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Comparison of bleaching treatments of linen fabrics for clothing and furniture applications: conventional versus ozone

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ABSTRACT

Flax is a local fiber mostly produced in France. It is well known by its important properties such as biodegradability, mechanical properties and the facility of cultivation. It doesn't need pesticides or any chemical additives. It is often used for clothing, furniture and as a reinforcement in composite materials. Many chemical treatments should be done to prepare the fabric for the dyeing process, such as scouring and bleaching which consume lots of water and chemical products. Many studies were carried to look for sustainable solutions to reduce environmental impact of conventional pre-treatments. Ozone is generated from oxygen or from dried air and experiments could be performed at ambient conditions without any chemical additives. Ozone is a powerful oxidizing agent which has proved its ability to bleach pulp fibers and to decolorize cotton fabrics dyed with a reactive color. This study explores the ability of ozone treatment to substitute conventional chemical bleaching of Flax fibers.

Keywords: Linen, bleaching, ozone, wettability, mechanical properties, clothing, furniture, sustainable development.

Introduction

Linen is a cellulosic fiber extracted from flax, originated under bast category. The main properties of linen fibers increased their popularity among fashion designers [1]. They are well used for both the apparel and the house- hold textile items because their freshness, comfort, elegance, high tenacity, excellent tensile properties along with good and wicking ability [2]. Many conventional pretreatments, such as decising scouring and bleaching, are done on linen fibers to remove impurities, to improve their wettability, their whiteness and to prepare them for dyeing process. Those pretreatments are harmful for both fibers and environment. Therefore, many trials were set to improve fiber properties after conventional pretreatments and to look for more sustainable methods to reduce environmental impact such as plasma or enzyme treatments [2]. Ozone bleaching has been developed as a reliable and economic technology to bleach cellulosic pulp. It permits low operating costs, lower AOX emissions and better quality of treatments on pulp fibers [3]. This paper studies the impact of ozone bleaching on the linen fabrics properties.

Materials and Methods

A grey linen fabric of plain weave, with a density of 407 g/m², was used for this study.

Ozone treatment was performed in a reactor with a capacity of 80 L at LaSalleO3 (UniLaSalle, France). The reactor is equipped with an ozone generator (Model, Ozonia).

Samples were also bleached chemically in order to compare the results to Ozone bleaching. All Chemical pre-treatments were performed using the Datacolor AHIBA equipment at GEMTEX (ENSAIT, France). Bleaching treatment presents the last stage before dyeing, it helps to obtain a white fabric which permits a good quality of dyeing especially with light colors.

Results and Discussion

Experiments were done with different concentrations of ozone, untreated fabric (a) low ozone concentration (< 15 mg.L of dissolved ozone) on (b) high concentration (> 15 mg.L of dissolved ozone) (c), and as shown in figure 1 fabric was bleached successfully.

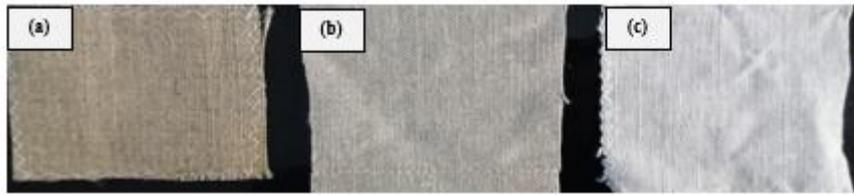


Fig 1: Results of Ozone bleaching treatment with different concentrations of dissolved ozone.

Surface structures of the bleached fabric were observed with an optical microscopy and with a Scanning Electron Microscopy (SEM). As shown in figure 2, the non-treated sample (a, b and c) is grey and fibers are covered with impurities, dust, pectin and lignin. After treatment, [Figure 2 (d, e and f)] fibers were significantly bleached and cleaned from those impurities.

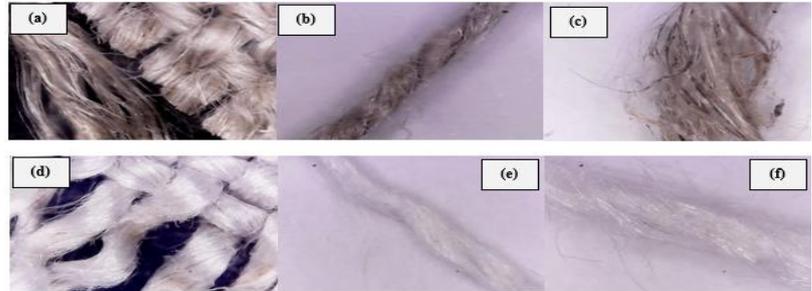


Fig 2: Microscopic pictures of a non-treated sample (a, b and c) and ozonated sample (d, e and f)

SEM pictures in figure 3, show the irregularity of untreated fabric surface (a and b) which became fine and clean in (c and d).

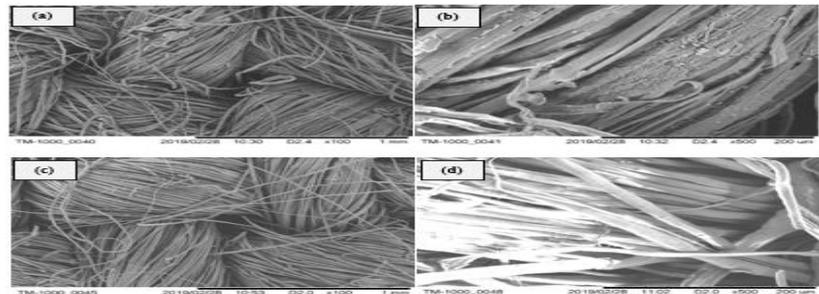


Fig 3: SEM pictures of non-treated fabric (a and b) and ozonated fabric (c and d).

Mechanical properties, spectroscopy and wettability results, including the environmental impact (ACV), will be presented and discussed in our presentation.

Conclusion

Ozone has proved its ability to bleach linen fabrics at ambient temperature and at pH 3. At lower concentration (<15 mg.L of dissolved ozone) the linen fabric wasn't bleached totally while at higher concentration (> 15 mg.L), ozone can damage the fiber surface. This is why the ongoing work aims to optimize the ozonation process by comparing the results obtained with conventional bleaching treatment on linen fabrics.

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