Swelling of Cotton Fibers by Amino acid

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Introduction

In cotton industry, the swelling of cotton fibres has captured attention because of its importance in textile processes such as dyeing, cross-linking and most importantly mercerisation.

Swelling of the cotton fibers by mercerisation treatment is well known. However, this treatment requires highly concentrated sodium hydroxide solution which is corrosive. A similar improvement by a noncorrosive chemical treatment is therefore important for the cotton industry in this 'green-era'.

In this view, this project focuses on developing a user-friendly, nonhazardous, biocompatible method to swell the cotton fibers in order to modify properties.

In cotton, there are hydrogen bonds (as shown in figure 1) and this hydrogen bond network can be rearranged using amino acids as studied in this project. This rearrangement and further the new bond formation will lead to the swelling of the fibre.

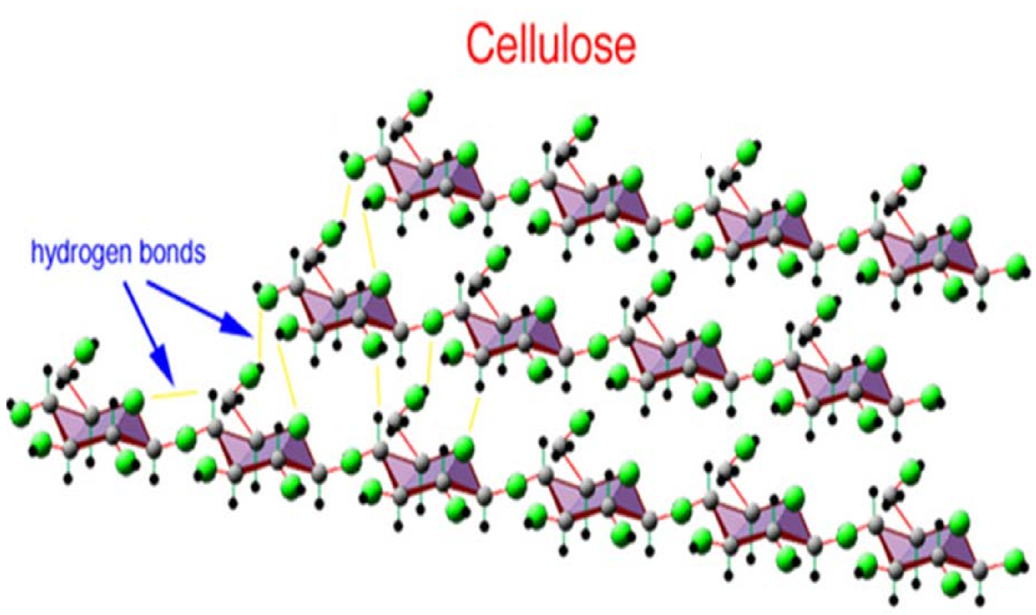


Figure 1: Hydrogen bonding in cotton cellulose

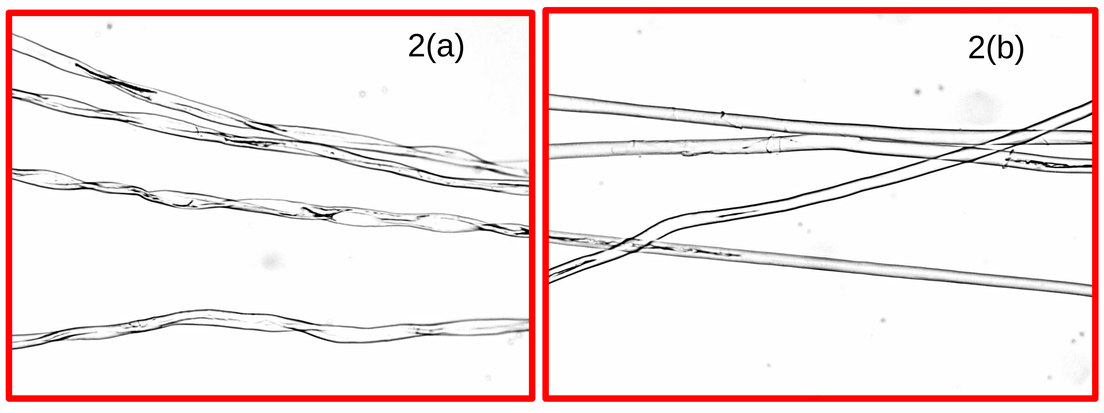
Goal: This project seeks to develop a non-hazardous and non-corrosive swelling method to improve the properties of cotton fibres

Objectives

- **To develop an user-friendly swelling treatment for cotton**
- **To study the effect of treatment on the properties of cotton fibres**

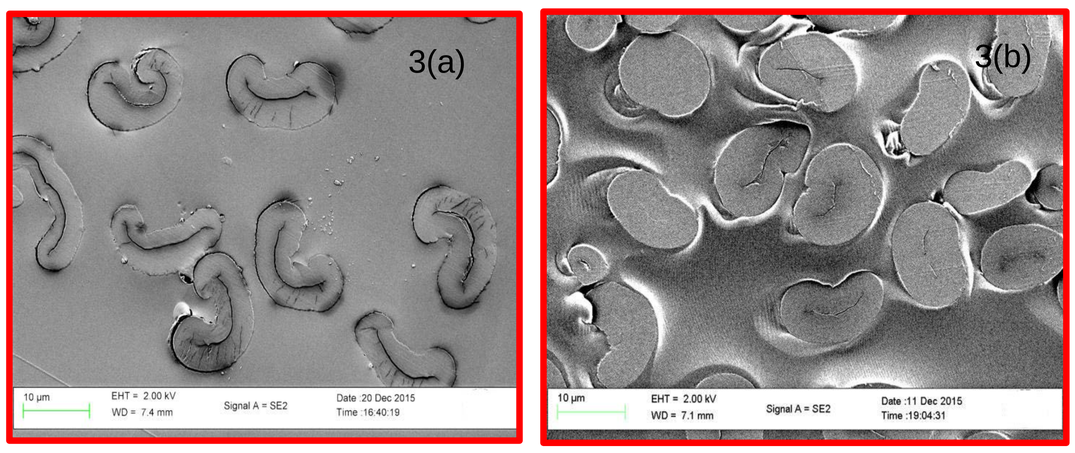
Results

From the optical images (figure 2) it can be observed that after glycine treatment the fibers were turned into more rod-like cylinders and the convolutions were completely removed. This is in agreement with the reported morphological studies of mercerised cotton fibres.



Figures 2(a) – (b): Optical microscopic images (x10) of scoured (a) and amino acid treated (b) cotton fibres

The cross-sectional shape of amino acid treated fibres have changed to more round in shape (Figure 3b)



Figures 3(a)-(b). Scanning Electron Micrographs (SEM) of scoured and amino acid treated cotton fibres cross sections

Table 1: Single fibre tensile test results (n = 200) and Moisture regain(%) of scoured and amino acid treated cotton fibres

Samples	Linear density(Tex) by cottonscope	Load (N) ± S.D	Specific stress (N/Tex) ± S.D	Strain (%) ± S.D	Moisture regain (%) ± S.D
Scoured cotton Control	0.198 ± 0.003	0.037 ± 0.010	0.194 ± 0.070	9.75 ± 2.900	6.63±0.500
Amino acid treated cotton	0.210 ± 0.019	0.045 ± 0.010	0.215 ± 0.060	15.48 ± 4.500	7.68±0.200

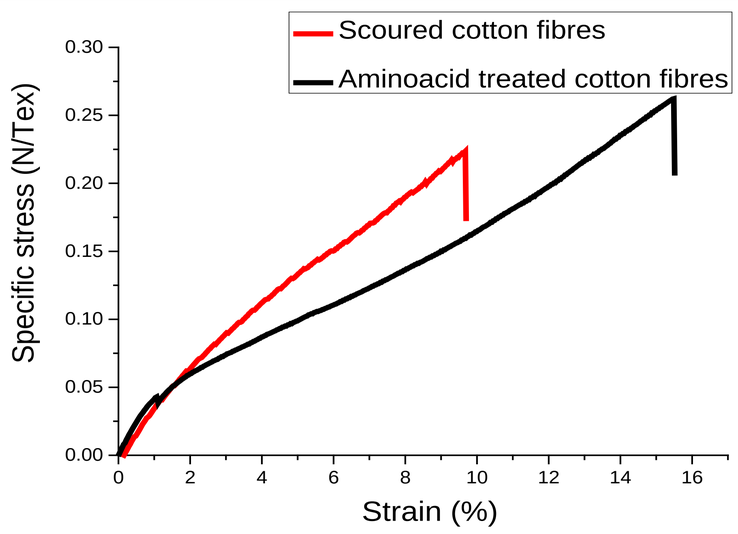


Figure 4: Specific stress- strain curve of scoured and amino acid treated cotton fibres

Conclusions

The amino acid treatment has:

- ✓ **removed convolutions of the cotton fibres**
- ✓ **changed the cross sectional shape of the cotton fibres.**
- ✓ **improved the tensile strength and elongation of the cotton fibres.**
- ✓ **Increased the moisture absorption of cotton fibres.**

References

- **Remadevi, R., Gordon, S., Wang, X. and Rajkhowa, R.,** 2017. Tensile, physical, and microstructure properties of glycine treated cotton fibers. *Textile Research Journal*, p.0040517517700196.
- **Remadevi, R., Gordon, S., Wang, X. and Rajkhowa, R.**, 2016. Investigation of the swelling of cotton fibers using aqueous glycine solutions. *Textile Research Journal*, p.0040517516665267

Acknowledgments

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