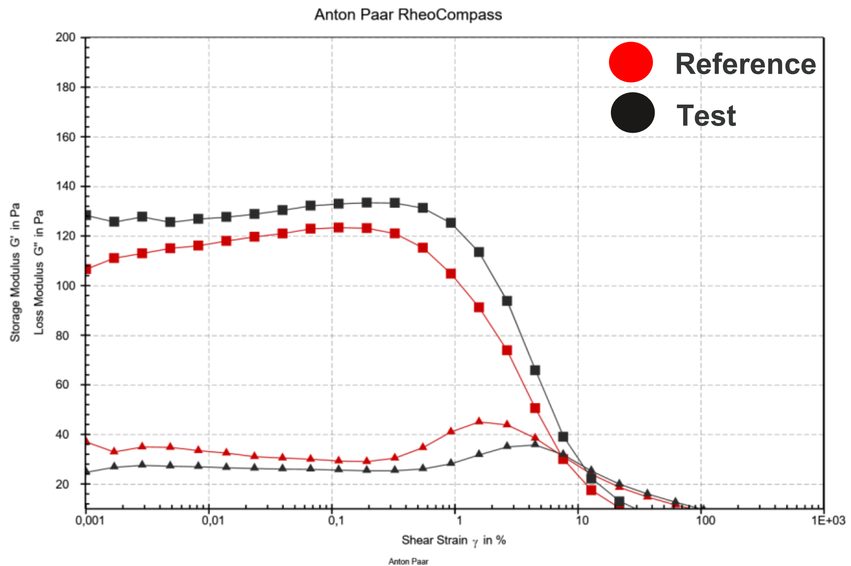
# Implementing the pigment in the Curtain Coater

## Laboratory scale

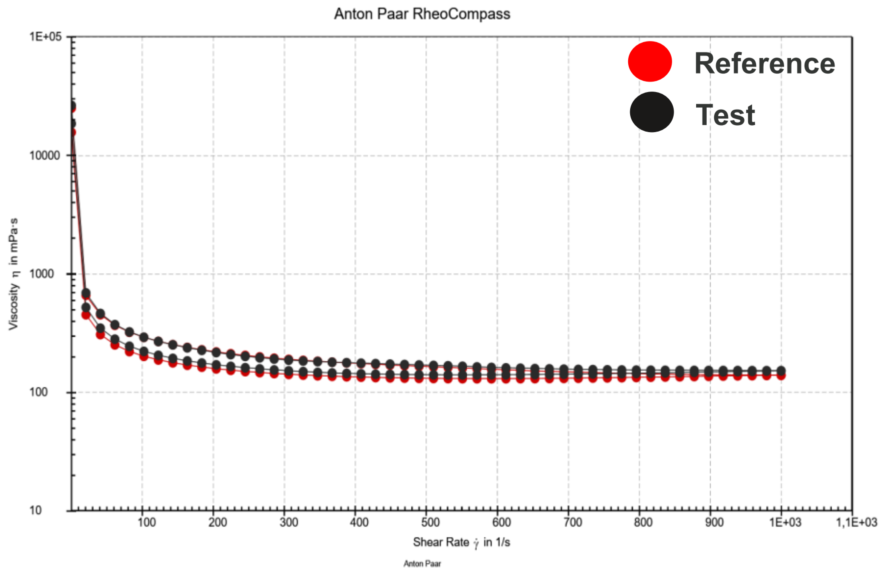
Table 1. Starting characterization of the pre-coat formulation

| | Reference<br>70%Pigment 1 + 30% Pigment 2 | Test<br>70% CoverCoat TP5 + 30% Pigment 2 |
|---|---|---|
| **pH** | 8,9 | |
| **Solid content [%]** | 64,9 | 65 |
| **Viscosity [mPa*s]** | 496 | 522 |
| **Water ret. [g/m$^2$]** | 114 | 121 |

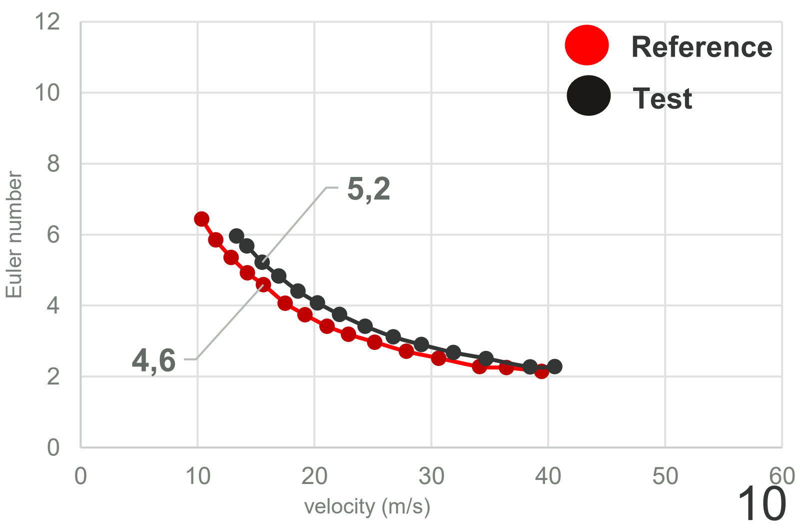
Amplitude sweep measurement




Flow curve measurement




Orifice measurement



# Implementing the pigment in the Curtain Coater

## Laboratory scale

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Table 2. Optical properties of coated papers

| Laboratory tests | | |
|---|---|---|
| **Sample** | **Reference** | **Test** |
| | **70%Pigment 1 + 30% Pigment 2** | **70% CoverCoat TP5 + 30% Pigment 2** |
| | **Brightness R457 [%]** | |
| **Base paper** | 57,4 | 57,1 |
| **+ Precoat** | 74,0 | 74,6 |
| **+ Top-coat** | 83,3 | 84,9 |
| | / | **+1,6** |

*Coating in the laboratory using* ***RKK laboratory sheet coater***

↓

*Low shear rates matching the range of applications of the curtain coater shear.*

**Exchange of pigment 1 to 1 on laboratory scale:**

- comparable viscoelasticity
- proper extensional viscosity
- higher brightness R457 vs reference

## Case study: Implementing the pigment in the Curtain Coater

# **Pilot trial**

# Implementing the pigment in the Curtain Coater

## Pilot trial

Table 3. Optical properties of coated paper form BASF pilot trials

| Pilot trial | | |
|---|---|---|
| **Sample** | **Reference** | **Test** |
| | **70% Pigment 1 + 30% Pigment 2** | **70%CoverCoat TP5 + 30% Pigment 2** |
| **pH** | 9,1 | 8,9 |
| **Solid content [%]** | 64,9 | 63,0 |
| **Viscosity [mPa*s]** | 460 | 540 |
| | **Brightness R457 [%]** | |
| **Base paper** | 48,5 | 49,4 |
| **+ Precoat** | 74,4 | 77,9 |
| **+ Top-coat** | 83,7 | 86,1 |
| | / | **+2,4** |

**Exchange of pigment 1 to 1 on pilot curtain coater:**

- consistent rheology
- proper extensional viscosity
- for more than 2,4% higher brightness R457 vs reference

Case study: Implementing the pigment in the Curtain Coater

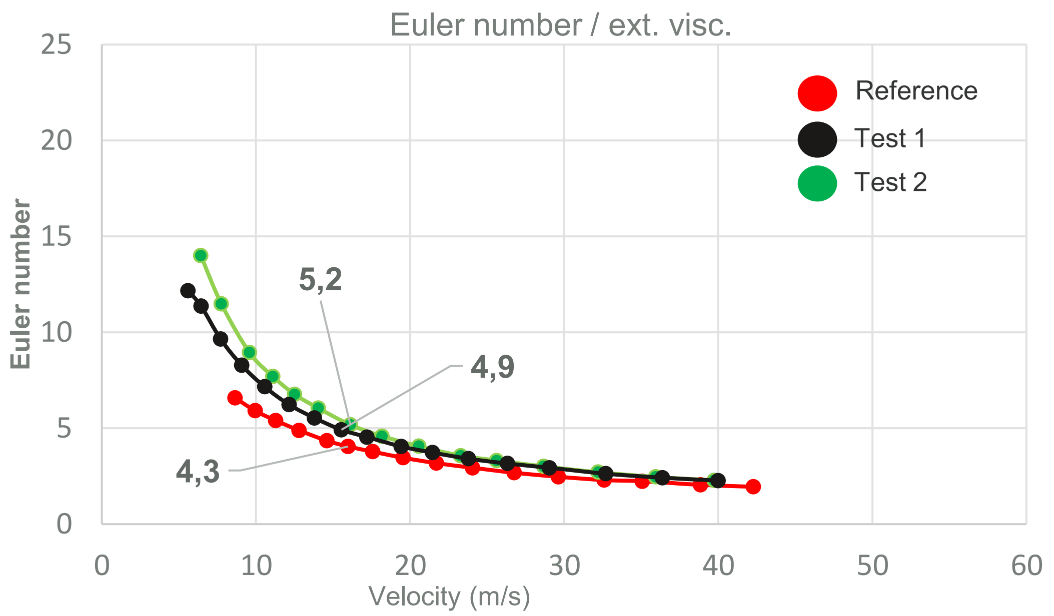
**Production trial**

# Implementing the pigment in the Curtain Coater

## Production trial

Table 4. Optical properties of coated paper form production trial

| Production trial | | | |
|---|---|---|---|
| **Sample** | **Reference** | **Test 1** | **Test 2** |
| | **70%Pigment 1 + 30% Pigment 2** | **70%CoverCoat TP5 + 30% Pigment 2** | **90%CoverCoat TP5 + 10% Pigment 2** |
| | | **Brightness R457 [%]** | |
| **Base paper** | 44,6 | 44,7 | 44,6 |
| **+ Precoat** | 77,8 | 79,5 | 80,4 |
| **+ Top-coat** | 85,7 | 87,2 | 88,3 |
| | / | **+1,5** | **+2,6** |




**Exchange of pigment 1 to 1**

- consistent rheology
- stable runnability on the machine
- stable production process
- for more than **2,6%** higher brightness R457 vs reference

**Cost Reduction potential**

# CONCLUSIONS

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- Understanding extensional viscosity and viscoelastic behavior is crucial for achieving a stable and defect-free curtain in curtain coater application
- By combining Euler number measurements and RKK laboratory coating tests, it is possible to reliably predict coating behavior before moving to pilot and production scale.
- A structured approach—from laboratory testing through pilot trials to production—secures safe pigment implementation and minimizes risks in industrial processes.
- Consistent results across laboratory, pilot, and industrial trials confirm that pigment and formulation approaches can be reliably scaled, supporting stable performance in high-speed curtain coating.

# Thank you for your attention!