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An explanation of bleach wash on denim cotton fabrics

Abstract

The process of giving denim special washed or vintage looks and color effects after stitching it into jeans or other garments. Different denim washing methods have been developed and used on various fabrics to produce a wide number of designs for fashionable denim garments and jeans over the last few decades. This study focused on the washing of denim fabrics with bleach and its effects on the denim fabrics. There were a total of three samples of three different structures of denim and bleached each sample in three different shades; light, medium, and dark. Among these samples, two samples were an indigo blue color, the composition of 98% cotton, 2% spandex, GSM–350 and 99% cotton, 1% spandex, GSM–330 respectively. KCI bleach for these two samples has found a good result. Another sample was black, 100% cotton, GSM–290. KCI bleach also applied on it but the result was not desired, bleaching results in a reddish effect over the fabrics, washed the remaining portion of the fabrics in caustic soda and got the desired result.

Keywords: denim, spandex, KCI bleach, caustic soda

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Introduction

Denim such a fabric that immensely using to make Shirts, Coats, Dungaree, Tops and Bottoms item. The major using products of denim fabric are Pants which is over 80% of total denim fabric consume and day by day consumer showing more interest in denim fabric made items. According to the sustainability of denim, the item is undoubtfully better than other fabric made products. Now, these days giant clothing brands such as H&M, Inditex, CK, C&A, Canadian Tiar, Primark are focusing more on denim products. Due to the priority of denim products for customer and competitive products price therefore economically taking a large part of outlet selling.

To get an aesthetic outlook, different types of wash applied on denim fabric and one of the most used wash is Bleach. Now, these days major concerning matter is the environment. Requires 1500 gallons of water to grow 1.5 pounds of cotton that is needed to produce a pair of jeans and during washing large litters of water required and it varies from wash to wash.[1]

Denim garments washing is an effective technology for changing the style, outlook, and comfortability of garments as well as creating new fashion trends. Denim garments are difficult to wear after completing treatments because of the weaving and dyeing results. For this, it mostly needs a finishing treatment to make it cleaner, smoother, and more convenient to wear. Technologists are attempting to incorporate new styles and fashion on denim fabrics using renewable washing processes to satisfy the rapid transition in existing consumer demands.[2–4]

Denim garments can be washed in a variety of ways after being pre-treated. Stone Wash, Acid Wash, Rinse Wash, Enzyme Wash, and Bleach Wash are some of the most widely used wash types.[5,6]

Among the washing methods, hypochlorite bleaching is a commonly used process in the industry, especially for denim washing, to achieve the desired color hue. With the aid of oxidizing or reducing chemicals, denim bleach may be used to decolorize indigo from denim. The strength of the bleach liquor, the temperature, and the treatment time all influence the bleach effect and discoloration. Strong bleach with a limited treatment time is preferable.[7,8]

Bleach wash is one of the precise textile washing methods that is used to fade a higher degree of color. It is extremely difficult to fade the pigment from all over the garments in one wash to such a high degree without using bleach. As a result, despite certain disadvantages such as bleach decomposes cellulose and hence kills the cloth, appears to turn the fabrics yellowish, requires neutralization, which raises expense and adds another phase to the manufacturing time, bleach washing cannot be prevented.[9,10]

Denim production and processing tests are available to further explain the process sequence and achieve different denim washing results. Indigo-dyed yarns have been produced for thousands of years using various methods. Continuous dye ranges that can yield thousands of pounds of dyed yams per hour have now replaced the initial batch methods for dyeing yarn skeins. Different experiments on denim washing and denim dyeing have been carried out in the past, both internationally and locally in different regions. In past, stone (pebbles) are used for washing which is known as a stone wash but nowadays stone (pebbles) are replaced by rubber balls because stone damaged the fabrics during the washing process.[4,10,11]

Another international experiment was conducted, with the primary goal of the discovery being to provide a means of handling denim fabrics in plain fabrics or garment type to manufacture stonewashed denim fabrics of various shades and colors without repeated measures, costly machinery, or vast inventories of fabrics and dyes. Another aim of the innovation is to make stonewashed denim fabrics in various shades and colors more affordable. Many denim washes have been produced in the past, and some of the denim washed names are mentioned below: Acid washes, enzyme washes, bleach washes, and stone washes are all options.[12]

Denim Bleach is a method for removing indigo from denim that involves the addition of a heavy oxidative bleaching agent such as sodium hypochlorite (NaCIO) or potassium permanganate ($KMnO_4$) during the washing process, with or without the addition of stone. Depending on the intensity of the bleach liquor, the temperature, and the treatment period, the discoloration produced is normally more noticeable. Good bleach with a limited treatment time is preferable. Bleached materials should be properly antichlored or washed with

peroxide afterwards to prevent yellowing. For color uniformity, materials should be carefully sorted before manufacturing.[8,13,14]

It's difficult to monitor the process, which means it's difficult to achieve the same amount of bleaching in several runs. When the target amount of bleaching is achieved, the time window for stopping the bleaching is very limited. Due to the harshness of the solvent, it can cause cellulose to be damaged, resulting in extreme strength losses and or cracks or pinholes at seams, pockets, and other locations.[8]

To produce fading results and a smooth feel, the bulk of denim fabrics finishing with enzymes is currently done batch by batch. However, if developments in biotechnology allow scientists to produce incredibly fast-acting and durable cellulases, and if machine manufacturers can install special continuous-range machines with greater mechanical operation, it might be possible to handle denim fabrics in a continuous-process range in the future. The development of such an enzyme and process would enable the textile industry to move toward a much higher throughput and a more efficient process by saving time, energy, and water. Since environmentally sustainable processes use less oil, they are more cost-effective.[15–18]

This research work aims to investigate the bleach wash effect of denim fabrics before and after wash treatment. After bleach washes the color fastness to wash properties has been observed. Also, the shrinkage, tear strength, EPI, PPI, and GSM changes have been evaluated.

Materials and methods

Materials

Fabrics type: For this experiment, three types of denim fabrics were used. The specification of these fabrics is noted below Table 1:

Table 1 Sample identifications

Sample types	Identification
Denim indigo color, Composition–98% Cotton, 2% Spandex, GSM–350	Sample 1
Denim indigo color, Composition–99% Cotton, 1% Spandex, GSM–330	Sample 2
Denim black color, Composition–100% Cotton, GSM–290	Sample 3

Chemicals: To determine the bleach effects of denim fabrics as chemicals Desizing agent, Soda ash, Alpha beta-amylase, Anti-back staining agent, Acetic acid, KCI bleach, Neutralizing agent (Sodium meta bi-sulphate), and Softener were used. These chemicals were collected from local market dyes and chemicals shops in Chittagong, Bangladesh.

Equipment: The bleaching process was done on a laboratory scale. To complete the experiment various types of machinery and equipment were introduced. Sample washing machine, Hydro extractor machine, Sample dryer machine, Tear tester, Crock meter, Pilling tester, GSM cutter, Electric balance, Grey scale, and Light box were used to complete the sample development process and testing purposes.

Methods

Bleach wash

Working procedure: First, the fabrics were cut in appropriate shape before and put that on the bath. The machine had to clean so that the chemicals that remained on the machine from the previous bath can be washed out. The chemicals ratio that required for the number of fabrics was calculated that are going to put on the bath. Then the fabrics put on the bath and start desizing it for 10min with the required chemicals. After desizing, bought out the fabrics from the machine and rinse washed the fabrics. Again the fabrics put on the bath with the addition of enzyme, acetic acid, anti-back staining agent and ran the machine for 15min. After that again rinse washed the fabrics for 2-3min. The fabrics put on the bath again with the addition of KCI bleach and ran the bath at 3 different times for getting 3 shades. Then bought out the fabrics from the bath and put that on the hydro-extractor machine for absorbing the excess water from the machine. After that, the fabrics put on the drying machine at 80˚C to dry the fabrics (Table 2).

Testing standard: To evaluate the bleach performance Tear strength test (ASTM D412), Color fastness to wash (ISO 105 C10: 2006), and Shrinkage test (AATCC 135) were carried out.

Table 2 Recipe of bleach wash

Shade	Sample 1	Sample 2	Sample 3
Light	KCl Bleach 500g	KCl Bleach 500g	Caustic Soda 100g
	Time 16 min	Time 9 min	Per Oxide 100g
	Temp. 50-55˚C	Temp. 50˚C	Time 30 min
		Brown Gtl 0.5g	
		Time 3-5 min	
Medium	KCl Bleach 500g	KCl Bleach 500g	Caustic Soda 100g
	Time 11min	Time 6 min	Per Oxide 100g
	Temp 50-55˚C	Temp. 50˚C	Time 20 min
Dark	KCl Bleach 500g	KCl Bleach 500g	Caustic Soda 100g
	Time 6 min	Time 3 min	Per Oxide 100g
	Temp. 50-55˚C	Temp. 50˚C	Time 10 min

Result and discussion

Effect of bleach wash on denim fabrics

In this project, bleach wash was done for 30 minutes at 45˚C temperature by sample washing machine. The machine runs three different times to get three different shades- light, medium, and dark (Figures 1–3).

Figure 1 Washing effect on sample 1, (a) Light shade, (b) Medium shade, (c) Dark shade.

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Figure 2 Washing effect on sample 2, (a) Light shade, (b) Medium shade, (c) Dark shade.

Figure 3 Washing effect on sample 3, (a) Light shade, (b) Medium shade, (c) Dark shade.

Effect of washing on the feel of the fabrics

The fabrics' hand feel changes dramatically after cleaning, and this change can be seen in each subsequent stage of manufacturing. The hand feel is softer after the desizing process than before the wash point, but the cloth is much softer after the bleaching process. The fabrics had the softest hand feel during the softening process.

EPI, PPI and GSM test

After washing the specimen, EPI, PPI & GSM of the fabrics were observed.

From Table 3, it describes the EPI, PPI and GSM of all bleached wash fabrics samples before and after wash treatment. It shows that after bleach wash, the EPI and PPI values are increased but the GSM value is decreased. So, it can be said that bleach wash has a great effect on fabrics EPI, PPI and GMS changes.

Table 3 EPI, PPI and GSM test

Bleaching stages	Samples	EPI (Ends/ Inch)	PPI (Picks/ Inch)	Fabrics weight (GSM)
Before Bleach wash	1	76	42	350
	2	74	41	330
	3	75	43	290
After Bleach wash	1	77 (+1.4%)	44 (+4.8%)	346
	2	75 (+1.4%)	44 (+7.1%)	324
	3	76 (+1.4%)	47 (+9.5%)	287

Shrinkage test

Table 4 indicates the shrinkage test behavior of bleached washed samples. From this table, it finds that sample 3 has more shrinkage behavior. This is because, in sample 3, no spandex yarn is used to make the fabrics and the GSM (290) is lower than other samples.

Table 4 Shrinkage test result

Samples	Before wash (Inches)	After wash (Inches)	Shrinkage (%)
1	12	11.4	5
2	12	11.16	7
3	12	11.22	8

Color fastness to wash

Table 5 shows the impact on color fastness to wash color fastness to wash. From this test, it reveals that when denim washed at comparatively higher time duration color fastness rating becomes excellent although at the same temperature. On the other hand, 10min exposure of time yields good wash fastness both for bleach washing at 45˚C and 50˚C.

Table 5 Color fastness to wash

Bleached washed Sample	Time (Min)	Temperature (˚C)	Color Change
1	10	45	4
2	10	47	4-Mar
3	10	50	5

Tear strength test

From Table 6, it shows that after washing, the tear strength value is higher for sample 2 rather than other samples. This is because the amount of 2 spandex yarn in this fabrics is higher than other samples and the GSM of sample 1 is higher as well (350).

Table 6 Tear strength test result

Shade	Bleaching stages	Sample 1 (kgf/cm)	Sample 2 (kgf/cm)	Sample 3 (kgf/cm)
Light	Before wash	3.65	1.92	1.92
	After wash	4.03	3.45	1.72
Medium	Before wash	3.65	1.92	1.92
	After wash	3.25	3.6	1.83
Dark	Before wash	3.65	1.92	1.92
	After wash	3.08	1.85	1.66

Conclusion

Bleaching is a necessary step in the manufacture of white fabrics. From this project, it discovered that increasing the amount of bleaching agent increases the whiteness of the cloth during bleaching. However, it may have an impact on the strength. The temperature of the bleaching solution does not exceed 100˚C because raising the temperature damages the consistency of the solution. As a result, the bleach should be applied at a temperature of 95-99˚C for maximum intensity and whiteness. The amount of time spent bleaching does not exceed the range. Though the whiteness improves, the temperature does significant harm to the fibres. So, after considering all of the evidence, conclude that the traditional bleaching recipe is the best

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overall. Here, achieve strong whiteness and fabrics strength. So, for factory production that standard recipe is used as the default bleaching recipe.

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Conflicts of interest

The authors have no conflict of interest to publish this article.

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