DETERMINATION OF WEIGHT LOSS PERCENTAGE AFTER BLEACHING OF CELLULOSE FABRICS WITH VARIOUS BLEACHING AGENTS

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Abstract: *Good preparation on textile materials is very much needed for successful coloration. Natural or synthetic chemicals in the fibres can interfere with wetting and dyeing performance. Hence preparation is the series of processes used to remove these chemicals for the effective coloration and finishing of textile materials. By the good preparation of a material it is possible to produce an even and regular colour on the material with facing least difficulties. The aim of this paper is to determine the weight loss percentage after bleaching of different cellulose fabrics with various bleaching agents. For this investigation commercially available three types of cellulose fabrics such as plain weave, single jersey and (1x1) rib have been chosen. Weights of these fabrics were calculated before and after bleaching with two different bleaching agents such as sodium hypochlorite and hydrogen per oxide. From the weight variations, weight loss percentages of these three fabrics have been calculated and after the completion of this investigation weight loss percentages were found to be less after using hydrogen peroxide as compared to sodium hypochlorite.*

Keywords: *Bleaching, Chromophore, Oxidizing Agent, Per Hydroxyl Ion, Hypochlorous Ion, Dechlorination.*

1. Introduction

The objective of preparation is to remove as much of the unwanted impurities and colour as possible from the fibres to produce a fabric that will uniformly absorb the solution of dyes and chemicals. [1] Hence the coloration process will be uniform. Scouring generally removes all impurities except the natural colouring matters which have to be broken down by bleaching operation either with an oxidizing or a reducing bleaching agent. Almost invariably the oxidizing agents give a more permanent white. When the colour is acted upon by a reducing agent, there is always the possibility that the oxygen in the air may reoxidize it to its original state.[2] Today the most commercial bleaches are oxidizing agents, such as sodium hypochlorite (NaOCl), hydrogen peroxide (H_2O_2), Calcium hypochlorite $Ca(OCl)_2$ etc. which are quite effective in "decolorizing" of substances via oxidation.[3] After bleaching operation the weight loss of textile materials takes place and it depends on different types of bleaching agents which are used. The bleaching process also eliminates any traces of other impurities remaining from the previous preparation steps and improves the absorbency of the material for dyeing and printing. Bleaching may be the only preparatory process or it may be used in conjunction with other treatments, e.g. desizing, scouring and mercerizing. During bleaching operation other chemicals will be used in addition to the bleaching agent. These serve various functions such as to activate the bleaching system, to stabilize or control the rate of activation, to give wetting and detergent action, to sequester metallic impurities etc. This section gives consideration to the selection of bleaching agents and to the role of the various chemicals used in conjunction. [4] Colour in organic materials is the result of light absorption by certain chemical configurations called chromophores in molecules. C=C and C=O are some examples of chromophores. A chromophore, eg C=C and C=O, is a part of a molecule that is able to absorb UV or visible light and producing color in organic compounds. Oxidizing bleaches break up these double bonds whereas reducing bleaches convert double bonds into single bonds.[5] Recall that an oxidizing agent is any substance which causes another

substance to loose one or more electrons. The decolorizing action of bleaches is due in part to their ability to remove these electrons which are activated by visible light to produce the various colours.[6] Sodium hypochlorite (NaOCl) is ionized into metallic oxide and hypochlorous acid. Produced hypochlorous acid (HOCl) is then decomposed into hypochlorous ion (OCl^-) which is responsible for bleaching action and will produce a white material.

$$NaOCl + H_2O \longrightarrow NaOH + HOCl$$
$$HOCl \longrightarrow H^+ + OCl^-$$

Fabrics bleached with hypochlorite will develop a distinctive chlorine odour. This odour can easily be removed with an after treatment consisting of sodium bisulphate or acetic acid. [7] It was at one time believed that the bleaching action of hydrogen peroxide was due to the liberation of nascent oxygen but this explanation is no longer tenable. It is known that under certain conditions, particularly with regard to P^H, hydrogen peroxide will liberate hydrogen and per hydroxyl ions in the following manner:

$$H_2O_2 \longrightarrow H^+ + HO_2^-$$

Alkalinity favours the liberation of perhydroxyl ions but alkalinity causes the peroxide to become unstable. Catalyst may promote the alternative reaction:

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

This liberated oxygen has no bleaching action and the catalysts are therefore a cause of loss of bleaching agent. [8]Due to the removal of colouring matters and fibres damage in bleaching, textile materials may loose its considerable weight and strength of materials can be highly affected for excessive fibre damage. So it is very necessary to study the weight loss of various fabrics occurred during different bleaching processes. However, the weight loss in case of various fabrics after bleaching with different bleaching agents is not clearly evaluated before.

The aim of this paper is to determine the weight loss percentage after bleaching of cellulose fabrics with various bleaching Agents.

2. Materials and Methods

2.1 Materials

For this investigation three types of cellulose fabrics have been chosen. Specifications of selected fabrics are mentioned below-

Fabric No.: 01
Fabric type: Plain weave
Fabric composition: 100% cotton fibre
Ends/inch: 62
Picks/inch: 50
Warp count (Ne): 20 Ne
Weft count (Ne): 20 Ne
Twist/inch: 16
Yarn twist direction: Z-twist
Fabric surface area density (gm/m^2): 164

Fabric No.: 02
Fabric type: Single jersey
Fabric composition: 100% cotton fibre
Course/cm: 50
Wales/cm: 37
Yarn count (Ne): 34 Ne
Twist/inch: 24
Yarn twist direction: Z-twist
Fabric surface area density (gm/m^2): 149

Fabric No.: 03
Fabric type: (1×1) Rib
Fabric composition: 100% cotton fibre
Course/cm: 76
Wales/cm: 31
Yarn count (Ne): 34 Ne
Twist/inch: 18
Yarn twist direction: Z-twist
Fabric surface area density (gm/m^2): 170

2.2 Methods

2.2.1 Method of Bleaching with Sodium hypochlorite (NaOCl):

Selected fabrics have been immersed in the bleaching solution with Sodium hypochlorite (NaOCl) bleaching agent and for this purpose following standard recipe was used.

Table 1: Recipe for bleaching with Sodium hypochlorite (NaOCl)

Chemicals used	Amount
Sodium hypochlorite (99.9% NaOCl)	4 g/l
Na_2CO_3	3 %
PCLF (Detergent)	0.5 g/l
P^H	9.0
M: L Ratio	1:10
Temperature	60^0 C
Time	6 hours

After bleaching operation at 60^0 C for 6 hours the fabrics were taken in hot and cold bath for proper rinsing and washing. The bleached fabrics were then neutralized with 0.5 gram/litre acetic acid (CH_3COOH) at 80^0C for 15 minutes. After that bleached fabrics were subjected to dechlorination or "antichlor" treatment which was affected by bisulphate in recipe as mentioned below.

Table 2: Recipe for dechlorination

Chemicals used	Amount
Sodium bisulphite	2 %
M: L Ratio	1:10
Temperature	40^0 C
Time	15 minutes

2.2.2 Method of Bleaching with Hydrogen Peroxide (H_2O_2):

Selected fabrics have been immersed in the bleaching solution with hydrogen peroxide (H_2O_2) bleaching agent and for this purpose following standard recipe was used.

Table 3: Recipe for bleaching with Hydrogen Peroxide (H_2O_2)

Chemicals used	Amount
HydrogenPeroxide (35% H_2O_2)	4 g/l
Peroxide Stabilizer	1.5 g/l
Na_2CO_3	5 g/l
PCLF(Detergent)	0.5 g/l
P^H	10.5
M: L Ratio	1:10
Temperature	95^0 C
Time	1 hour

After bleaching operation at 95^0C for 1 hour the fabrics were taken in hot and cold bath for proper rinsing and washing. The bleached fabrics were then neutralized with 0.5 gram/litre acetic acid (CH_3COOH) at 80^0 C for 15 minutes.

2.2.3 Method of weight loss percentage (%) calculation:

Weight of three types of cellulose fabrics have been measured before and after bleaching process for using both bleaching agents. For weight measuring purpose digital electronic balance was used. After weight measurement, loss in weights due to bleaching were calculated and expressed as percentage.

3. Result and Discussion

3.1 Weight loss (%) of various fabrics after bleaching with Sodium hypochlorite (NaOCl):

Table 4: Determination of weight loss (%) for various fabrics after bleaching with Sodium hypochlorite (NaOCl)

Fabric no.	1	2	3
Fabric type	Plain Weave	Single Jersey	(1×1) Rib
Weight of Unbleached fabric (gm)	5	5	5
Weight of Bleached fabric (gm)	4.47	4.74	4.36
Weight Loss (%) after bleaching	10.60	5.20	12.80

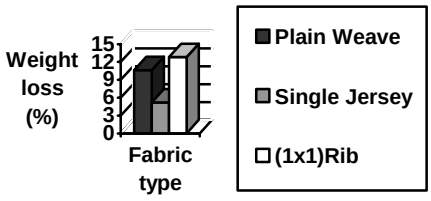

Fig. 1: Curve of Weight loss (%) for various fabrics after bleaching with Sodium hypochlorite (NaOCl)

The Fig.1 is representing the maximum weight loss of (1x1) Rib fabric after bleaching with

sodium hypochlorite (NaOCl) whereas this is minor for single jersey and moderate for plain weave as gsm (gm/m^2) were different for different fabrics.

3.2 Weight loss (%) of various fabrics after bleaching with Hydrogen peroxide (H_2O_2):

Table 5: Determination of weight loss (%) for various fabrics after bleaching with hydrogen peroxide (H_2O_2)

Fabric no.	1	2	3
Fabric type	Plain Weave	Single Jersey	(1×1) Rib
Weight of Unbleached fabric (gm)	5	5	5
Weight of Bleached fabric (gm)	4.63	4.82	4.51
Weight Loss (%) after bleaching	7.40	3.60	9.80

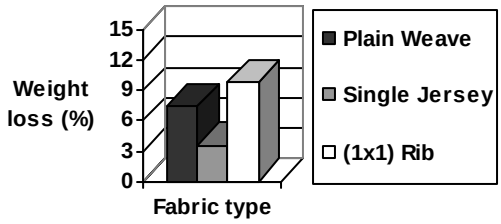

Fig. 2: Curve of Weight loss (%) for various fabrics after bleaching with hydrogen peroxide (H_2O_2)

The Fig.2 is representing the maximum weight loss of (1x1) Rib fabric due to bleaching with hydrogen peroxide (H_2O_2) whereas this is minor for single jersey and moderate for plain weave due to variations in gsm (gm/m^2) of different fabrics.

3.3 Weight loss (%) of various fabrics after bleaching with Sodium hypochlorite (NaOCl) and hydrogen peroxide (H_2O_2):

Table 6: Determination of weight loss (%) for various fabrics after bleaching with hydrogen peroxide (H_2O_2) and Sodium hypochlorite (NaOCl)

Fabric no.	1	2	3
Fabric type	Plain Weave	Single Jersey	(1×1) Rib
Weight loss (%) after bleaching with NaOCl	10.60	5.20	12.80
Weight loss (%) after bleaching with H_2O_2	7.40	3.60	9.80

From the table 6, it can be notified that between two bleaching agents the weight loss of three fabrics has become higher for using sodium hypochlorite (NaOCl) compare to hydrogen per oxide (H_2O_2) as fibres have been damaged in greater extent during bleaching process.

4. Conclusion

Bleaching is very necessary to remove colouring matters from cellulose fabrics and bleaching agents must be taken into consideration for that purpose. But it is most important to identify which bleaching agent is more effective for bleaching as well as industrial use. By this investigation it was possible to make a comparison between two different types of bleaching agent such as sodium hypochlorite and hydrogen peroxide and it can be said that both not lead to same results. Results show that the hydrogen peroxide is most effective bleaching agent as amount of fibres damged for applying this is less than sodium hypochlorite for cellulose fabrics. So this paper will help to select a suitable bleaching agent for bleaching of different cellulose fabrics.

References

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