O 88. AN ENVIRONMENTALLY-FRIENDLY BLEACHING FOR HEMP AND LINEN FABRICS

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ABSTRACT: The hemp and linen fibers and the fabrics produced with these materials have great importance in the textile industry due to their lots of beneficial properties. The raw hemp and linen fabrics are bleached in the harsh conditions and these conventional scouring and bleaching processes are costly, non-environmentally friendly and lengthy operation, since it is multistage in nature. For this reason, in the present study, the ecological bleaching facilities for the hemp and linen fabrics, with reinvigorated oxygen molecules were researched. For this purpose, tetraoxygen molecule (O_4), meant reinvigorated oxygen molecules were used. After the process, the bleaching performances of the both samples were compared to conventional bleaching through Berger whiteness value.

Keywords: Hemp, Linen, bleaching, whiteness index, tetraoxygen molecules

1. INTRODUCTION

The cellulosic fibers are commonly used in the textile industry because of the excellent properties. Among the cellulosic fibres, bast fibers such as linen, hemp and jute are so important due to their biodegradable and ecofriendly characteristics (Que et. al, 2005). The bleaching treatments of these fibres are difficult because of the having more impurities in their structure than cotton. However the bleaching proses for the cellulosic materials could be applied with sodium hypocloride, sodium hydroxide or sodium chloride, in the industrial operations, hydrogen peroxide (H_2O_2) is the most common bleaching agent. In the bleaching process of these materials, hydrogen peroxide is generally used by consuming a large quantity of chemicals, various auxiliaries and water at the high temperature. Thus, the conventional bleaching of the linen and hemp materials is costly, non-environmentally friendly and lengthy process, since it is multistage (Perincek et. al., 2013).

During the recent years, every branch of industry has taken precautions in order to use the nature sources more beneficial and went towards to the clean technologies due to the problems of environmental pollution, limited water sources, and wasting of energy, etc. (Beşen, 2012; Beşen and Balcı, 2016; Gülümser et.al., 2009; Perincek, 2006; Perincek et.al., 2009; Sancar and Balcı, 2013). The environmental impacts of industry can be substantially reduced via using advanced techniques and technologies, which help to decrease wasting of energy and water, and cut emissions (Öztürk and Eren, 2010; Pazarlıoğlu et.al., 2005; Perincek et. al., 2007). Through the advanced technologies, ozone application has had high popularity for many years (Beşen, 2012).

The ozone (O_3) is the most extremely strong oxidant known after the fluorine (Perincek, 2006; Beşen, 2012) and it is prone to participate in many chemical reactions with inorganic and organic substances due to strong oxidizing property (Perincek et.al., 2007; Hsu et.al, 2001; Sancar and Balcı, 2013). Due to this property, it is used in many industrial applications. Recently, reinvigorated oxygen molecules have been used as an alternative of the ozone gas. The reinvigorated oxygen molecules were reported as more effective and consuming less energy than ozone, as well as non-toxic.

In the present study, in order to bleach the linen and hemp fabrics via environmental-friendly way, the possibilities of bleaching these fabrics with the reinvigorated oxygen molecules were investigated. This environmental friendly bleaching process was compared with the conventional H_2O_2 bleaching. After the process, the whiteness degrees (Berger) and CIELab color values of the fabrics were measured.

2. MATERIAL AND METHOD

2.1. Material

In the environmental friendly bleaching processes, the reinvigorated oxygen molecules generator having 50 g/h capacity, a glass colon having 2-liter capacity and a stone diffuser were used. In the conventional bleaching processes, H_2O_2, NaOH, organic stabilizer, and washing agent were used. All the chemicals were used without purifications. The distilled water was used in the experiments.
Raw woven linen and hemp fabrics were used. Both fabrics were plain woven (1x1) having 20 yarn/cm weft and warp density (yarn count: Nm20).

2.2 Method

In the environmental friendly bleaching, the fabric samples were placed in to the glass colon which was filled with 1 liter distilled water. The reinvigorated oxygen molecules produced by the generator was directed to the fabric samples through the diffuser placed at the bottom of the glass colon. The application was applied at the room temperature till the fabric samples had white color. The applications lasted 1 hour for the linen fabric while 4 hours for the hemp one.
The conventional bleaching was applied with exhaust process, and the liquor ratio was determined as 1:40. The process was carried out with the application recipe given in Table 1 at 80 ˚C during 90 minutes. After the process, the fabric samples were washed with boiling water for 10 minutes, then overflow cold washing for 5 minutes.

Table 1. The application recipe of the conventional bleaching

Chemical	Amount (ml/l)
H_2O_2	2
NaOH	1
Organic stabilizer	4
Washing agent	2

After the processes, the fabric samples were dried at the room temperature and the whiteness degrees and CIELab color values of the samples were measured via spectrophotometer (Datacolor). All of the samples were measured for three times and the average of the results were calculated. The whiteness degrees were measured in order to investigate the bleaching effect of the reinvigorated oxygen molecules on the linen and hemp fabrics while the CIELab color values were measured in order to research whether the reinvigorated oxygen molecules caused the yellowing effect on the fabrics.

3. RESEARCH FINDINGS

3.1. The Whiteness Degrees of the Fabric Samples

The whiteness degrees of the raw and both conventional and environmentally-friendly bleached fabric samples were given in Table 2.

Table 2. The whiteness degrees of the fabric samples

Fabric Sample	Whiteness Degree (Berger)
Raw Linen Fabric	16,20
Conventional Bleached Linen	26,11
Environmentally-Friendly Bleached Linen	25,11
Raw Hemp	9,20
Conventional Bleached Hemp	19,91
Environmentally-Friendly Bleached Hemp	31,74

When Table 2 was focused, it could be seen that the environmentally- friendly bleached linen fabric sample had approximate Berger value with the conventional one while the hemp fabric had higher. Thus, it could be said that it was possible to bleach linen and hemp fabrics via reinvigorated oxygen molecules as environmentally-friendly way. In addition, the whiteness degrees of the fabric samples could be adjusted according to the requested amount by the way of changing of the application time of the reinvigorated oxygen molecules.

3.2. The CIELab color values of the Samples

The CIELab color values of the fabric samples were given in Table 3.

Table 3. The CIELab values of the fabric samples

Fabric Sample	CIELab Values				
	L^*	a^*	b^*	C^*	h°
Raw Linen Fabric	71,53	1,82	8,17	8,37	82,96
Conventional Bleached Linen	80,85	1,21	8,20	8,29	83,66
Environmentally-Friendly Bleached Linen	80,71	1,27	8,42	8,51	83,63
Raw Hemp	68,76	1,62	10,08	10,21	83,49
Conventional Bleached Hemp	85,20	1,16	11,24	11,30	84,09
Environmentally-Friendly Bleached Hemp	75,64	0,79	4,90	4,96	80,80

In the CIELab color system, while the L^* value indicates the lightness and darkness, the b^* value gives information about the yellowness and blueness of the fabric samples. The L^* value changes between 0 and 100, and the color becomes lighter as the L^* value increases. The increment in the b^* values mean that the color goes to the yellowness. The a^* value is about the reddish and greenish of the fabric and the reddish of the sample increases as the value rises. Table 3 showed that the reinvigorated oxygen molecules did not cause the yellowing effect on the samples, contrary yellowness of the samples declined by the applications.

4. CONLUSIONS AND DISCUSSION

Recently, due to environmental consciousness, it has been necessity to move towards environmentally-friendly processes for every branches of industries. At this scope, there are a lot of actions in the textile industries. The ozone applications are one of them and they are applied at the bleaching in the pretreatment process, garment washing in denim production or fading process for many years. In the present study, the possibilities of bleaching the linen and hemp fabric samples through the reinvigorated oxygen molecules as an alternative way to the ozone gas were investigated. For this purpose, the

reinvigorated oxygen molecules were applied to the fabric samples in the water till the fabric samples had white color. In order to compare the results, the bleaching process was also carried out with the conventional one. After the processes, the whiteness degrees and CIELab color values of the fabric samples were measured. The results showed that it was possible to bleach linen and hemp fabric samples with reinvigorated oxygen molecules, and the whiteness degrees of the fabrics could be adjusted according to the requested amount by the way of changing of the application time.

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