# How to introduce Silfit Z 91 into latex thread applications as partial replacement for titanium dioxide

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# Contents

- Introduction
- Experimental
- Results
  - Titanium dioxide slurry related
  - Performance of titanium dioxide slurry in NR-Latex
- Summary

# Status Quo



Addition of calcined clays as a slurry to white pigmented latex for titanium dioxide extension is often found in the industry. The calcined clay slurry production requires a lot of time-consuming effort, often causing problems in rheology and sedimentation stability.

The properties of the Calcined Neuburg Siliceous Earth grade Silfit Z 91 can be characterized by

- High brightness
- High color neutrality
- Low particle size
- Very low sieve residues
- Excellent dispersion properties
- Improved pigment dispersion by „spacer-effect“ likewise exploiting this effect for partial $TiO_2$ replacement which offers itself as an alternative to calcined clay with new capabilities.

# Objective



Exploiting the unique property profile of Silfit Z 91 as a partial replacement of titanium dioxide in **a direct addition process into the titanium dioxide slurry** for latex threads, thus avoiding the effort of preparing a separate slurry as done with regular calcined clay.

# Filler, Characteristics



| Calcined Neuburg Siliceous Earth | | Silfit Z 91 |
|---|---|---|
| Color L* | | 95 |
| Color a* | | -0.1 |
| Color b* | | 1 |
| Particle size $d_{50}$ | [µm] | 2.0 |
| Particle size $d_{97}$ | [µm] | 10 |
| Oil absorption | [g/100g] | 55 |
| Sieve residue >40 µm | [mg/kg] | 10 |
| Specific surface area BET | [$m^2/g$] | 7.0 |
| Density | [$g/cm^3$] | 2.6 |

# Formulation of $TiO_2$ Slurries



| | Control $TiO_2$ Slurry | 10 % $TiO_2$ replaced by Silfit Z 91 | 20 % $TiO_2$ replaced by Silfit Z 91 |
|---|---|---|---|
| Water demineralized | 27.5 | 27.5 | 27.5 |
| DMA (40% in water) | 2.5 | 2.5 | 2.5 |
| Titanium dioxide, Anatas (Kronos 1001) | 70 | 63 | 56 |
| Silfit Z 91 | - | 7 | 14 |
| **Total** | **100 %** | **100 %** | **100 %** |

# Preparation of $TiO_2$ Slurries

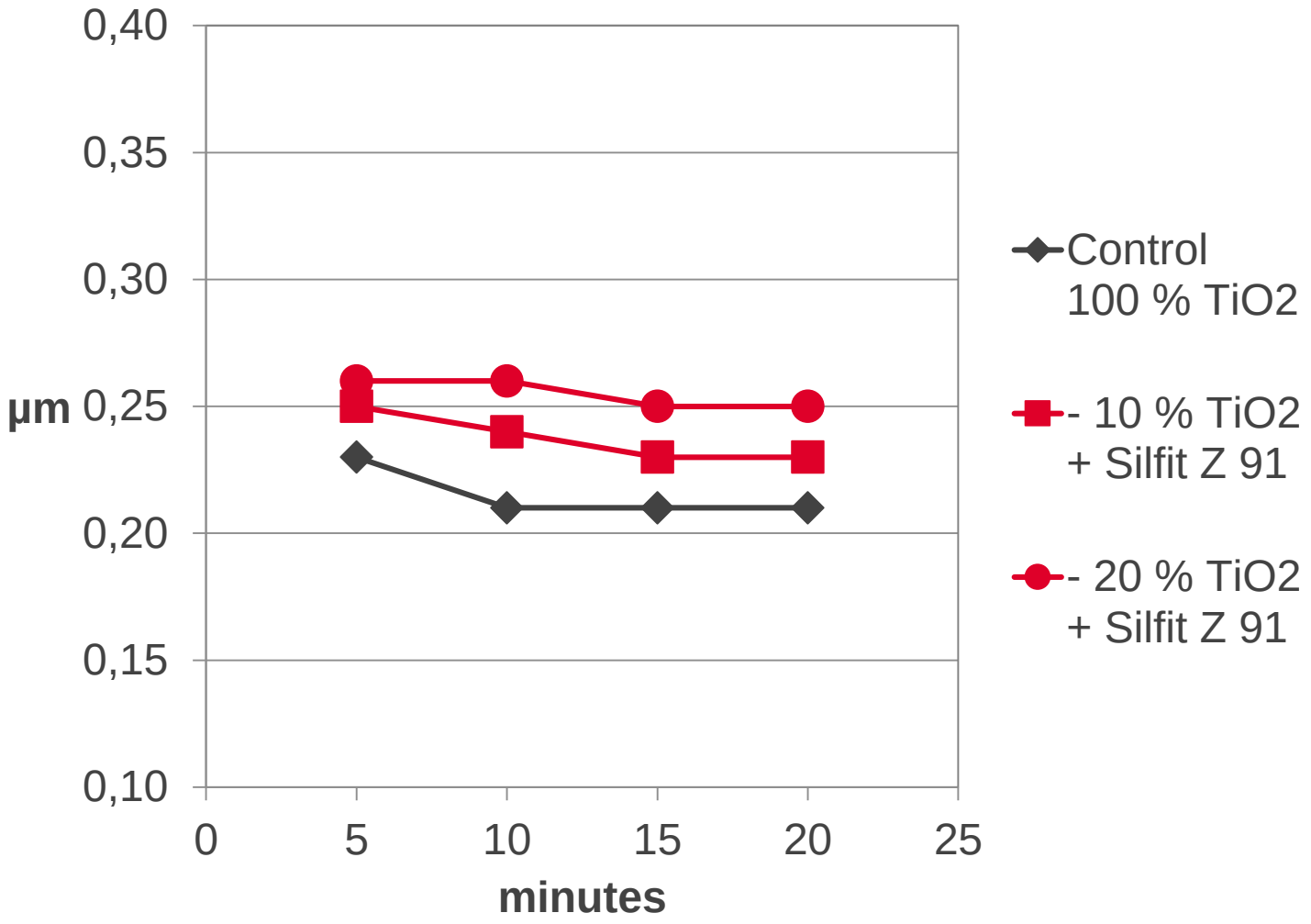


| | |
|---|---|
| Batch size | • Total quantity 500 g |
| Mixing and Dispersing<br>  <br>  <br>source VMA-Getzmann | • Premixing of water and DMA with dissolver equipped with<br>• smooth teflon disc 7.5 cm ∅ in<br>• 1 litre stainless steel vessel 10.5 cm internal ∅ (APS 1000, VMA-Getzmann)<br>• Addition of $TiO_2$ or $TiO_2$ + Silfit respectively<br>• Addition of 400 ml glass beads (2 mm ∅)<br>• Grinding at 2000 rpm (= 7.9 m/s tip speed) under water cooling of vessel<br>• Grinding time 5, 10, 15, 20 minutes |

# Titanium dioxide slurry related

# Mean Particle Size $d_{50}$ vs. Grinding Time





# Top Cut Particle Size $d_{97}$ vs. Grinding Time

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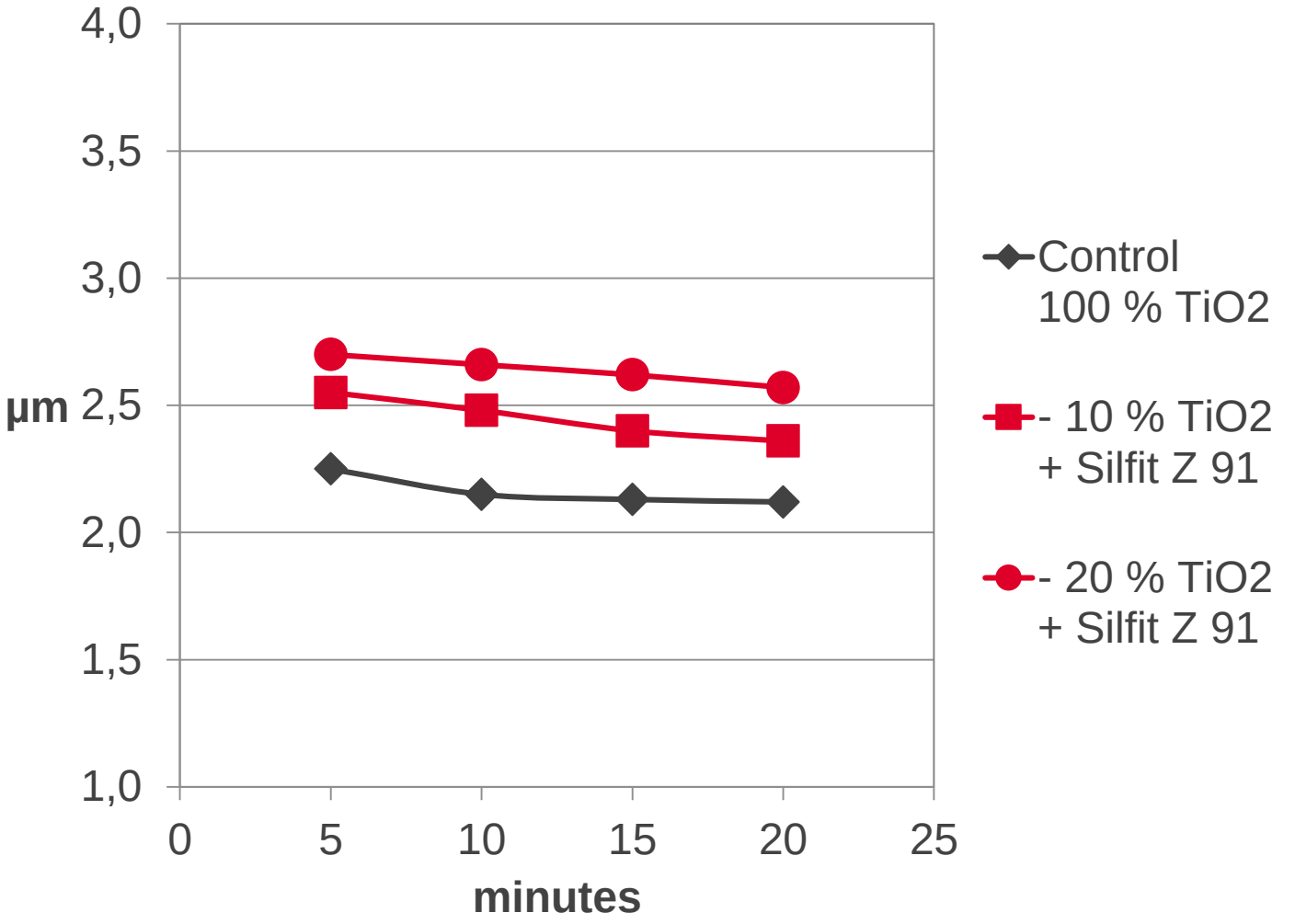
INTRODUCTION

EXPERIMENTAL

RESULTS

- Titanium dioxide related

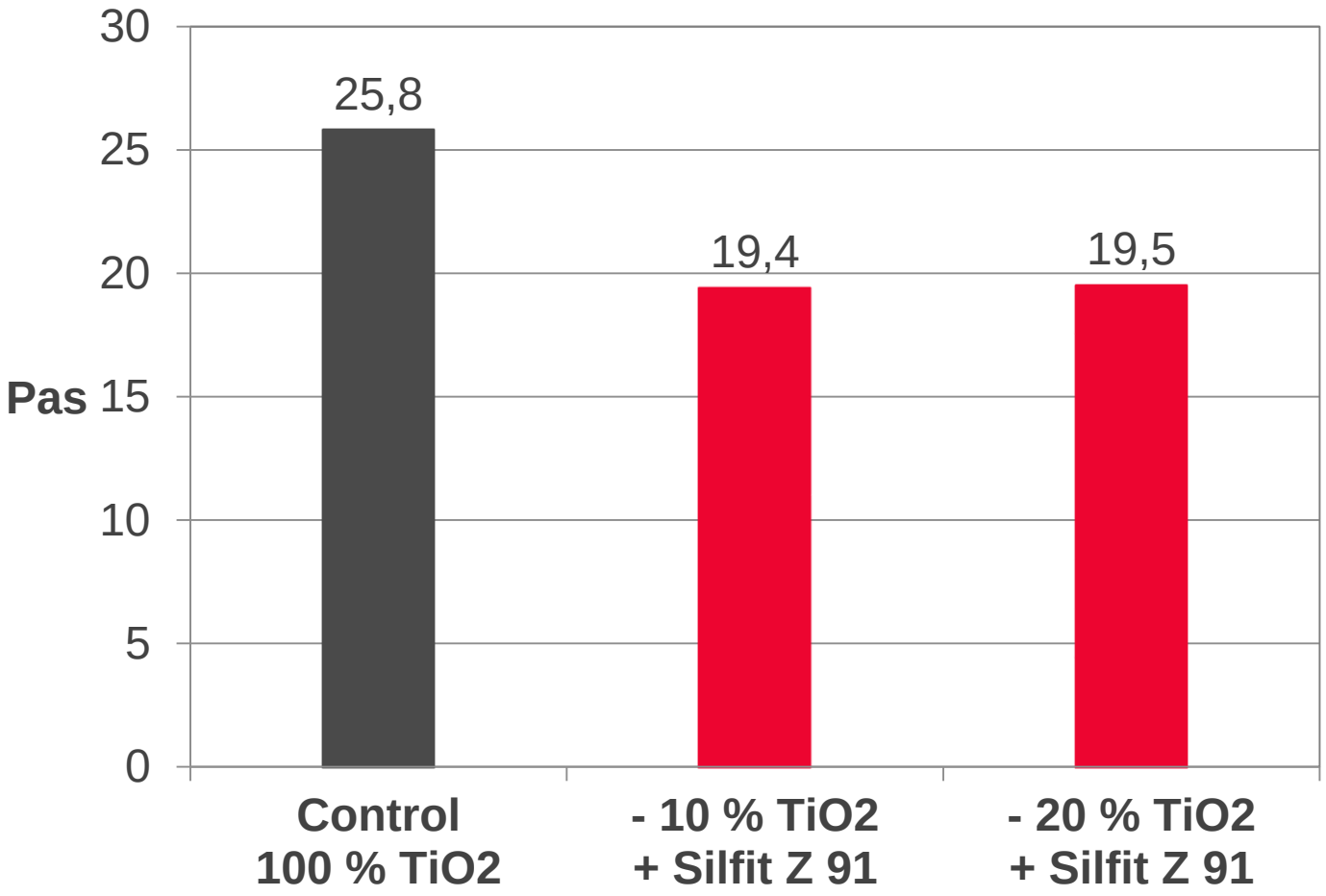
SUMMARY



# All following results are based on 20 minutes grinding time

# Viscosity at Low Shear Speed 0.1 $s^{-1}$





# Viscosity at High Shear Speed 1000 $s^{-1}$

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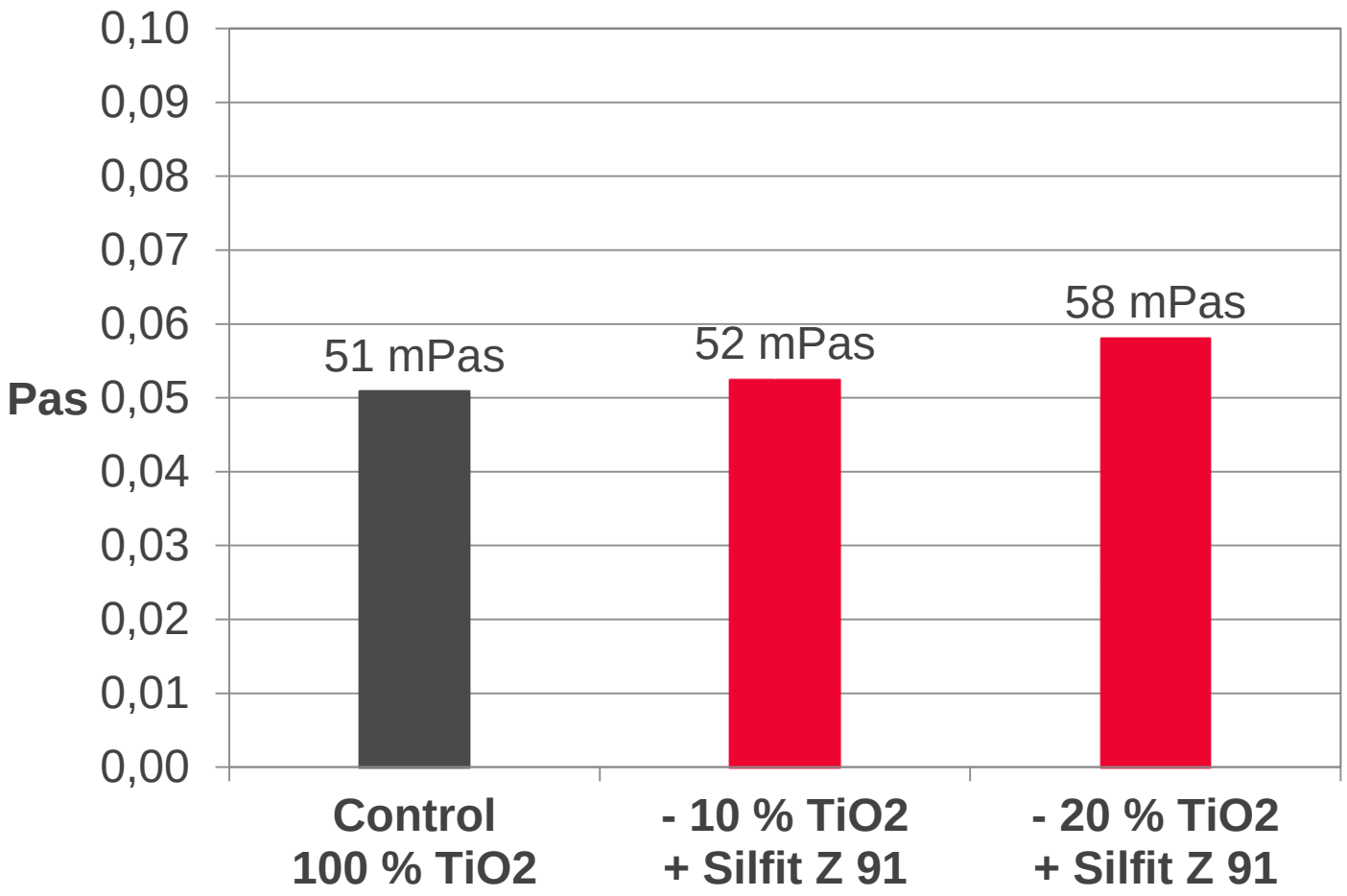
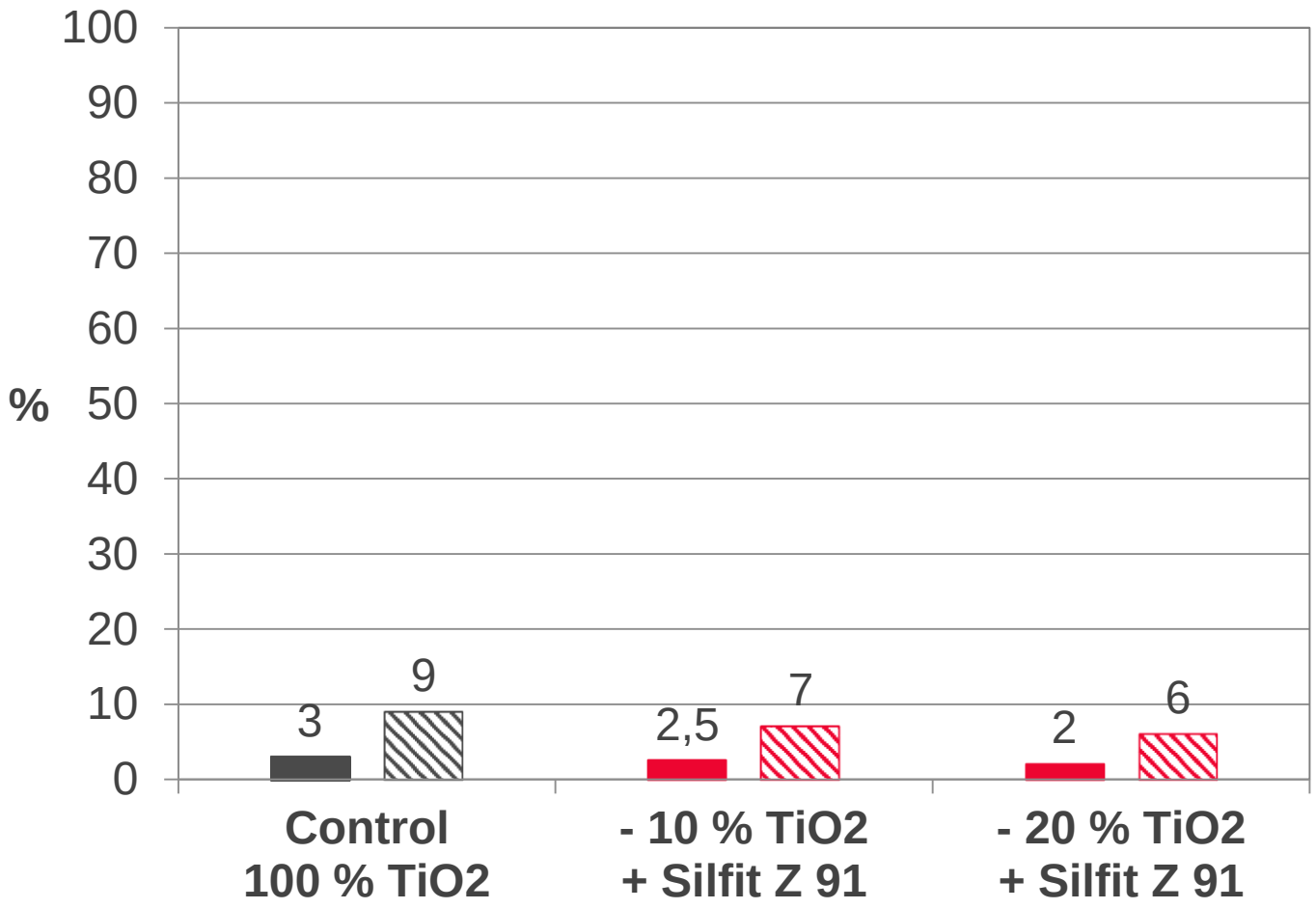


# Supernatand (Clear Phase) after 7 days / 19 days





# Sediment
# after 7 days / 19 days

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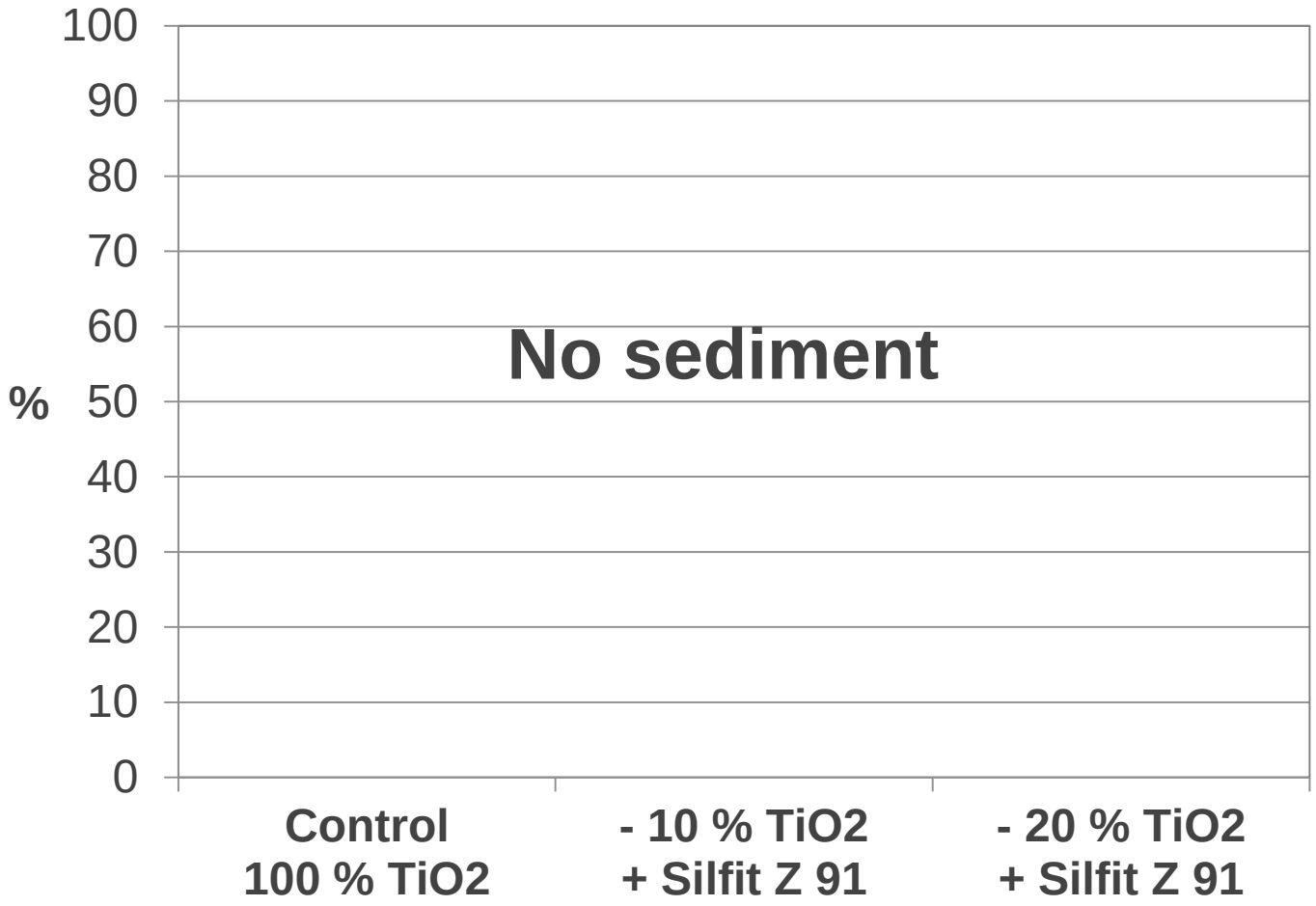


# Performance of $TiO_2$ Slurry in NR-Latex batch

# Formulation of the Latex batch with $TiO_2$ Slurry



| | All formulations |
|---|---|
| NR-latex, 60 % solids, low ammonia | 70 |
| $TiO_2$-Slurry | 30 |
| **Total** | **100 %** |

# Preparation of the Latex Batch with $TiO_2$ Slurry



| | |
|---|---|
| Batch size: | 100 g |
| Beaker height: | 7 cm |
| Beaker diameter: | 5 cm |
| Stirrer: | three blade propeller type, diameter 4 cm |
| Stirrer velocity: | 550 rpm during addition of $TiO_2$-Slurry for 3 min |
| | 750 rpm for homogenation/mixing for 10 min |

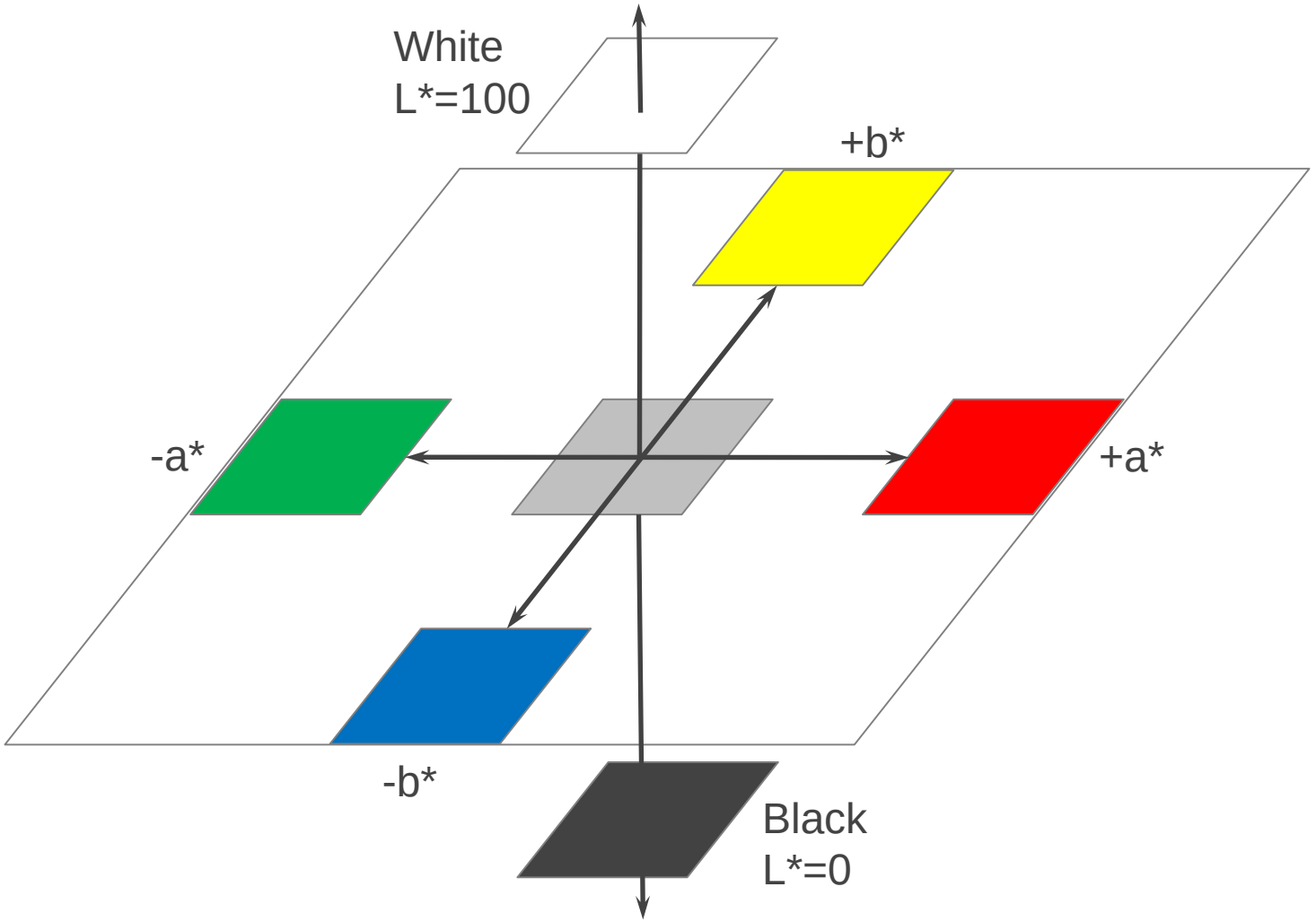
# Preparation of Films



- Applying the latex batch on contrast boards (checkerboard style) with a 4 sided film applicator
- Let dry for 18 h
- Measure dry film thickness, color, opacity

# Color
# CIE-LAB System





# Color L* (Brightness)

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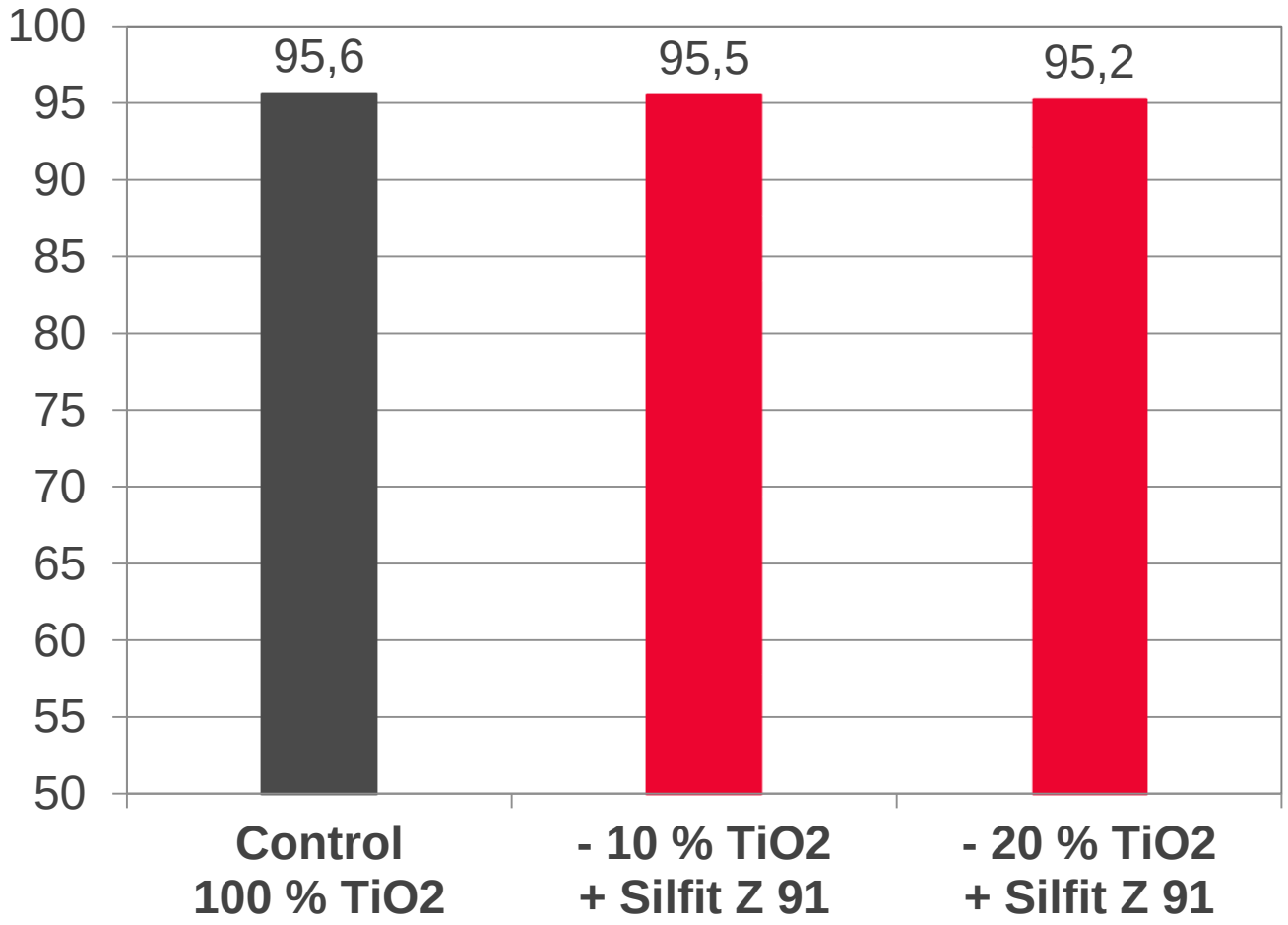
Dry film thickness 210 to 220 µm

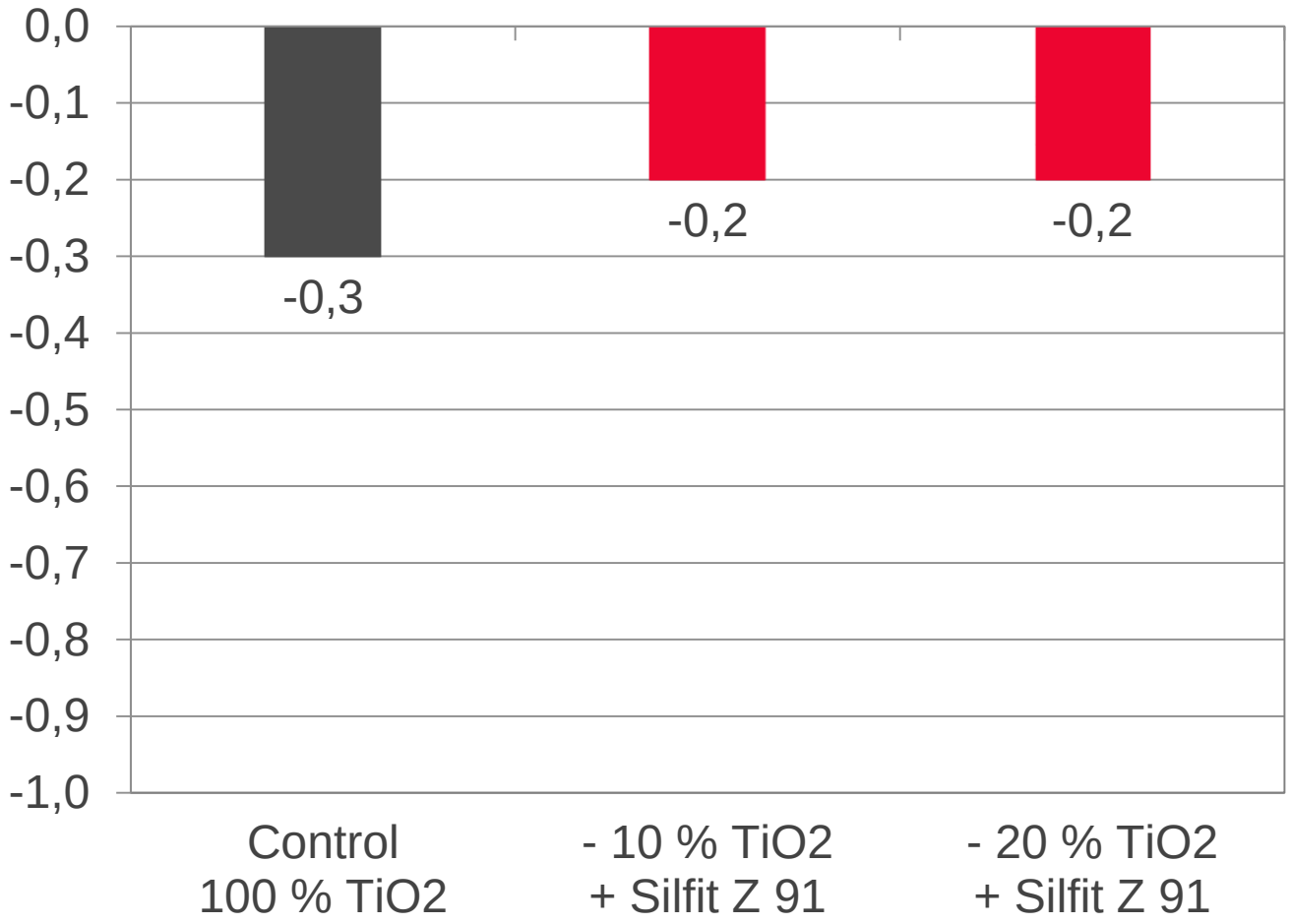




# Color a* (Red/Green)

Dry film thickness 210 to 220 µm

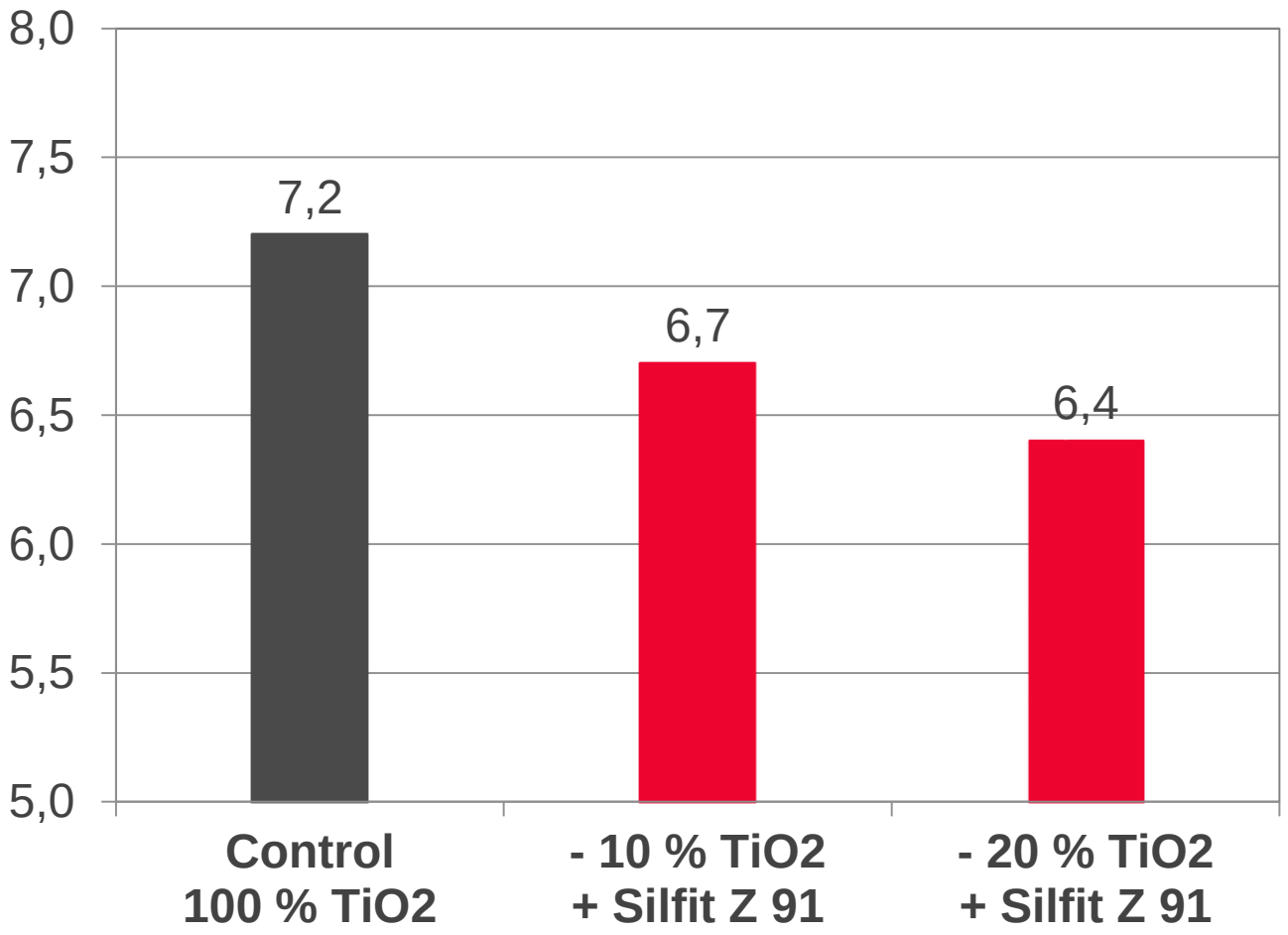




# Color b* (Yellowness)

Dry film thickness 210 to 220 µm

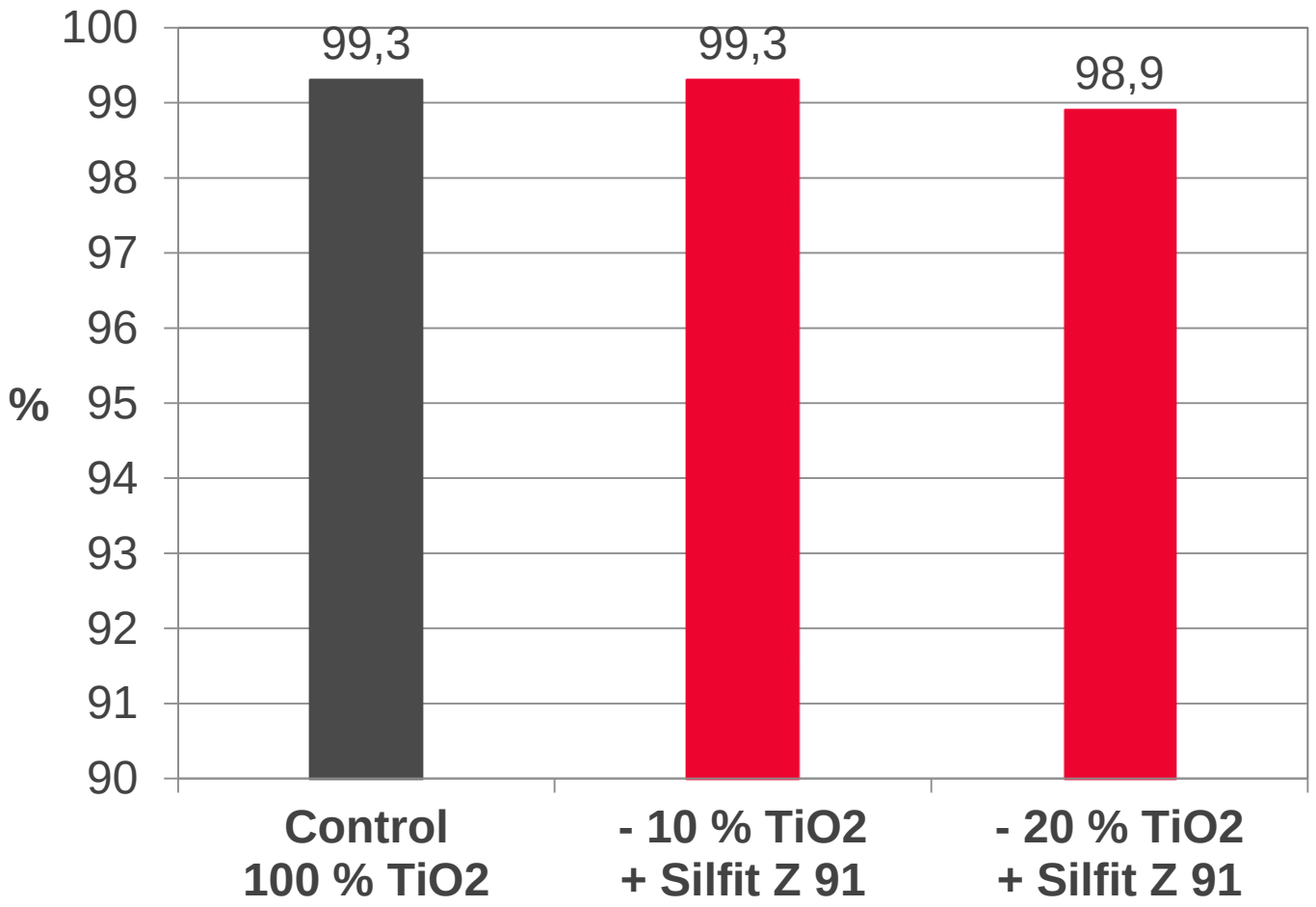




# Performance of Slurry in Latex, Opacity

Dry film thickness 210 to 220 µm





# Conclusion



The replacement of 10 to 20 % of titanium dioxide by Silfit Z 91 results in:

- ✓ Retained features
  - ✓ dispersion
  - ✓ viscosity
  - ✓ sedimentation
  - ✓ color
  - ✓ Opacity
- \+ Improved features
  - \+ tremendous reduction of effort due to no preparation of separate slurry
  - \+ reduction of yellow tint of the pigmented latex
  - \+ cost reduction

# We supply material for good ideas!

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