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Influence of Industrial Bleach Wash on the Physical and Comfort Properties of Denim Garments

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ABSTRACT

As the faded denim or old look denim is preferred by the today's youth, washing has become a crucial issue for the technologists to modify denim apparel to fulfill the demand of existing trend. The main factors affecting consumers when selecting garments are aesthetic appearance and fashion. Denim garments are subjected in industrial washing to obtain specific appearance and handle. The washing and finishing processes are utilized for the purpose of fashion and different recipes are applied for different effects which are quite significant for marketing. Washing is a novel process to impart worn-out look, to modify the appearance and to improve the comfort ability of apparel. Bleach wash is used to fade the color of denim as well as it has an effect on the physical and comfort properties of the denim also. This project represents the impact of bleach wash and subsequent softening treatment on 98.88% cotton, 1.12% spandex denim dyed with Sulphur bottom Indigo top (SBIT). Garments are washed using a different bleach concentration i.e. 3 g/l, 5g/l and 10 g/l for the constant time and temperature i.e. 30 minutes and 60°C and then softened using standard recipe. The physical and comfort properties are analyzed in before wash, after bleaching and after softening. The properties that are analyzed include GSM, shrinkage, EPI and PPI, stiffness, tensile strength, tear strength, drape test and comfort properties. Bleach washed and softened garments exhibit a great difference in the physical and comfort properties than the unwashed garments.

Keywords: Denim, Bleach wash, Physical properties, Comfort

1. Introduction

Among all the textile products, no other fabric has received such a wide acceptance as denim garments [1]. It can be considered as the most widely used garment in the fashion business. It is well known that denim and jeans have had a major influence on the lives of consumers since their inception [2].

Denim has a lot of demand in the market of regular garments as well as in the fashion market. People of all ages, especially the youth have a great interest on the denim. Different values by adding processes like industrial washing make denims not only look beautiful but also impart some functional properties to the garments [3].

In the readymade garments industry sector garments washing is a new technology. After making garments from solid color from dyed or pigment printed fabrics, the garments are washed by garments washing, color and outlook of the garments are modified. As a result, new outlook and appearance is produced in the garments, which is not possible in any other method [4]. Among different techniques of garments washing, bleach wash is chosen to fade a higher degree of color. It is very difficult without bleach wash, to fade the color from all over the garments at one wash in such a higher degree. That's why despite of having some drawbacks like- bleach decomposes the cellulose hence destroys the fabric, tends to make the fabric yellowish, needs to be neutralized hence increases cost and adds a more step to the processing time the bleach wash cannot be avoided. Besides these drawbacks, bleaching agents especially chlorine bleaches are health hazardous and the effluents are hazardous to the environment [5], the process controlling is very tough and same results

cannot be achieved in every batch even after following the same recipe [6]. Bangladesh is a country where ready-made garments are the top export item and among ready-made garments the share of woven items is maximum [7].

The aim of this project work was to analysis of comfort, tensile strength, tear strength, drape ability, GSM, stiffness, shrinkage, EPI and PPI of denim garments. The findings of this research work will help the technologists to explore the consequence of bleach wash on 98% cotton with 1.12% spandex denim apparel at different concentration while the washing time and temperature remain same.

Objectives:

The objectives of this project were-

- i. To study of various types of washing process.
- ii. To study and analysis of different physical and comfort properties of denim garments after bleach washing and softening.
- iii. To comparison of physical and comfort properties of denim garments between before washing and after bleach washing and softening.
- iv. To characterize the effect of concentration of bleaching powder on the physical and comfort properties of denim garments.
- v. To characterize the effect of softening process on the physical and comfort properties of denim garments.

2. Methodology

Sample collection:

Sample collected from apparel washing laboratory

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Type: Denim garments.
 Fabric: 98.88% cotton, 1.12% spandex twill (3/1)
 Construction: (12OSL+12oe) × 12L40D/85×55
 Dye type for warp yarn: We used Sulphur bottom
 Indigo top (SBIT) fabric of different concentration.
 Bleaching powder: Chlorine Bleach: 35% chlorine.
 Origin: China.
 Experimental Condition:

Table 1 Experimental Condition of Bleach wash.

	Condition 1	Condition 2	Condition 3
Sample	1kg	1kg	1kg
M:L	1:8	1:8	1:8
Bleach	3g/l	5g/l	10g/l
Temp	60°C	60°C	60°C
Time	30min	30min	30min

Procedure of Bleach Wash:

Calcium Hypochlorite Bleaching was used to perform the bleach wash due to its availability rather than Sodium Hypochlorite. The following steps were involved in bleach wash procedure.

Desizing procedure:

The initial treatment of bleach wash was desizing process which was carried out by desizing agent (DP-7). The purpose of desizing process was to remove the starch materials present in the garments fabric.

Table 2 Recipe of desizing procedure.

Recipe	Sample 1	Sample 2	Sample 3
Lot size	1kg	1kg	1kg
Water@ of 1:8	8 litre	8 litre	8 litre
Desizing agent	15g	15g	15g
Temperature	55°C	55°C	55°C
Time	15 min	15 min	15 min

Then dropped the liquor and cold washed for 3 minutes. This process of cold was done for three times.

Bleaching procedure:

Calcium hypochlorite bleaching is carried out to increase the fading effect of overall garments.

Table 3 Recipe of bleaching procedure.

Recipe	Sample 1	Sample 2	Sample 3
Liquor ratio	1:8	1:8	1:8
Calcium Hypo chloride	3g/l	5g/l	10g/l
pH	8	8	8
Temperature	60°C	60°C	60°C
Time	30 min	30min	30 min

Then drop the liquor and cold wash of 3 min at 2 times.

Neutralization:

After the beaching treatment the neutral wash was completed by the reducing agent sodium hyposulphite.

Table 4 Recipe of neutralization process.

Recipe	Sample 1	Sample 2	Sample 3
Liquor ratio	1:7	1:7	1:7
Sodium Hyposulphite	0.714g/l	0.714g/l	0.714g/l
Temperature	60°C	60°C	60°C
Time	5 min	5 min	5 min

Then drop the liquor and cold wash of 3 min at 2 times.

Softening process:

To improve fabric handle and other valuable properties, softeners are widely used in the finishing process.

Table 5 Recipe of Softening process.

Recipe	Sample 1	Sample 2	Sample 3
Liquor ratio	1:10	1:10	1:10
Softener	8.33g/l	8.33g/l	8.33g/l
Temperature	40°C	40°C	40°C
Time	5min	5min	5min

Then dropped the liquor and unloaded the garments from the washing machine into a perforated trolley.

Hydro-extraction process:

After unloading garments from the washing machine garments were sent to hydro extractor machine for removing excess water from the washed garments.

Drying process:

Then the garments were dried with the help of garments drying machine at 100°C for 15 min following a cold dry of 10 min to return the garments in normal position.

3. Results and Discussion:

A comparative study and analysis of physical and comfort properties of denim garments between before wash and after wash.

3.1 Shrinkage Test:

Shrinkage percentage= (change in length after wash / original length) × 100%.

Sample size: 35cm×35cm

Equipment: (i) Scale (ii) Template (iii) Scissor (iv) Chalk

Table 6 Effect of bleach washing on Shrinkage.

Concentration	Shrinkage (%)	
	Warp way shrinkage (%)	Weft way shrinkage (%)
3gpl, Bleach	2.77	12.85
3gpl, Bleach & softening	2.57	13.82
5gpl, Bleach	3.14	14.97
5gpl, Bleach & softening	3.14	14.77
10gpl, Bleach	3.14	13.71
10gpl, Bleach & softening	3.14	14.28

From the above table 6 it is seen that shrinkage increased gradually in warp way both for bleaching and softening as concentration of bleaching powder increased. In weft way shrinkage was increased for 3gpl and 5gpl both for bleaching and softening. But for 10gpl, shrinkage was decreased for bleaching in weft way than 5gpl.

GSM Test

Equipment: (i) GSM cutter (ii) Electronic balance

Table 7 Effect of bleach washing on GSM.

Concentration	Condition	GSM
3gpl	Before Wash	333
	Bleach	359
	Bleach & Softened	372
	Bleach	355
5gpl	Bleach & Softened	372
	Bleach	351
10gpl	Bleach & Softened	375

From the above table7 it can be said that GSM increased gradually for bleaching and softening as concentration of bleaching powder increased comparing with the unwashed garments. But for 10gpl GSM was decreased for bleaching than 3gpl and 5gpl.

EPI & PPI Test:

Sample size: 1 inch × 1 inch

Equipment: (i) Counting glass (ii) Scale (iii) Needle (iv) Scissor (v) Chalk

Table 8 Effect of bleach washing on EPI and PPI.

Concentration	Condition	EPI	PPI
3gpl	Before wash	85	55
	Bleach	96	56
	Bleach & Softened	100	55
	Bleach	92	57
5gpl	Bleach & Softened	96	51
	Bleach	104	56
10gpl	Bleach & Softened	112	54

From the above table 8 it is clear that EPI is increased as concentration of bleaching powder increased in both for bleaching and softening comparing with the unwashed

garments. But PPI is increased only for bleach as concentration of bleaching powder increased.

Stiffness Test:

Sample size: 204mm×102mm

Equipment: (i) Scissor (ii) Chalk (iii) Template (iv) Stiffness tester

Table 9 Effect of bleach washing on Stiffness.

Concentration	Condition	Stiffness
3gpl	Before wash	10.5 N
	Bleach	5.2 N
	Bleach & Softened	3.8 N
	Bleach	4.3 N
5gpl	Bleach & Softened	3.6 N
	Bleach	3.8 N
10gpl	Bleach & Softened	3.6 N

From the above table 9 it is clear that stiffness has diminishing characteristics in both for bleaching and softening as concentration of bleaching powder increased.

Tensile Strength Test

Sample size: (i) 20cm × 10cm (for warp) (ii) 10cm × 20cm (for weft)

Equipment: (i) Titan-5 (vertical strength tester) (ii) Scale (iii) Template (iv) Scissor (v) Chalk Method: ASTM-D 5034

Table 10 Effect of bleach washing on Tensile strength.

Concentration	Tensile Strength (Newton)	
Before wash	Warp	696.23
	Weft	504.56
3gpl, Bleach	Warp	673.36
	Weft	429.45
3gpl, Bleach and softened	Warp	612.47
	Weft	395.41
5gpl, Bleach	Warp	617.63
	Weft	399.32
5gpl, Bleach and softened	Warp	456.39
	Weft	338.95
10gpl, Bleach	Warp	448.36
	Weft	289.06
10gpl, Bleach and softened	Warp	363.02
	Weft	261.99

From the above table 10 it is seen that strength of the denim garments decreased in both warp and weft way as concentration of bleaching powder increased both for bleaching and bleaching & softening.

Tear Strength Test:

Sample size: 100mm × 63mm

Equipment: (i) Elma Tear Tester (ii) Scale (iii)

Template (iv) Scissor (v) Chalk Method: ASTM-D 1424

Table 11 Effect of bleach washing on Tear strength.

Concentration	Tear Strength (Newton)	
Before wash	Warp	63.10
	Weft	64.76
3gpl, Bleach	Warp	44.99
	Weft	46.62
3gpl, Bleach and softened	Warp	44.53
	Weft	44.14
5gpl, Bleach	Warp	39.59
	Weft	41.45
5gpl, Bleach and softened	Warp	39.07
	Weft	38.68
10gpl, Bleach	Warp	25.56
	Weft	27.33
10gpl, Bleach and softened	Warp	26.03
	Weft	33.83

From the above table 11 it is seen that tear strength of the denim garments decreased both for bleaching and softening in warp and weft way as concentration of bleaching powder increased.

Drape Test:

Sample size: 18cm in dia

Equipment: (i) Drape Tester (ii) Scale (iii) Template

(iv) Scissor (v) Chalk

Table 12 Effect bleach washing on Drapability.

Concentration	Static Drape Coefficient %	Dynamic Drape Coefficient (%)
Before Wash	100	100
3gpl, Bleach	96.95	93.32
3gpl, Bleach & Softened	95.91	93.93
5gpl, Bleach	90.74	93.03
5gpl, Bleach & Softened	89.59	92.80
10gpl, Bleach	87.95	90.35
10gpl, Bleach & Softened	87.22	90.11

From the above table 12 it is obvious that drapability of the denim garments increased with the increasing of concentration of bleaching powder.

4. Conclusion

To complete this research work 3/1 right hand twill stretch fabric was used. The construction of the fabric was (12OSL+12oe) ×12L40D/85×55 where lycra was inserted with weft at the percentage of 1.12. Due to the presence of lycra in the fabric, shrinkage was increased both in warp way and weft way but weft way shrinkage was higher than warp way direction. As shrinkage occurred, GSM and EPI×PPI were gradually increased with the increasing of concentration of bleaching powder. But Tear strength, Tensile strength and Stiffness were gradually decreased with the increasing of concentration of bleaching powder comparing with unwashed fabric. From this experiment it is concluded that, for 5gpl concentration comfort property was not up to the mark. But physical properties were good enough comparing with consumers recommendation.

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