ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

STRENGTH OF A WAX COATED SILK YARN UNDER PERSPIRATION SOLUTIONS

BONET Maria Angeles [1], BOU-BEDA Eva [1], MARTINEZ-MUNTÓ Raquel [2], GISBERT Payá Jaime [1], DÍAZ GARCÍA Pablo[1]

[1] *Universitat Politècnica de València, Textile and Paper Department, Plaza Ferrándiz y Carbonell s/n, 03801, Alcoy, Spain.*

[2] *Hospital Virgen de los Lirios, C/ Caramanxell s/n, 03804, Alcoy, Spain.*

Corresponding author: Bonet, M. E-mail: maboar@txp.upv.es

Abstract: *Medical products play an importan role in our society. Textile structures offer a wide variety of products which can be used in a wide variety of medical apllications. When treating a deep wound, it needs to be sewed with some yarns in order to stick both sides in the wound. It recquires the yarn to be in contact with the skin and depending on the place the wound is located, it is soaked on corporal fluids such as perspiration, saliva, blood, etc. The aim of this work is to determine if silk threads can be damaged by perspiration and lose some properties. Yarns with different conditions have been treated for 10 days with perspiration solutions and results showed that traction resistance decreases for some of the studied yarns and that microorganisms grow on the yarn surface. Despite the fact that some yarns show antimicrobial treatments, this test showed that wax coated is not enough to prevent the presence of microorganisms on the yarn. This is an important fact as the yarn is in directly in contact with the wounded area and it can implie infections for the patiente. Results evidence that perspiration solutions can reduce the yarn´s resistance and it can be a problem if the yarn lasts longer than 10 days. Obbiously, the test was conducted at room temperature, about 22º C, and patiente´s bodys is at higher levels 36.5-37º C. Thus, further studies should be conducted in order to test temperature or even though fineness influence*

Key words**:** *Yarn, wound, traction resistnace, perspiration, and microrganisms.*

1. INTRODUCTION

Nowadays, medical products play an importan role in our society. They have increased its demand considerably [1]. Its increasing interest and the presence of infectious–contagious diseases has contributed to accelerate the development of new materials in order to answer the recquirements and specifications of helath care services. [1-2]

Textile structures offer a wide variety of products which can be used in diverse medical aplications. When treating a deep wound, it needs to be sewed with some yarns in order to stick both sides in the wound. It recquires the yarn to be in contact with the skin and depending on the place the wound is located, it is soaked on corporal fluids such as perspiration, saliva, blood, etc.

Despite the fact that some publications show the interes in developing new products based on avoiding suture by different methods [3], the use of yarns is far from being forgotten. Some yarns are made of biocompatible or absorbable materials [4-6]. Depending on the place the bound is located the thread material recquires some properties, but absorbable is not allways compulsory.

The aim of this work is to determine if silk threads can be damaged by perspiration and loose some properties. Yarns with different fineness have been treated for 10 days with perspiration solutions and results showed that traction resistance decreases for some of the studied yarns.

2. EXPERIMENTAL

2.1 Materials

One yarn 3.5 metric has been tested. Yarns were labelled as "Wax coated Braided Silk".

2.2 Perspiration text

Perspiration fluid can be prepared by two different recipes depending on the pH of the solution. The test was conducted with two different solutions, acid perspiration or alkali perspiration. Throughout this paper the term "A" will refer to acid and the term "B" will refer to alkali. Solutions were prepeared according to Standard UNE EN ISO 105 E04. Textiles. Test for colour fastness. Part E04: Colour fastness perspiration.

Samples of 200 mm were immersed into 100 mL of solution and they remained on fluid at room temperatura for 10 days and 30 days.

Thus, different references were obtained depending on the pH from the solution and the number of days they had been inmersed on the solution. In this dissertation acronyms have been used. Table 1 Shows the abbreviation for each experiment considering the test conditions.

Table 1: *References for conducted tests*

REFERENCE	SOLUTION	TIME (days)
Y3.5	NONE	0
Y3.5_A10	ACID	10
Y3.5_B10	ALKALINE	10
Y3.5_A30	ACID	30
Y3.5_B30	ALKALINE	30

2.3 Traction Resistance

We evaluated the modification in the traction resistance for the treated yarns and compared with results for the yarn without any perspiration treatment. Traction resistnace test was conducted according to the standard "Textiles. Seam tensile properties of fabrics and made-up textile articles. Part 1: determination of maximum force to seam rupture using the strip method (ISO 13935-1:1999)".

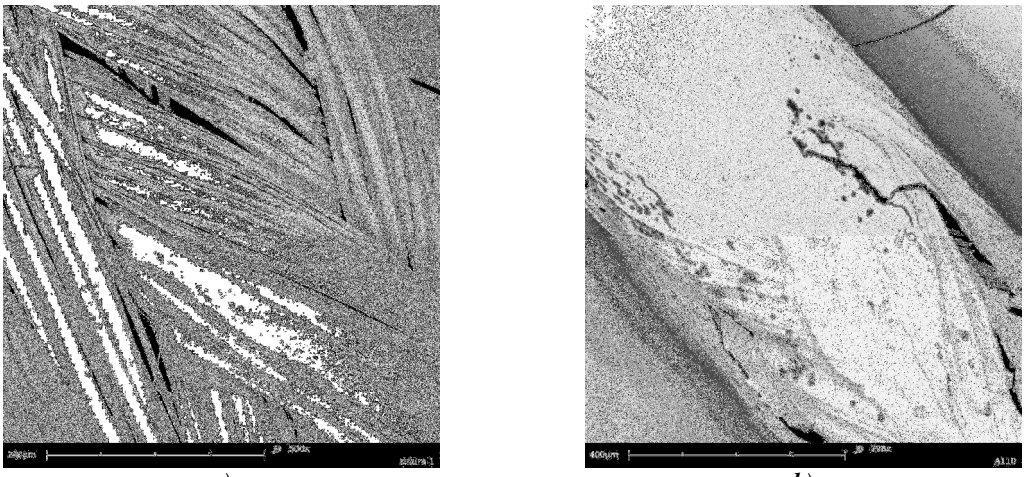
2.4. SEM microscopy.

Yarn surface was obserbed by SEM microscopy. A scanning electron microscopy (Phenom Microscope FEI Company, Hillsboro, OR, USA) was used. Each sample was fixed on a standard sample holder and sputtered with gold and palladium accurately in order to convert the sample into a conductive one so as to be observed properly.

3. RESULTS AND DISCUSSION

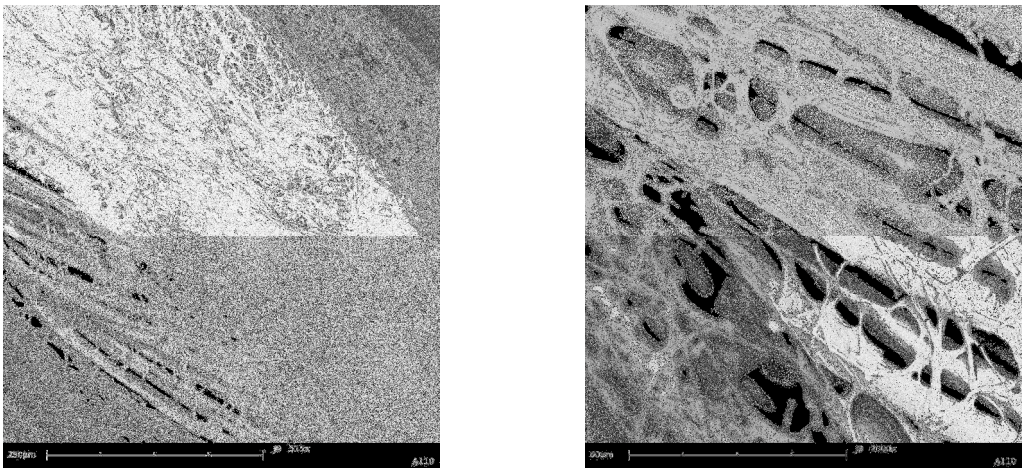
Surprisingly, on the 4^{th} day of treatment some samples innmersed on acid solution showed some white spots on the yarn surface, simmilar to a nonwoven from electrospinning, which implied the grow of microorganisms. It must be pointed out that day-by-day spots appeared in almost every sample, mainly the ones which lasted 30 days.

Figure 1a shows the appearance of the yarn without any treatment, and figure 1b the extent of the microorganisms net on the yarn surface which seems to cover the yarn surface compleately. Figure 2 corresponds to the image from 1b enlarged so that it could be appreciated the net structure of the coating.



a) *b)*

Fig. 1: *Tested yarn. a) Without treatment. b) immersed on acid perspiration solution for 30 days.*



a) *b)*

Fig. 2: *Tested yarn immersed on acid perspiration solution for 30 days.. a) enlarged X500. b) enlarged x2000*

Knowing the presence of microorganisms on the fibres surface, the yarns were thoroughly rinsed with cold water previously to test its traction resistnace. SEM images showed that all the microorganisms net had been removed.

Traction resistance text showed that regarded the was coating on the fibres, the perspiration solution can affect its resistance as it can be observed in table 2.

Table 2: *Traction resistance results*

REFERENCE	HIGH FORCE-FH (N)	ELONGATION (%)
Y3.5	54,26	18,09
Y3.5_A10	54,02	18,01
Y3.5_B10	52,04	17,35
Y3.5_A30	46,68	15,56
Y3.5_B30	45,62	15,21

This study was interpretative in nature, as it could be appreciated from table 2 that the yarn´s traction resistance and elongation was reduced because of its contact with perspiration solutions. As it cpuld be expected, the treatment for 30 days shows a higher reduction than the yarns exposed for 10 days. However, the recution is about 15 % for 30 days.

4. CONCLUSIONS

The reader should bear in mind that the study is based on a small sample, one yarn and two corporal fluids at room temperature. However, some conlusions could be extracted which originate new variables to be studied.

Despite the fact that some yarns show antimicrobial treatments, this test showed that wax coated is not enough to prevent the presence of microorganisms on the yarn. This is an important fact as the yarn is in directly in contact with the wounded area and it can implie infections for the patiente.

Results evidence that perspiration solutions can reduce the yarn´s resistance and it can be a problem if the yarn lasts longer than 10 days.

Obviously, the test was conducted at room temperature, about 22º C, and patiente´s bodys is at higher levels 36.5-37º C. Thus, further studies should be conducted in order to test temperature or even though fineness influence.

REFERENCES

[1] B.K. Behera, H. Arora, *" Surgical Gown: A Critical Review"*. Journal of industrial textiles, 38, 2009, pp. 205-230.

[2] L.M. Ferreira, M.H. Casimiro, C. Oliveira, M.E. Cabeço Silva, M.J. Marques Abreu, A. Coelho*, "Thermal analysis evaluation of mechanical properties changes promoted by gamma radiation on surgical polymeric textiles"*, Nuclear Instruments and Methods in Physics Research B, 191, 2002, pp. 675–679.

[3] Sutureless closure for a skin wound or incisión. US 5176703 Patent.

[4] Method of forming an absorbable biocompatible suture yarn. US5688451 Patent

[5] Method for making prosthesis of polymeric material coated with biocompatible carbón. US 5133845 Patent

[6] C.C. Chu, The effect of pH on the *in vitro* degradation of poly(glycolide lactide) copolymer absorbable sutures. Journal Of Biomedical Materials Research. 16.2.1982. 117-124. DOI: 10.1002/jbm.820160204