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STIFFNESS MODIFICATION OF COTTON IN CHITOSAN TREATMENT

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Abstract: *Chitosan is a biopolymer obtained from chitin, and among their most important aspects highlights its applications in a lot of industrial sectors due to its intrinsic properties, especially in the textile sector. In the last years, chitosan is widely used in the cotton and wool finishing processes due to its bond between them and its properties as an antifungical and antimicrobial properties. In this paper three different molecular weight chitosan are used in the finishing process of cotton to evaluate its influence in the surface properties modification. In order to evaluate the effect of the treatment with chitosan, flexural stiffness test is performed in warp and weft direction, and then the total value is calculated. The cotton fabric is treated with 5 g/L of different types of chitosan in an impregnation bath. This study shows the extent of surface properties modification of the cotton provided by three types of chitosan treatment. The results show that all types of chitosan modify the cotton flexural rigidity properties but the one which modifies it in a relevant manner is chitosan originated from shrimps.*

Key words: *Chitosan, textile, flexural stiffnes, chitin, cotton.*

1. INTRODUCTION

Chitosan is known well known for its use in wound dressing [1, 2] but it has however a lot of other uses and can be used as artificial skin, colour removal in textile mills, paper finishing, or textile finishing due to its antibacterial properties [3]. Recently other different use is developed as pre-mordant in cotton and wool dyeing [4]. Chitin can be easily acquired from crab or shrimp shells but has to be deacetylated in 40% sodium hydroxide at 120°C for 1-3h. to produce 70% deacetylated chitosan [5].

The bond between chitosan and cotton is a difficult bond because of the likeness of the two polymers and it has to be dissolved in an acid to improve it. This is only possible as result of the highly basic nature of chitosan. Then bonding of chitosan with cotton happens after the cotton is oxidised [6]. Figure 1 shows how the cotton (I) is oxidized (II). Once the cotton is oxidized it is able to react with the chitosan molecules.

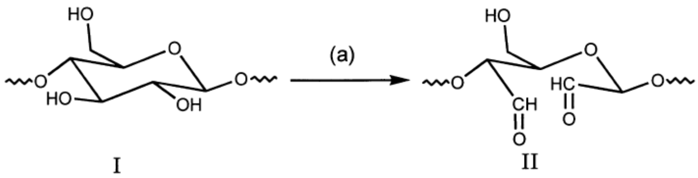

Fig. 1: *Oxizidation of cotton (a)* ***[6]***

2. OBJECTIVE

The main objective of this work is to study the influence of the chitosan molecular weight in pre-tratment of the cotton treated with three different molecular mass chitosan, low, medium and originated from shrimps.

3. MATERIALS AND METHODS

Chitosan is used as a natural mordent at the present paper. All chitosan used, low molecular weight (XL), medium molecular weight (XM) and chitosan originated from shrimps were commercial products, supplied by Sigma-Aldrich. As that paper's purpose is evaluate the influence of chitosan as bio-mordant the concentration used is 5 g/L for all tipes of chitosan.

The fabric used is a cotton twill fabric with 210 g/m^2 which has been chemically bleached in an industrial process. The treatment with chitosan was performed in an impregnation bath adding 6 ml of acetic acid to have a slightly acid solution, in order to dissolve the chitosan better. To be sure the solution is completely dissolved the solution stirred for 24h hours. After the chitosan treatments, cotton samples were dryed at 80°C in a screen printing engineering TD-20 and cured at a temperature of 80°C in a WTC Binder 030.

The influence of cotton pre-treatment with chitosan was performed by flexural rigidity test as described in the standard UNE-40-392-79.

4. RESULTS AND DISCUSSION

The flexural rigidity test is used in order to verify the degree of modification of the cotton properties treated with different types of chitosan. As chitosan is used in most of applications as a pre-treatment it is very important that the cotton properties remain regular. In the present paper the cotton fabric is treated with three types of chitosan to evaluate flexural stiffness, obtaining the following results.

It has been evaluated, as indicated in the standard, in the weft and warp direction by both sides of the fabric. The results show higher values of flexural rigidity in the warp direction than in the weft direction for the three types of chitosan, and also for the untreated sample due to the fabric structure. As can be seen in figure 3, whilst the flexural stiffness values in warp direction are higher than 2000 mg/cm, in weft direction the values are lower than 1800 mg/cm.

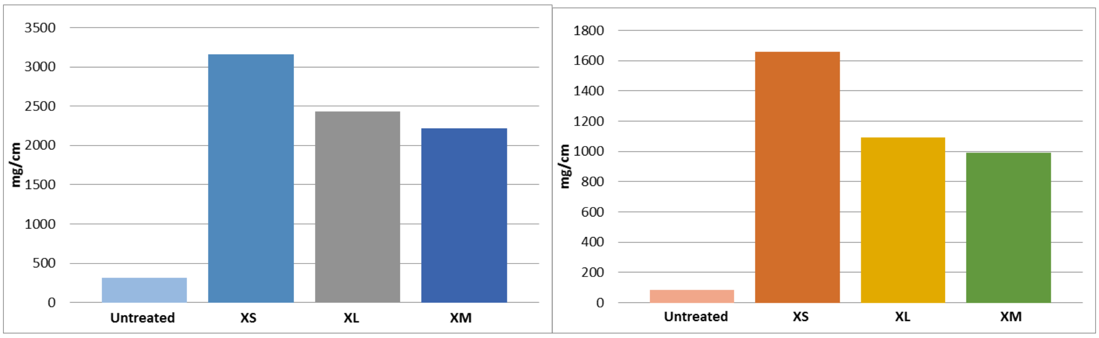

Fig. 2: *Flexural stiffness in warp and weft direction of the cotton treated with different types of chitosan*

Comparing the results of flexural rigidity of the fabric treated with the three types of bio-mordants, the chitosan that present the highest flexural rigidity is the chitosan from the shell of shrimps, followed by the low molecular weight chitosan. The medium molecular weight chitosan is the one which modify in a less extent the cotton properties in both warp and weft directions. Must be said that the difference between the medium and low molecular weight chitosan is very small.

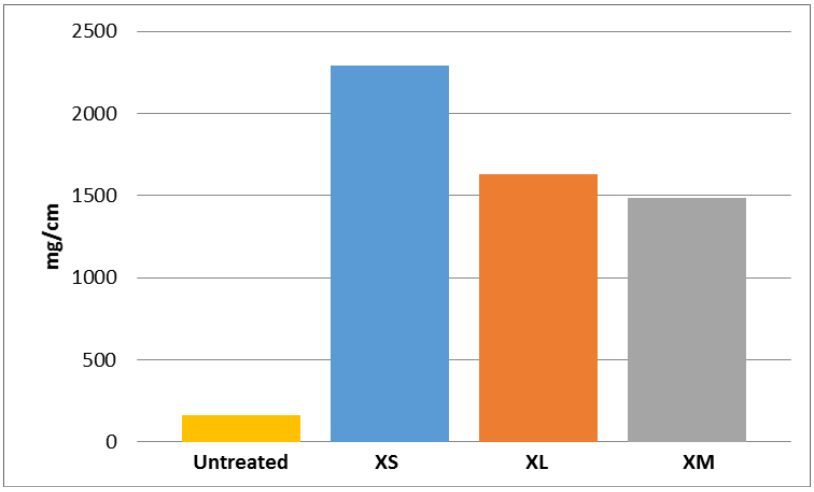

Fig. 3: *Total flexural stiffness of the cotton treated with different types of chitosan*

The total flexural rigidity of the treated fabric with different types of chitosan reinforces the flexural rigidity values obtained in the weft and warp direction. The chitosan originated from shrimp shells is the one that gives the most rigidity to the cotton, with a great difference from the low and medium molecular weight chitosan. The chitosan of medium and low molecular weight hardly offers significant differences, and as can be seen in figure 4, both values are around 1500 mg/cm.

5. CONCLUSIONS

The next conclusions can be extracted:

- Medium and low molecular weight chitosan have similar flexural stiffness values.
- In comparison to the untreated cotton with those treated with different types of chitosan, a remarkable increase in flexural stiffness in the weft, warp and total stiffness was observed.
- Chitosan originated from shrimp shells is discarded because it modifies the properties of cotton in a high manner.

- Based on the flexural stiffness test the best chitosan is medium molecular weight because it doesn't modify the cotton properties as other types of chitosan does.

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