

# NANOMATERIALS FOR THE CONSOLIDATION OF IRON-TANNATE DYED TEXTILES

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Degree project in engineering physics



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## The problem

Iron-tannate dyes

Black-brownish color to textiles for thousands of years

**BUT**

Textile degradation



Similarities with iron-gall inks

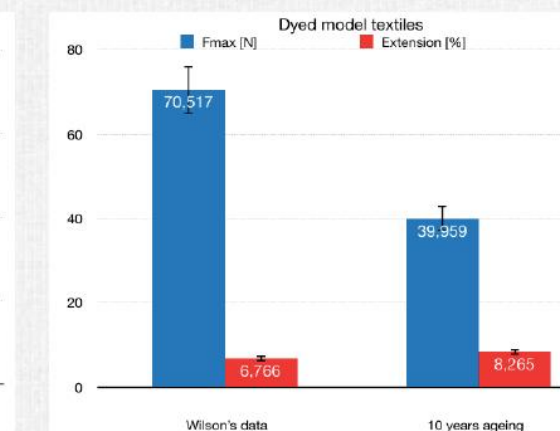
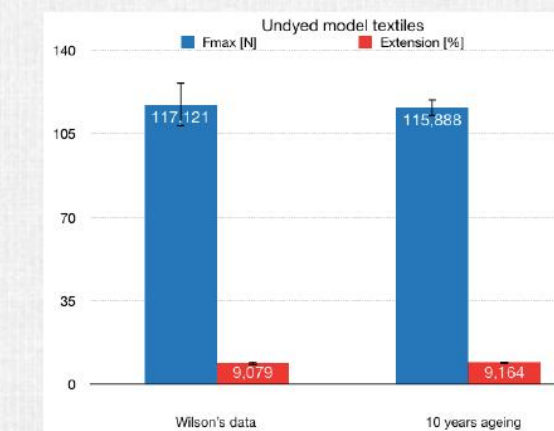
Deterioration of paper and parchment

Loss of information

## Starting point

Cotton dyed with iron-tannate dye 10 years previously.

Undyed cotton showed no significant change while the dyed models were clearly degraded.



## Consolidation treatments

- Calcium carbonate nanoparticles (CSGI II)
- Nanosilica (SNP) stabilized with polyvinylpyrrolidone (PVP) or carboxymethylcellulose (CMC)
- Nanocellulose (CNC)



• 6: CSGI II (CaCO<sub>3</sub> NPs)

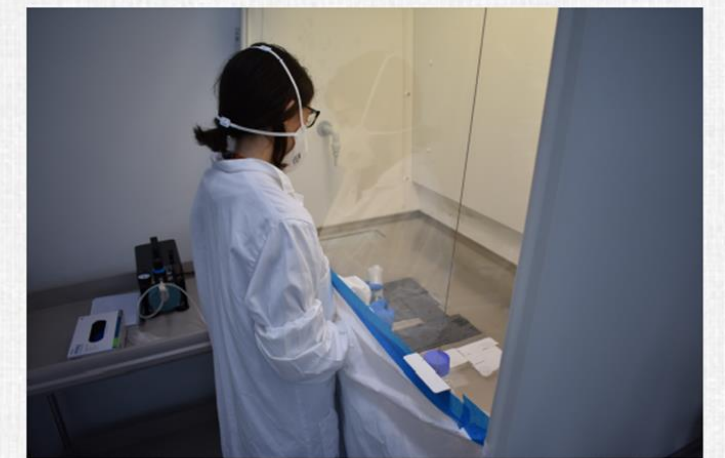
• 7: CSGI II + PVP@SNP + CNC

• 8: CSGI II + CNC

• 9: CSGI II + CMC@SNP

• 7": 7 but by brushing

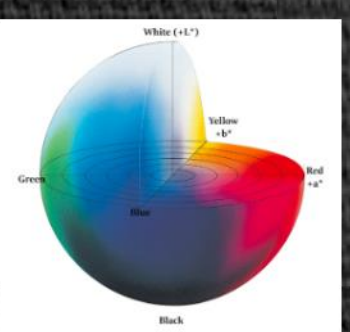
• 3": PVP@SNP + CNC by brushing



Application by nebulization

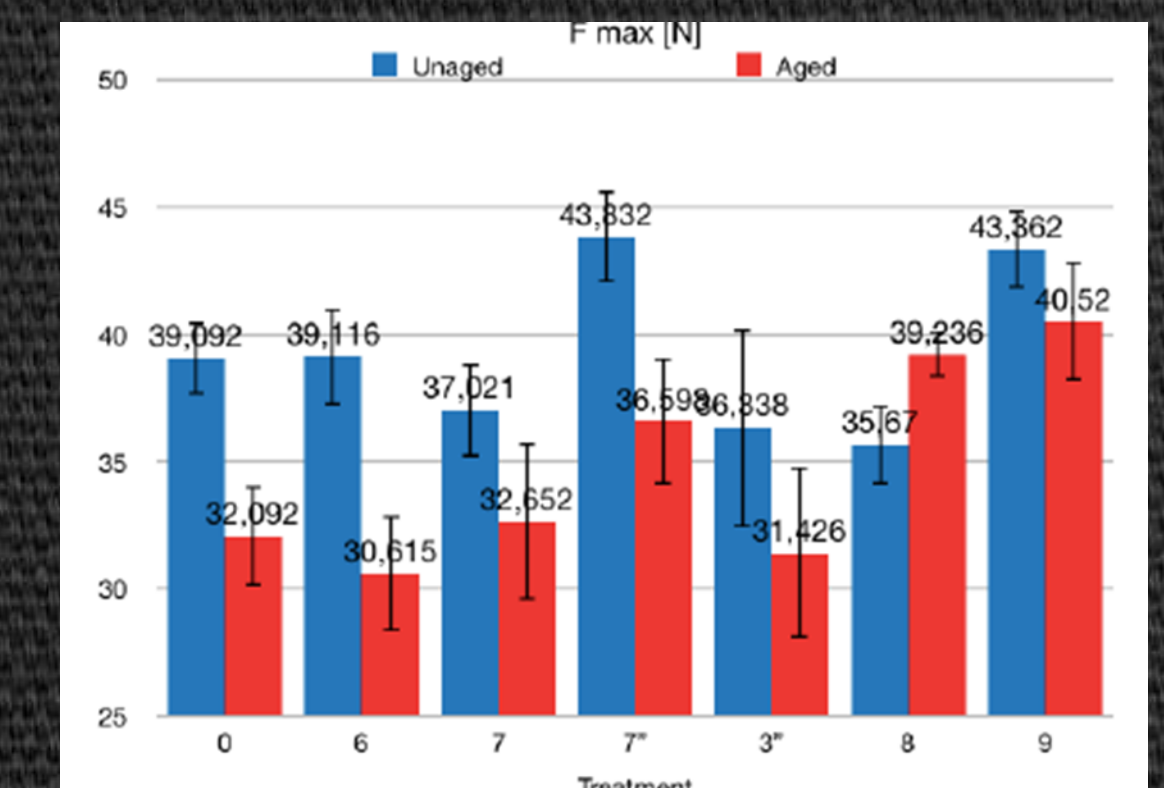
Ageing: 70°C, 50% RH, 1 week

## CHARACTERIZATION



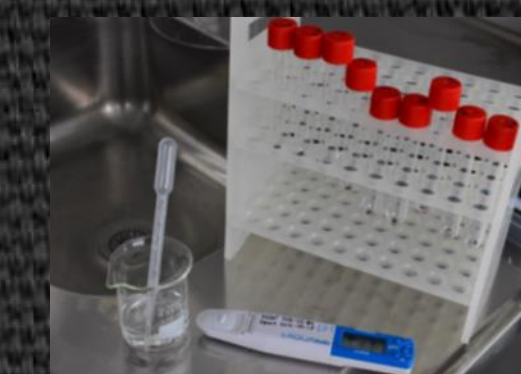
Colorimetry

Most color variation due to deacidifier



Tensile tests

Best results for 7" and 9

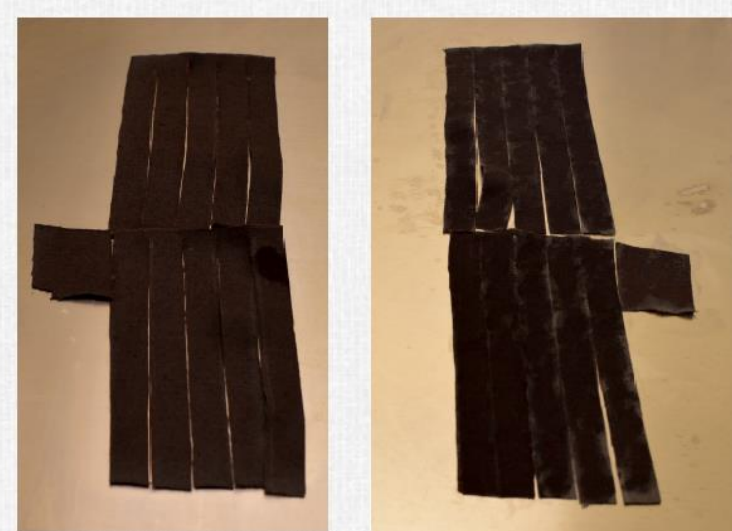


pH

Deacidifier effective also upon ageing

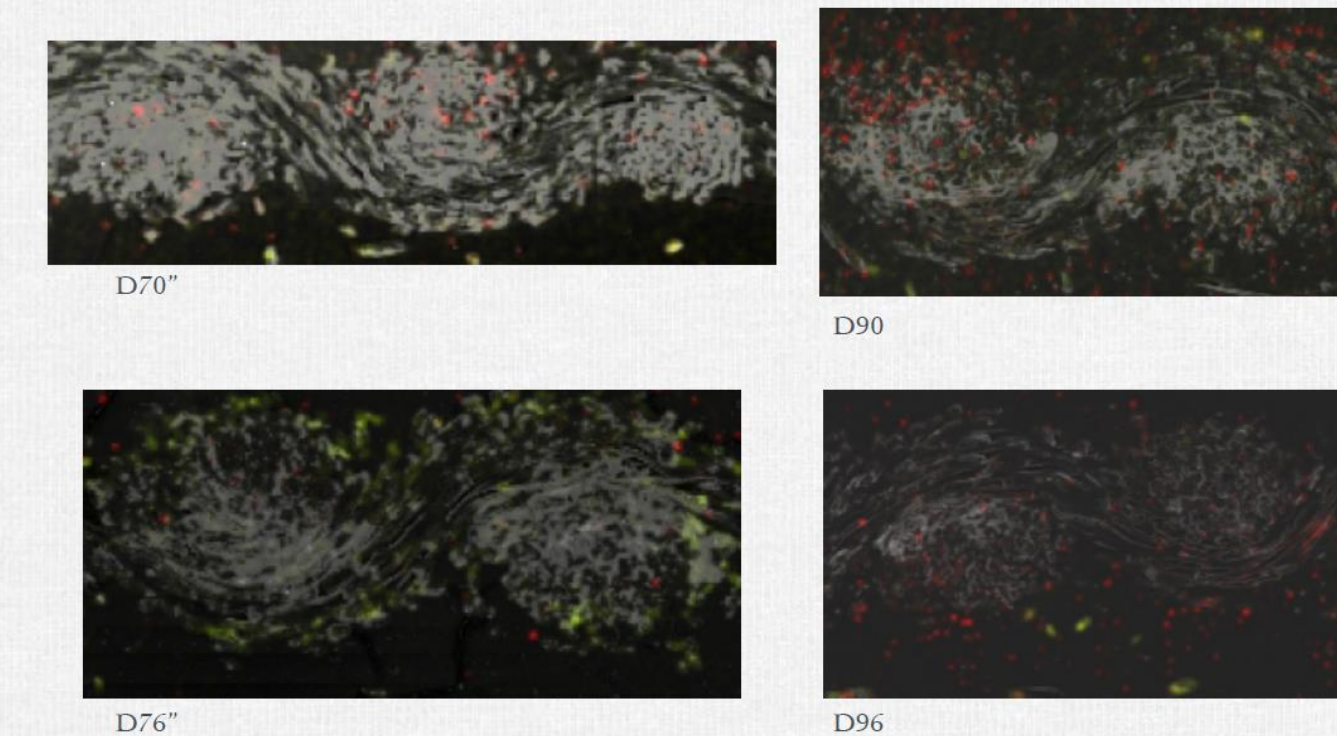
## Conclusions

- Deacidifier and proper weight uptake necessary to exploit consolidation
- No improvement of extensibility
- No pH buffer from SNPs
- Effectiveness of nebulization (uniform coverage)
- Acceptable color variation



## Future perspectives

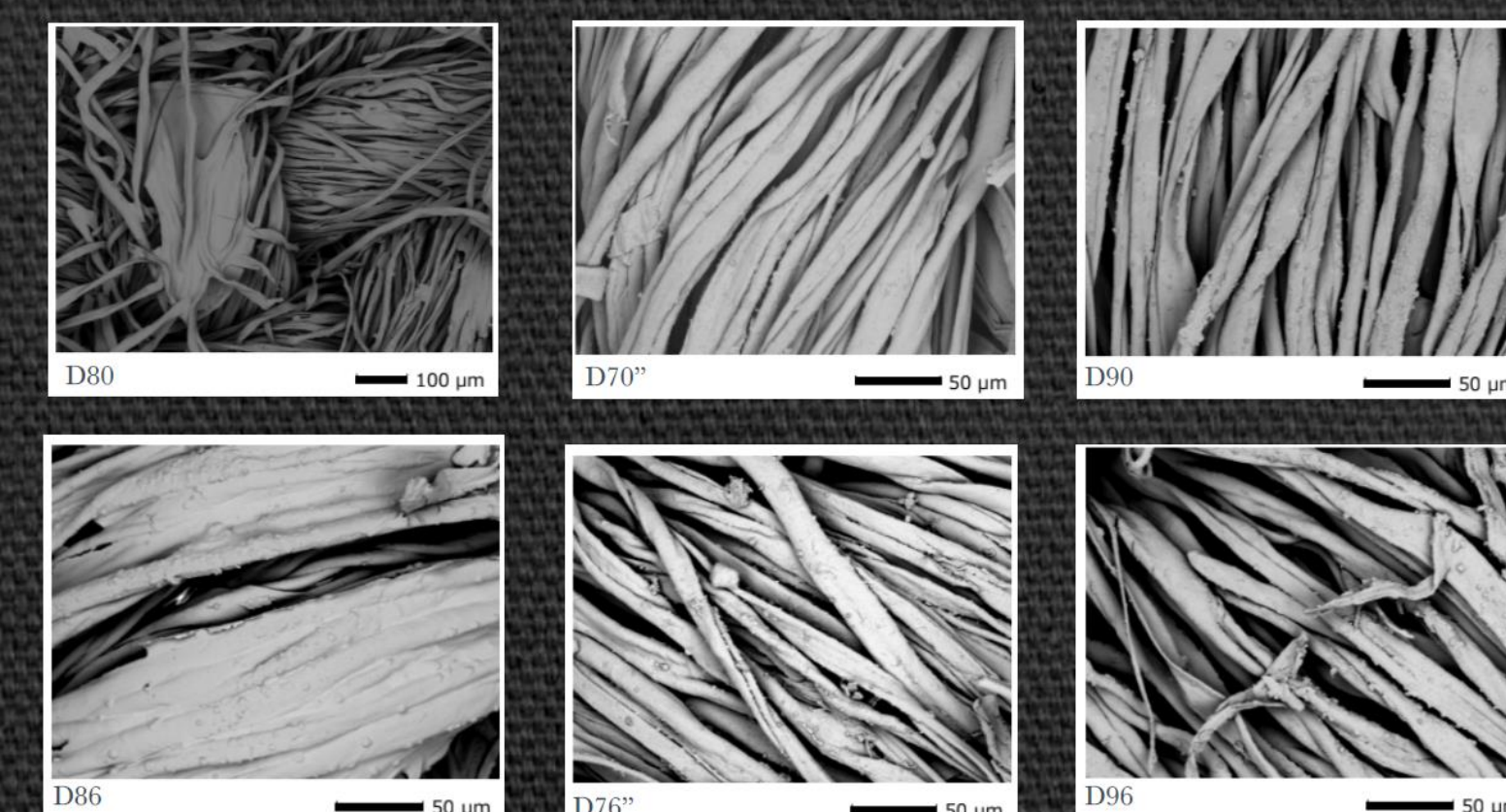
- Further characterization (photoluminescence, XRF)
- Use of less diluted dispersions
- Addition of antioxidants
- Tests with different amount of material and ageing regimes
- Tests on different substrates
- Investigation of adhesion NPs-cellulose
- Working with conservators



## CHARACTERIZATION

SEM-EDX of cross-sections

Better penetration of CaCO<sub>3</sub> NPs by brushing and upon ageing



## CHARACTERIZATION

SEM-EDX

Uniform materials deposition at surface