ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

EVALUATION OF FLEXURAL RIGIDITY OF COTTON FABRICS TREATED WITH POLIURETHANE AND ACRILYC RESIN AND MONTMORILLONITE PARTICLES

CARETTE Margaux[1], DÍAZ-GARCÍA Pablo[2], MONTAVA Ignacio[3], GISBERT-PAYÁ Jaime[4], BOU-BELDA Eva[5]

[1,2,3,4,5,]Departamento de Ingeniería Textil y Papelera, Universitat Politècnica de València
Plaza Ferrándiz y Carbonell s/n, Alcoi, Spain

Corresponding author: Bou, Eva, E-mail: evbobel@upv.es

Abstract: *Textile manufacturers are demonstrating an increasing interest in the application of different types of micro or nanoparticles in order to add new properties to the fabric. For example, it is demostrated that fabrics treated with some type of silicate particles, like montmorillonite improve the wrinkle resistance of cotton fabric or improve the flame retardant effect, among other interesting properties. Usually these particles, are not a reactive agent that can react with the fibers. Because of that, the resin product are necessary to make them adhere to the fiber, otherwise they will be lost during the actions of treated fabric use and maintenance such as washing, ironing, drying, etc. The resin plays an important role in treating the fuctionalization of the textile. Instead, this compound can modify its properties. In this work, flexural rigidity of treated cotton fabrics with binder and with and without montmorillonite particles were evaluated. Two different resins were studied, acrilyc and poliurethane, and 1, 2.5 and 5 g/L of this product were applied. It was appreciated that fabric treated with particles modify the flexural rigidity in less difference than when treating it only with resin, regardless of the type of binder used.*

Key words: *fabric properties, functionalization, silicates, binder, stiffness.*

1. INTRODUCTION

Many studies focus on the addition of micro or nanoparticles to provide the textile with new properties, which is known as textile functionalization. Depending on the type of particle add in the fabric, it is obtaind a new property. Within this type of textile functionalization it can be encompassed microcapsules, which contain different active substance inside with which to provide new functions to the fabric, such as thermal property by phase change material [1-3], aroma release [4-6], moisturizing [7, 8], etc. On the other hand, it is possible to treat fabrics using nano and microparticles that by their own nature and composition also provide properties to the substrate, like tourmaline or nanoclays [9, 10]. Some of these type of particles can improve the textile comfort improving the amount of negative ions in the air.

However, when particles are used, which do not have any affinity for textile fiber, it is necessary to add some type of resin in the treatment bath in order to increase fix particles on textile fibers [11]. But this type of treatment can modify the properties of the textile, like flexural rigidity.

The aim of this work is to study the effect of the use of binder in the treatment with and without microparticles on the flexural rigidity property of the cotton fabric. Two types of resin of different composition, polyurethane and acrlys, were used. Some treatments were carried out varying the concentration of the resin used. In order to know the influence of microparticles in the modification of the fabric properties, the addition of microparticles of nanoclay (montmorillonite) was performed together with the highest concentration of resin. All the results were compared with the flexural rigidity values of untreated cotton fabric.

2. EXPERIMENTAL

2.1 Materials

A 100 % twill cotton fabric with 210 g/m² was used. The fabric had been desized, scoured and bleached.

Lurapret® dispersion TX 6072 (supplied by Archroma) was used as a waterborne polyurethane binder. In this study, the Lurapret (supplied by Archroma)polyurethane binder is referred to as “PUR” . Resina Color Center STK-100 was used as an acrylic binder and is referred as “Ac” in this work.

The silicate Montmorillonite K10 (supplied by Sigma Aldrich) was used as microparticles. These K10 particles fall in between the size range of 1-40 µm.

2.2 Methods

Treatments were carried out by padding, getting around of 80-85% of pick-up, dried at 90ºC and cured at 120º C for 2 min. Different formulations were prepared using different concentration of two resins (acrilyc and poliurethane binder). To study the influence of using microparticles in the treatment on the flexural rigidity of the fabric, treatments were performed using each resin together the K10 particles. In table 1 the formulation of bath treatments prepared are described.

Table 1: *Concentration of products prepared for each treatment*

	Poliurethane binder (g/L)	Acrilyc binder (g/L)	K10 particles (g/L)
Untreated cotton	-	-	-
1PUR	1	-	-
2,5PUR	2,5	-	-
5PUR	5	-	-
20K10 5PUR	5	-	20
1Ac	-	1	-
2,5Ac	-	2,5	-
5Ac	-	5	-
20K10 5Ac	-	5	20

Flexural rigidity of samples are tested following the standard UNE 40392:1979 “Determination of the flexural rigidity of a fabric”, in order to compare the results of different treatments using different concentration of resin, the untreated fabric was tested too.

3. RESULTS AND DISCUSSION

Flexural rigidity results of each sample tested are shown in table 2 and represented in the graphic of Figure 1.

Table 2: *Concentration of products prepared for each treatment*

Sample	Bending lenght	Flexural Rigidity (mg.cm)
Untreated cotton	3,71	1,08
1PUR	2,9	0,51
2,5PUR	2,8	0,46
5PUR	2,87	0,5
20K10 5PUR	3,34	0,79
1Ac	2,99	0,56
2,5Ac	2,96	0,55
5Ac	2,89	0,5
20K10 5Ac	3,26	0,72

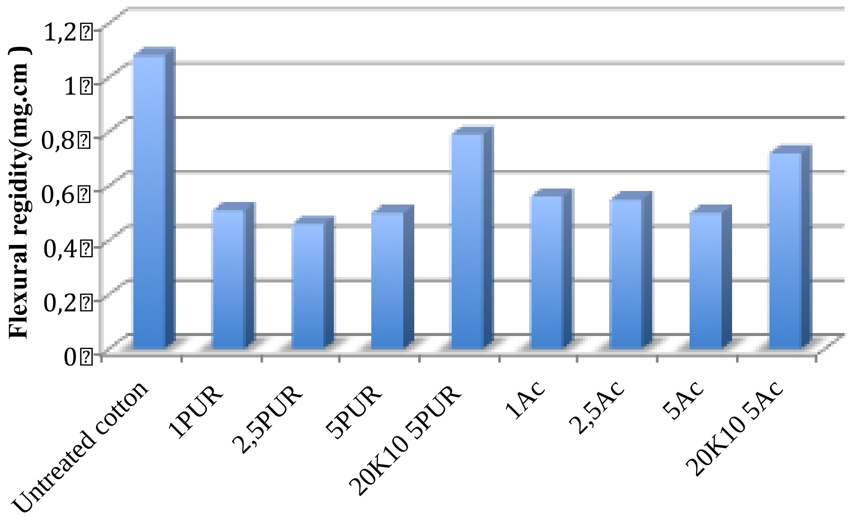

Fig. 1: *Flexural rigidity results*

If the results of fabrics treated only with acrylic and polyurethane binder are compared using different Concentrations (1, 2.5 and 5 g / L), it can be observed that there is no significant difference between them, but the loss of rigidity upon application is remarkable. flex when these results are compared to the value of the raw fabric.

However, flexural rigidity improves when the treatment is carried out with a K10 microparticle binder, regardless of the resin used. This behavior may be due to the particle breaking in a certain way the crosslinking of the polymerized resin and thus decreasing its rigidity.

5. CONCLUSIONS

This study showed that the use of acrylic and polyurethane resin in the treatment, added to improve the fixation of particles on the textile fibers in order to provide new properties, increases the stiffness of cotton fabrics. This is an effect that could be problems due to the change of the flexibility of the fabric, as this property is very important to achieve a good behavior during its use. On the other hand, the modification of this property is lower when the treatment carried out using resin and montmorillonite particles, showing a greater difference in the results of the treated fabric only with the resin. This behavior may be due to the particle breaking in a certain way the crosslinking of the polymerized resin and thus decreasing its rigidity.

Further research will be conducted regarding polyester fibers in order to determine if this difference is so evident on that synthetic fiber.

ACKNOWLEDGEMENT

Author would like to acknowledge the financial support given by Spanish Ministry of Science, innovation and universities under the RETOS DE LA INVESTIGACIÓN, I+D+i ORIENTADA A LOS RETOS DE LA SOCIEDAD program on the 2018 call, because of the project reference RTI2018-094014-B-I0.

REFERENCES

[1] FALAHI, ELHAM, Mohammad Barmar, and Kish M. Haghighat. *"Preparation of phase-change material microcapsules with paraffin or camel fat cores: application to fabrics."* (2010): 277-286.

[2] Alkan, Cemil, et al. *"Preparation, characterization, and thermal properties of microencapsulated phase change material for thermal energy storage."* Solar Energy Materials and Solar Cells 93.1 (2009): 143-147.

[3] Salaün, F., et al. *"Thermoregulating response of cotton fabric containing microencapsulated phase change materials."* Thermochimica Acta 506.1-2 (2010): 82-93.

[4] Bonet, M. Ángeles, et al. *"Studying bath exhaustion as a method to apply microcapsules on fabrics."* Journal of the Textile Institute 103.6 (2012): 629-635.

[5] Rodrigues, S. N., et al. *"Scentfashion®: Microencapsulated perfumes for textile application."* Chemical Engineering Journal 149.1-3 (2009): 463-472.

[6] Miro Specos, Maria M., et al. *"Aroma finishing of cotton fabrics by means of microencapsulation techniques."* Journal of industrial textiles 40.1 (2010): 13-32.

[7] Son, K., D. I. Yoo, and Y. Shin. *"Fixation of vitamin E microcapsules on dyed cotton fabrics."* Chemical Engineering Journal 239 (2014): 284-289.

[8] Fiedler, Juliana Oliveira, et al. *"Application of Aloe vera microcapsules in cotton nonwovens to obtain biofunctional textiles."* The Journal of The Textile Institute (2019).

[9] Yang, Wei-jun, et al. *"Factors affecting anion-generating capacity of anion fabric."* Journal of Textile Research 27.12 (2006): 88.

[10] Jiguo, Ren Cailing Meng Jiaguang Wang. *"Test and Analyses on Negative Ions Finishing Processing of Pure Cotton Fabric."* Cotton Textile Technology 12 (2011): 12.

[11] Monllor, Pablo, et al. *"Improvement of microcapsule adhesion to fabrics."* Textile research journal 80.7 (2010): 631-635.