MODIFICATION OF TEXTILE COTTON PRODUCTS WITH CROSSLINKED GELATINE

Anna Bednarowicz, Zbigniew Draczynski, Cesar Hernandez, Dominik Sikorski, Nina Tarzynska, Izabella Krucinska

Lodz University of Technology, Department of Material and Commodity Sciences and Textile Metrology
anna.bednarowicz@edu.p.lodz.pl

KeyWords: gelatin, cellulose fibers, FTIR, surface modification

1. INTRODUCTION

The most popular cellulose fiber used in the textile industry is cotton. The physical and chemical properties of cellulose have an indispensable influence on the properties of cotton fibers. An undoubted advantage of this kind of fibers is high hygroscopy and wetting speed. They are also characterized by good heat protection, a pleasant hand and a low tendency to electrify. Their next advantage is the ease of dyeing process. However, they are not ideal fibers and have several drawbacks, among which we can mention the low chemical and biological resistance, low abrasion resistance, easy flammability. They also get easy dirty and it is difficult to remove dirt, as well as they easily deform after the washing process. [1]

Many modification can be carry out in case of cellulose fibers for example mercerisation or cationization. Research was also carried out on grafting collagen on their surface in order to change properties and give them properties similar to protein fibers. However, this process is complicated and requires a number of operations, which results from the lack of reactive groups on the surface of cotton fibers. Collagen, however, may pose a potential danger to users, due to the presence of amino acid sequences responsible for the possibility of an immunogenic reaction of a potential user of the product. It is possible to replace it with gelatine, which as a result of chemical treatment is deprived of this unfavorable property, and moreover, unlike collagen, it is possible to easily dissolve it in water without the use of additional chemicals. [2]

2. MATERIALS AND METHODS

2.1. Modification of the cotton fabric with gelatin

0.3% aqueous gelatine solution was applied onto cotton fabric. The modification was carried out for 15 minutes at room temperature. Then after drying samples, a crosslinking process with use of glutaraldehyde was carried out. Solutions with concentrations of 0.5; 1 and 1.5% were prepared. The process was carried out at room temperature, and its duration was 10, 20, 30, 40, 50 and 60 minutes. The samples were rinsed in distilled water to wash off excess of crosslinking agent.

2.2. Fourier-transform spectroscopy

In order to confirm the modification, an FTIR analysis was carried out. [3,4]

2.3. Dyeing process

Another method of confirming the modification was dyeing process using an acid dye. The dyeing process was carried out according to parameters presented in Table 1.

Table. 1. Conditions of the dyeing process

Concentration of dye	2 % in relation to the fiber mass
Bath module	1:50
Time	1 h
Temperature	20 °C

2.4. Spectrophotometric color measurement

The measurement of the color components was made using the Jasco spectrophotometer. The measurements were made in the wavelength range of 360- 830 nm.

3. RESULTS

3.1. UV VIS spectroscopy

Figure 2 shows values of ΔE of modified fabrics in comparision to unmodified cotton fabric. A significant difference in color can be observed for each modification, however the biggest changes occurred as a result of sample modified with gelatin crosslinked with a 1.5% glutaraldehyde solution. The time of the crosslinking process does not significantly affect the value of ΔE. More intensive color for all samples compared to the reference sample indicates the effectiveness of the modification.

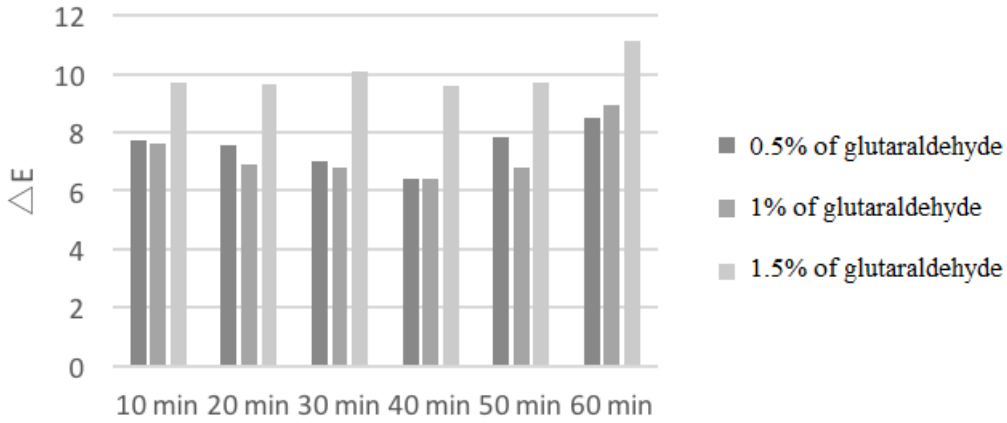

Fig. 2. ΔE values for modified cotton fabrics

3.2. Fourier-transform spectroscopy

The spectra (Fig. 3) obtained for fabrics modified with gelatine and crosslinked with glutaraldehyde at various concentrations and different time variants, indicate the appearance of N-H groups in the wavelength range of 1500-1650 cm^{-1}. We can see that in all cases we managed to implement gelatine onto cotton fibers. In the case of some spectrum, peaks are much more visible what is probably caused by partial modification as well as the point analysis method.

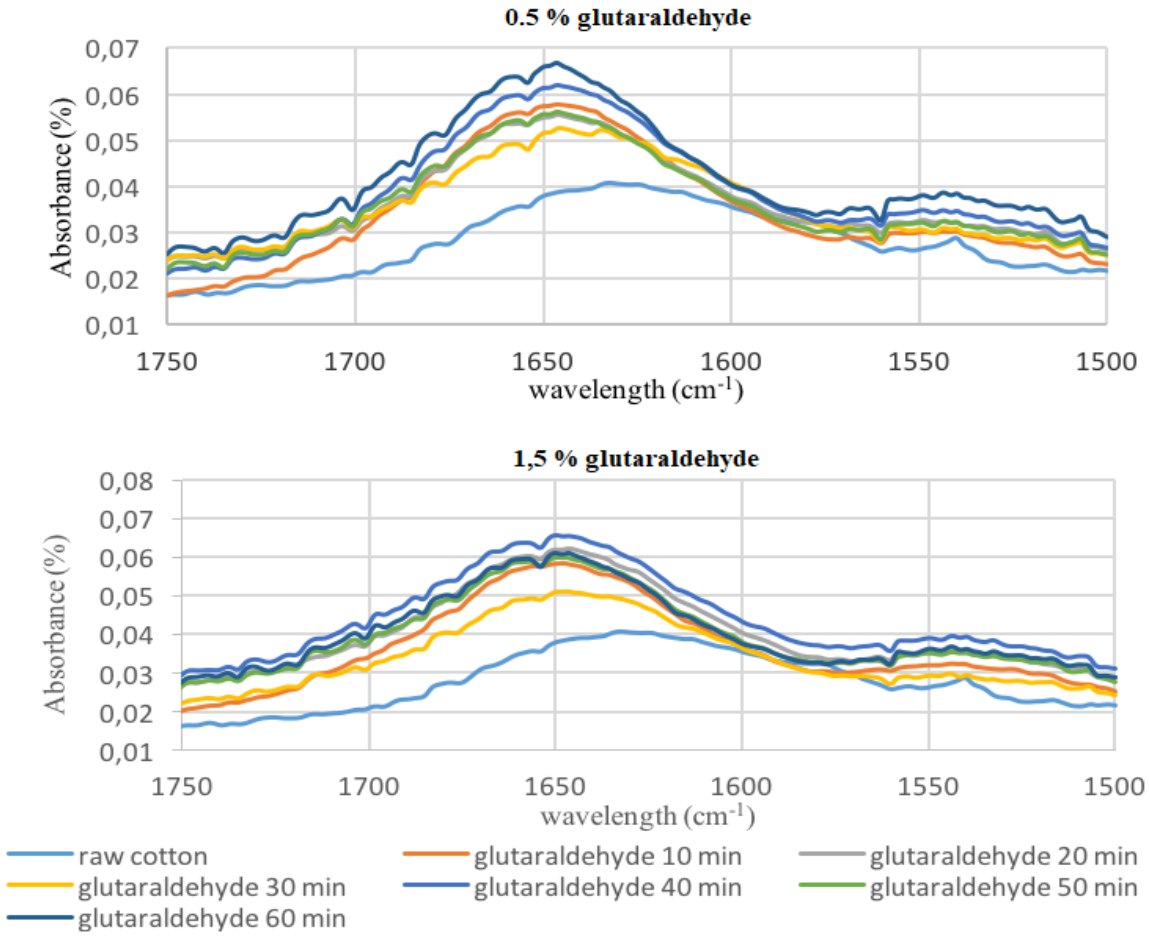

Figure 3. FTIR spectrum for cotton fabric modified with gelatine crosslinked with 0.5 and 1,5 % glutaraldehyde.

4. CONCLUSION

Modification of the cotton fabric with cross-linked gelatin is possible to carry out in a simple way and allows to change the characteristics of cellulose fibers. These fibers gain properties similar to protein fibers, which can be evidenced by possibility of dyeing them with acid dye, traditionally used for dyeing protein fibers .[5]
FTIR analysis confirmed the presence of -NH groups characteristic for protein products. An undoubted advantage of this type of modification is the lack of possibility of an immunological reaction of a potential user of the product, which can be hygienic and cosmetic products.

REFERENCES

[1] Urbańczyk G. *Nauka o włóknie.* Warszawa : Wydawnictwo Naukowo- Techniczne, 1985.
[2] Banaś M. Pietrucha K. *Typy i struktura białka kolagenowego.* Zeszyty naukowe Politechniki Łódzkiej Nr 1058, 2009
[3] Lipp- Symonowicz B. Sztajnowski S. Kulak A. *IR Spectroscopy as a Possible Method of Analysing Fibre Structures and Their Changes Under Various Impacts.*
[4] Sztajnowski S. *Metoda spektroskopii absorpcyjnej w podczerwieni w badaniach polimerowych materiałów włókienniczych.* Łódź: Monografie Politechniki Łódzkiej, 2016.
[5] Ingamells W. *Colour for Textiles: A user's handbook.* Society of Dyers and Colourists, 1993.