BOOK OF ABSTRACTS

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RAUL FANGUEIRO

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FOREWORD

The International Conference on Natural Fibers is established as a leading scientific event on fields related to natural fibers, from harvesting to its application in high demanding areas. Over the last 3 editions this event assumed a very important worldwide placement addressing and defining the most important trends in the field as an outcome of the high quality of the research works presented and the strong interaction among the participants.

Due to the increasing environmental concern and depletion of non-renewable resources, natural fibres are greatly enlarging their range of applications in different industrial sectors including automobiles, sports, architecture, design and many others. Consequently, extensive technological and scientific research and developments are being undertaken by various institutes and companies around the world, turning these amazing materials into eco-friendly added-value products and stepping towards a greener world.

ICNF2019 is dedicated to the topic “Smart and Sustainable Solutions”. In fact, over the last few years, intensive research has been developed to turn natural fibers into smart solutions being able to respond to external stimuli, in addition to their intrinsic sustainable features. Besides, ICNF2019 is covering a wide range of trends defined for natural fibers, with particular emphasis on nanocellulose based fibers and structures, fiber surface treatments, functional natural fibers, smart natural fibers, environmental impact, ecocomposites, biomimetics, and, of course, product development based on natural fibers.

ICNF2019 is the meeting point for all those interested in these fantastic materials called Natural Fibers.

Guimarães, 27th June 2019

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PLASMA PRETREATMENT AND DIGITAL INK JET TECHNOLOGY: A TOOL FOR LONG-LASTING MICROBIAL BARRIER ON CELLULOSE KNITWEAR?

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ABSTRACT
The purpose of this research was to analysed the influence of a plasma treatment on the surface properties of cellulose based knitwear, especially on the hydrophilicity of raw cotton material. The main goal of this research is to answer the question: is it possible to achieve long-lasting barrier of silver nanoparticles on treated substrate using digital textile printing, which aims to improve antimicrobial efficiency? It is certain that plasma pretreatment increases the hydrophilic properties of textile materials and impacts the colour spectral parameters of printed area. An increase in the colour yield and fastness, as well as handle of ink jet printed samples was observed on plasma pre-treated sample materials. Antimicrobial analyses showed that the silver nanoparticles, as active compounds of antimicrobial agent, were partially blocked with polymer, which contributed to limiting effect of antimicrobial effectiveness, while the printed area of the sample exhibited better antimicrobial protection and visible inhibition zone was observed.

INTRODUCTION
In a context of constant research of surface treatment techniques for improving textile properties in a more economical and ecological way, the research on the application of cold plasma technology in the treatment of textiles has markedly developed during the last two decades. Indeed low-pressure plasma treatment is one of the most versatile techniques of material surface modifications and represents safe and dry technique from the ecological and economical aspect. It has been widely used in many applications of textile area for targeted surface modifications including wettability, hydrophobicity, printability, dyeability, antimicrobial efficiency, flame retardancy, adhesion, sterilization, antistatic properties, UV protection etc. (Shishoo 2007; Ledvani 2019). Due to its efficiency, digital Ink Jet printing technology, has demonstrated wider possibilities over the customary textile printing methods, such as excellent pattern quality, considerably little pollution, quick response to the frequent shifts on textile product market and the reduction of overall printing costs. By following an integrated approach, the benefits of textile ink jet printing can be maximized by improving the final printed image quality, colour and colour fastness, as well as the “handle” of the final textile Ink Jet printed product (Dawson 2004). In this paper, the influence of surface pretreatment using oxygen and argon plasma on colour spectral parameters of printed surface, and the effectiveness of antimicrobial treatment by deposition of silver on the pretreated surface were explored.

RESULTS AND CONCLUSIONS
Pretreatment of cellulosic (from raw and lyocell fibres) knitwear for clothes was performed using low-pressure plasma type Nano LF-40 kHz under different plasma processes. Antimicrobial treatments were
done by padding process in a commercial solution containing nanosilver (0.05% iSysAG, CHT). Printing was made with a digital Ink Jet printer (Azon Tex Pro). The color spectral parameters were analyzed with a remission spectrophotometer, while the antimicrobial effectiveness against *E. coli* and *S. aureus* was tested according to standard ISO 20645:2004. According to the results of liquid wicking rate, plasma pretreatments carried out under all tested process conditions resulted in an increase in wicking rate (fig.1a), except for cotton sample treated with argon (4_CO and 5_CO). Nevertheless, all pretreatments caused surface changes that enhanced color yield of digital Ink Jet prints (fig.1b). The pretreatment resulted in an increase in K/S value of 107.5 % for cyan, 23.5 % for magenta, 50.0 % for yellow and 7.46 % for blue color. In accordance to K/S values, optimum treatment conditions for lyocell are exposure time of 2 min at 500 W using argon.

![Graphical representation of a) maximum wicking height obtained with capillarity test in axial direction and b) color differences between untreated and plasma pretreated cotton samples](image)

**Fig. 1** Graphical representation of a) maximum wicking height obtained with capillarity test in axial direction and b) color differences between untreated and plasma pretreated cotton samples

Posteriorly, the samples were inserted into PCA (Plate Count Agar) culture medium containing the bacteria *Listeria* and *Salmonella* to evaluate the growth inhibition.

![Antibacterial activity of treated samples](image)

**Fig. 2** Antibacterial activity of treated samples a) 8_CLY and sample b) 11_CO against *S. aureus*

Overall, pretreated samples of lyocell fibers exhibited higher antibacterial activity against both tested bacteria, and follow conclusion was observed: for achievement of long-lasting barrier of nanosilver using digital textile printing, with aims to prolonged time of antimicrobial efficiency, additional research should be implemented.

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**REFERENCES**

