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TRACTION RESISTANCE IN CHITOSAN TREATED COTTON

LOX Wouter[1], CATRY Mieke[1], BOU-BELDA Eva[2], BONET M. Angeles[2], DÍAZ Pablo[2]

[1]University College Ghent, Life Sciences & Technology, Chemistry, 9000, Ghent, Belgium,

[2] Universitat Politècnica de Valencia, 03803 Plaza Ferraniz y Carbonell s/n, Spain. maboar@txp.upv.es

Corresponding author: Bonet, María Ángles, maboar@txp.upv.es

Abstract: *Nowadays natural products interest has increased. However, when some products are included on textile fibres, they have no affinity and need some binders or other kind of auxiliaries to improve the yeld of the process, and some of them are not so natural as the product which are binding and consequently the "bio" definition is missed as some of them can be considered as highly pollutant. Chitosan is a common used bonding agent for cotton. It improves the antimicrobial and antifungal activity, improves wound healing and is a non-toxic bonding agent. The biopolymer used in this work is chitosan, which is a deacetylated derivative of chitin. These properties depend on the amount of deacetylation (DD) and the Molecular weight (MW). Along with these improving properties, as it recquires some acid pH to ve solved the treatment with chitosan can have some decreasing mechanical properties. The aim of that paper is to evaluate the change in breaking force of the treated samples and a change in elongation of those samples. It compared different amounts of concentration of chitosan with non treated cotton. The traction resistance test were performed on a dynamometer. The test was conducted according to the UNE EN ISO 13934-1 standard.*

Key words: *chitosan, breaking force, elongation, heat treatment, oxzidized cotton.*

1. INTRODUCTION

Chitosan is an N-deacetylated derivative biopolymer of chitin. The deacetylation of the chitin is never completed. Fig 1 shows the molecular structures of cotton, chitosan and chitin. [1] Chitosan has a wide range of use due to antimicrobial and antifungal activity, non-toxicity and ability to improve wound healing.[2, 3] Three important parameters influence these properties: degree of deacetylation (DD), molecular weight (MW) and the amount and location of the aminogroups. [3] Despite these usefull properties, the curing of the cotton-chitosan has a reduction in mechanical strength.[4] Therefore we investigate the traction resistance according the UNE EN ISO 13934-1 standard.

2. EXPERIMENTAL

2.1.Materials

The used chitosan is deacetylated chitin. One has low molecular weight (XL), one medium molecular weight (XM) and one chitosan comes from shrimp shells (XS). All chitosan were commercial products, obtained by Sigma-Aldrich. Different kinds of concentration were 3g/L and 5g/L. The amount of both was 2l to obtain a good pick-up in the impregnation bath. The solution stirred 24 hours before it was used in the impregnation bath.

The cotton fabrics were cotton samples from the Universitat Politecnica de Valencia. There denisty was 210g/m². The cotton in these fabrics were oxidized cotton as shown in Fig 2 [5]. The test was performered in the weft direction.

The impregnated cotton was dryed at 80°C in a screen printing engineering TD-20. Afterwards different pieces were cutted and cured at different temperatures in a range from 80 °C till 200 °C in a WTC Binder 030.

Tensile strength was performed on a dynamometer Zwick/Roell following the UNE EN ISO 13934-1 procedure.

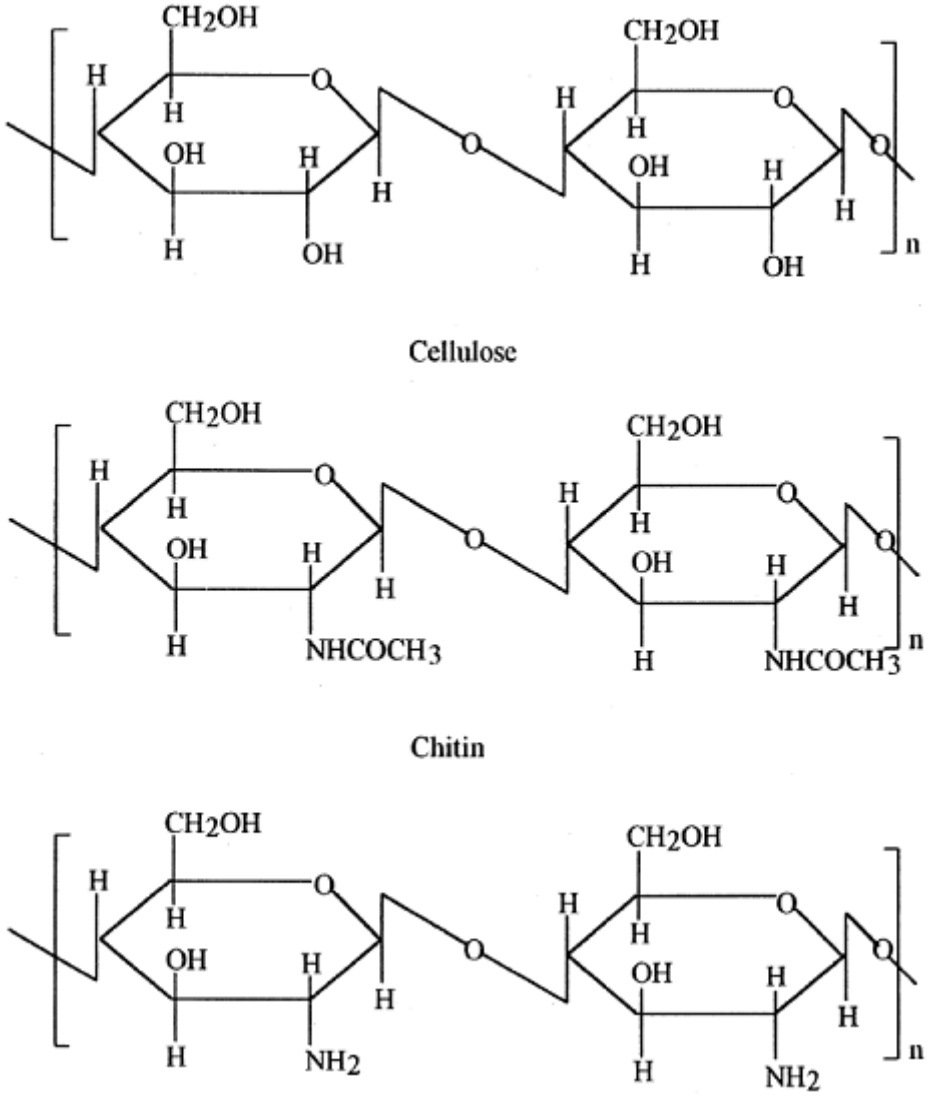

Fig. 1: *Structure of cotton, chitin and chitosan*

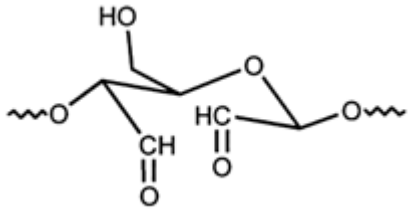

Fig. 2: *Oxidized cotton*

2.2. Treatment of the cotton

Cottons were impregnated in the different chitosans by using an impregnation unit, with a 3 bar pressure between the rolls. After drying in the screen printing dryer, the cotton was cutted in different pieces to let them cure at different temperatures as shown in table 1.

Table 1: *Different cure temperatures of the chitosan for both of the different concentrations of chitosan.*

Name	Cure Temperature(°C)	Name	Cure Temperature(°C)	Name	Cure Temperature(°C)
XM_80	80	XM_80	80	XM_80	80
XM_100	100	XM_100	100	XM_100	100
XM_120	120	XM_120	120	XM_120	120
XM_140	140	XM_140	140	XM_140	140
XM_160	160	XM_160	160	XM_160	160
XM_180	180	XM_180	180	XM_180	180
XM_200	200	XM_200	200	XM_200	200

2.3. Testing the traction resistance

The samples were cutted in the weft direction. The size of the samples was 25cm by 5 cm. The distance between the two clamps was 20 cm. According the UNE EN ISO 13934-1 procedure.

3.RESULTS AND DISCUSSION

3.1. Breaking force

Fig 3and 4 show the differences in breaking force between the different chitosan treated and untreated cotton. There is not a lot of difference between the different chitosans, its concentration, and is curing temperature. Untreated is the one that stay somewhat the same until 200°C. The treated samples go up and down, and ther is no constant. Fig 5 shows that when a cotton is heated the breaking force decrease allready with 40% at 80°C and decrease slighty until 180°C. At 200°C it has decreased with 60%.

The difference in breaking force between the unheated and heated cotton is that the cellulose in cotton start decomposing slowly after 60°C. The difference in breaking force between 200°C and the other curing temperatures is that after 180°C the decomposition accelerated. [6] Decomposing of the cotton results in loss of mechanical strength. Fig 3, 4 and 5 show that not the treatment with chitosan but the heating is the source of the loss in breaking force.

3.2. Breaking elongation

Fig 6 and 7 show that if a cotton fabric is treated with chitosan its percentage of breaking elongation increase. The reason for this increase is the treatment of cotton with the chitosan. Chitosan is a wet solution, this will make the cotton fabrics shrink and more dense. [4]

Fig 8 shows an increase in breaking elongation after a heat treatment, this can be explained by the shrinking of cotton and loss of mass due the decomposition of the cotton after 60°C. Decrease of elongation after 180°C is of the decomposition of the cotton cellulose. [4, 6] The results of fig 6, 7 and 8 show that because of heat treatment and chitosan treatment the breaking elongation is higher than without chitosan treatment. This is the combination of the two reasons the cotton shrinks, so it elongation is higher.

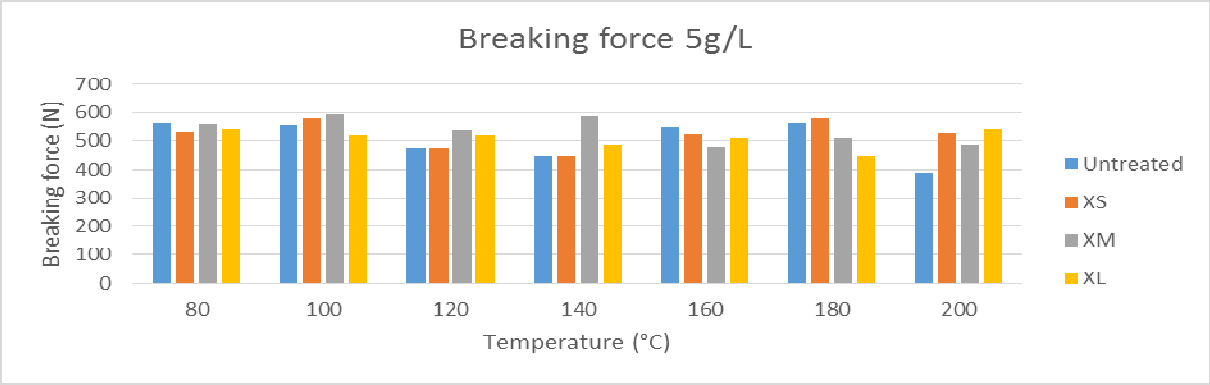

Fig. 3: *Breaking force in the weft condition for 5g/L at different temperatures for the different types of chitosan*

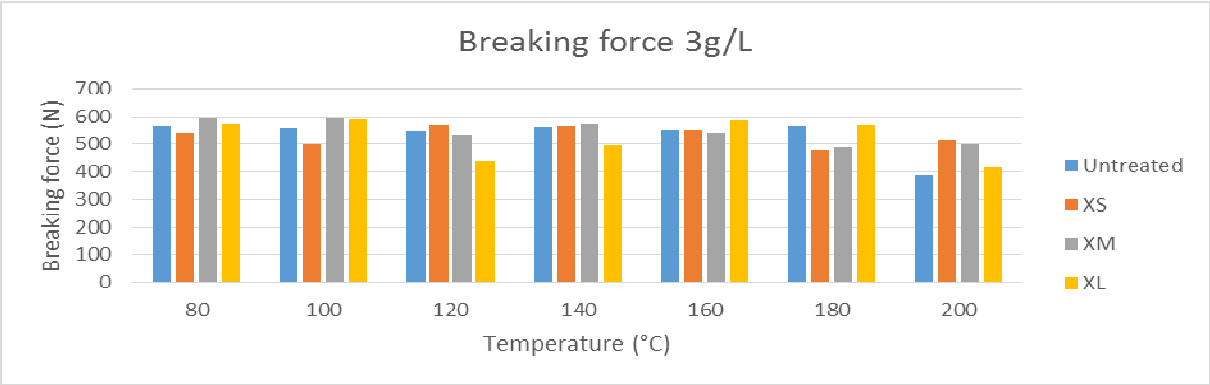

Fig. 4: *Breaking force in the weft condition for 3g/L at different temperatures and the different types of chitosan*

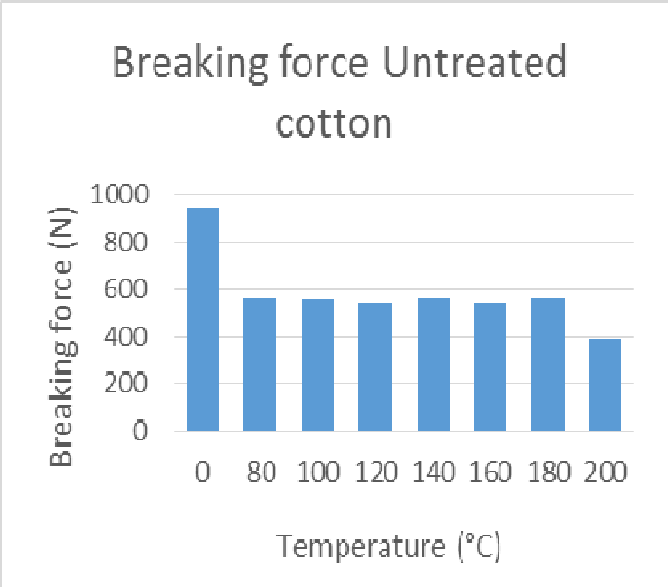

Fig. 5: *Untreated cotton on different curing temperatures (0°C is not cured cotton)*

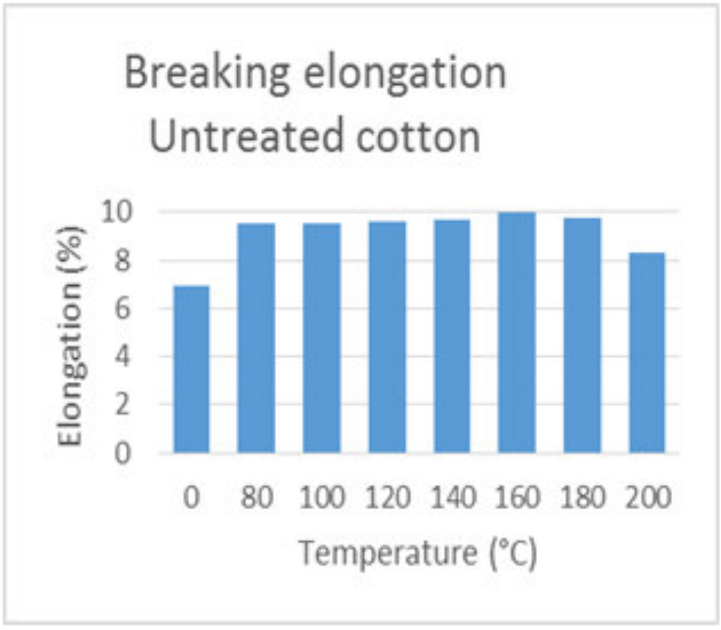

Fig. 6: *Elongation of untreated samples at different temperatures*

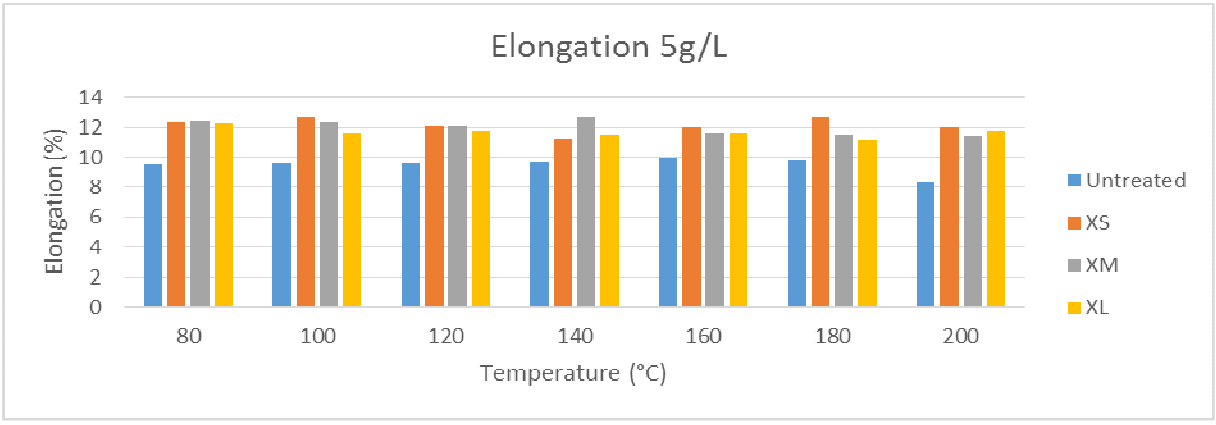

Fig. 7: *Elongation of the fabric cured at different temperatures in the weft direction for treatment with 5g/L*

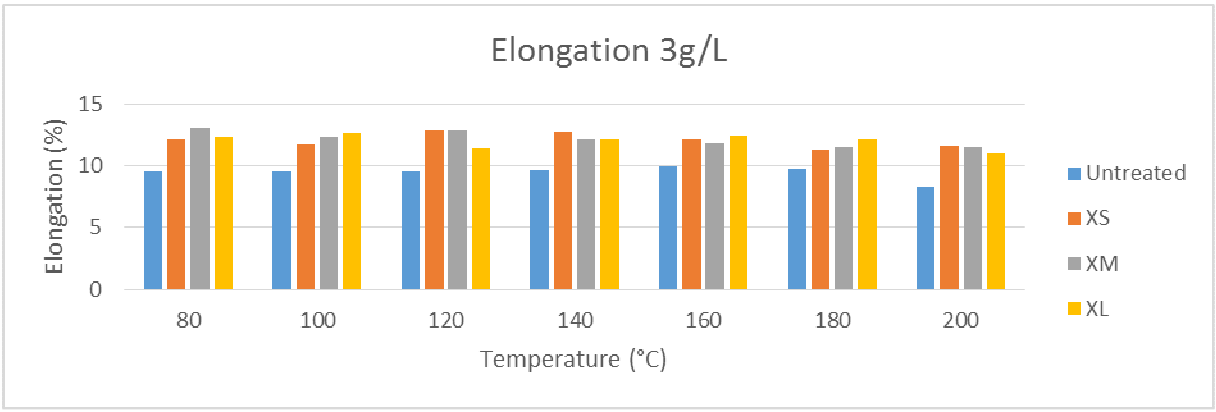

Fig. 8: *Elongation of the fabric cured at different temperatures in the weft direction for treatment with 3g/L*

4.CONCLUSIONS

Breaking force reduces after treatment with heat and chitosan. The reason of the loss in not the treatment with chitosan, but the heat treatment to bond the chitosan with the cotton cellulose. When the temperature gets to high, the cotton starts decomposing and the breaking force reduces significantly.

Elongation increases after treatment with chitosan and heat due to shrinking of the water and heat treatment. It decreases again after decomposing of the cotton.

Chitosan treatment lets the decompising at high temperature become even higer.

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