

1 "Diverse Washing Consequence on Denim Fabric and its Physical 2 & Mechanical Characteristics Analysis"

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7 Abstract

8 This is a study on different type of washing on denim fabric and its physical mechanical
9 characteristics. A series of experiments and investigations help us to determine the properties
10 of Denim fabric, effects of different washing parameters on denim fabric. The textile
11 technologist needs to know the prediction of the aspect of a finished denim look, physical
12 mechanical properties after different wash with the reality. In this paper we studied the
13 washing effect with the Bleach Enzyme, in the sector of denim, washes done by different
14 washing chemical different washing process. Here, all the experimental work done on denim
15 then analysis those data to show various effect. These effects can be divided into two parts.
16 One is physical (Color Fastness, Dimensional Stability, Stiffness) other is mechanical (GSM
17 and Tensile strength).

18 *Index terms*— denim, bleach, enzyme, G.S.M, color fastness, stiffness, bending length, tear strength.

20 1 I. Introduction

21 enim is very strong, stiff and hard wearing woven fabric. Denim is cotton and twill weave fabric that uses colored
22 warp and grey weft yarn. Denim is normally dyed with indigo, vat and sulphur dyes. Since denim constitutes
23 the largest portion of the garments that are washed, the term 'wash' has come to mean the finishing of denim
24 garments.

25 The most commonly denim washing methods are enzyme wash, bleach wash, acid wash, normal wash, stone
26 wash, etc. Among the washing methods, bleach method is widely used method in industry especially for denim
27 washing to achieve required color shade by hypochlorite bleaching. Denim Bleach is a process that can be used
28 to decolorize indigo from denim. In this process a strong oxidative bleaching agent such as sodium hypochlorite
29 or KMnO₄ is added during the washing with or without stone addition. Discoloration produced is usually more
30 apparent depending on strength of the bleach liquor quantity, temperature and treatment time. It is preferable
31 to have strong bleach with short treatment time. Care should be taken for the bleached goods so that after
32 washed with peroxide to minimize yellowing. [1] Bleaching agents essentially destroy chromophores (thereby
33 removing the color), via the oxidation or reduction of these absorbing groups. Thus, bleaches can be classified
34 as either oxidizing agents or reducing agents. [2] Bleaching process is difficult to control i.e. difficult to reach
35 the same level of bleaching in repeated runs. When desired level of bleaching reached the time span available to
36 stop the bleaching is very narrow. Due to harshness of chemical, it may cause damage to cellulose resulting in
37 severe strength losses and/or breaks or pinholes at the seam, pocket, etc. [2] Enzyme washing is a laundering
38 process that uses enzymes to clean clothing or to finish fabric, especially in the case of denim and other garments
39 with a worn-in look. Various enzymatic cleaners are available from stores that specialize in laundry supplies,
40 and they can also be special ordered. For regular cleaning, enzymes carry many economic and environmental
41 benefits. On an industrial scale, it has replaced laborious laundering techniques such as stonewashing, saving
42 money and environmental impact for companies. The enzymes used in this technique are proteins produced by
43 living organisms. [3] 'GSM' means 'Gram per square meter' that is the weight of fabric in gram per one square

44 meter. By this we can compare the fabrics in unit area which is heavier and which is lighter. ??4] Stiffness is a
45 special property of fabric. It is the tendency of fabric to keep standing without any support. It is a key factor
46 in the study of handle and drape of fabric. Stiffness is the rigidity of an object -the extent to which it resists
47 deformation in response to an applied force. ??5] The fabric bending property is apparently a function of the
48 bending property of its constituent yarns. In other words, it reflects the difficulty with which a fabric can be
49 deformed by bending. The higher the bending rigidity, the higher the fabric ability to resist when it is bent by
50 an external force. In addition, the effect of density and fabric thickness are also very profound for this property.
51 ??6] Color fastness refers to the resistance of color to fade or bleed of a dyed or printed textile materials to
52 various types of influences e.g. water, light, rubbing, washing, perspiration etc. ??7] The chemical nature of
53 the fiber, for example, cellulosic fibers dyed with reactive or vat dyes will show good fastness properties. That
54 is to say compatibility of dye with the fiber is very important. If the dye molecule is larger in size, it will be
55 tightly entrapped inside the inter-polymer chain space of a fiber. Thus the fastness will be better. The manner
56 in which the dye is bonded to the fiber or the physical form present. The amount of dye present in the fiber i.e.
57 depth of shade. A deep shade will be less fast than a pale or light shade. ??7] Rubbing Fastness depends on: i.
58 Nature of the Color ii. Depth of the Shade iii. Construction of the Fabric. ??8] In simpler terms tear resistance
59 or tear strength is a measure of how well a material can withstand the effects of tearing. Tear strength is the
60 tensile force required to rupture a pre-slit woven fabric sample under controlled conditions. Materials with low
61 tear resistance tend to have poor resistance to abrasion and when damaged will quickly fail. ??9] II.

62 2 Material and Methodology

63 100% cotton indigo dyed 380 GSM denim fabrics were washed through desizing using detergent and desizing
64 agent. Then desized denim fabrics were processed using non chlorine & chlorine (KCI) bleach in bleach process &
65 enzyme were used in enzymatic process. The physical and mechanical properties of treated denim were examined
66 using testing equipment. a) Testing and Analysis Washed denim fabrics were conditioned in 65% RH and 20°C
67 for 24 h before testing.

68 3 Recipe

69 ? GSM was calculated from raw and different washed fabric by using GSM cutter. ? Stiffness was measured
70 from the bending rigidity in fabric by Shirley stiffness tester.
71 ? Change in the original color shade of the fabric was rated using gray scale for color change. ? Tearing
72 strength was determined by GESTER GT-C10 tear tester. ? Dimensional changes (shrinkage %) was calculated
73 from the difference in fabric length and width before and after washed.

74 4 III. Result and Discussion

75 From the Table ??3 the value indicate, the light wash of enzyme, non-chlorine & chlorine bleaches decrease the
76 weight slightly and the heavy wash of that enzyme, non-chlorine & chlorine bleaches decrease the weight so high.
77 Higher the concentration with time, higher loss of weight. The weight of the fabric loss gradually from enzyme
78 washes to non-chlorine bleaches then chlorine bleaches.

79 5 b. Effect of different wash on fabric stiffness

80 Graph 2 : Effect of different wash on fabric stiffness From the Table ??3 the value indicate that the light wash
81 of enzyme, non-chlorine & chlorine bleaches decrease the stiffness low and the heavy wash of that enzyme, non-
82 chlorine & chlorine bleaches decrease stiffness high. The stiffness of the fabric reduces gradually from enzyme
83 wash to non-chlorine bleaches then chlorine bleaches. c. Effect of different wash on fabric colorfastness observe
84 that, the non-chlorine bleach is reacting with cotton denim fabric not with the Indigo dye. According of Table ??3
85 it can be said that the fabric tearing strength fall after enzymatic wash. Enzyme eat the cotton wall gradually
86 and higher the concentration higher the strength loss. Bleach wash also do the same. But bleach are more
87 effective than enzyme as it cause of chemical reaction that break the polymer bond rapidly. The bleach effect
88 on fabric depend on bleaching concentration with time. By increase of hardness and time, the fabric loses its
89 physical stability. So it loose strength and become soft. It is observed from table that fabric is dimensionally
90 decreased much more at length wise (warp direction) for all the operation and in some cases slightly increase
91 at width wise (weft direction). During weaving cotton denim fabrics were subjected to considerable tensions,
92 particularly in the warp direction. In subsequent finishing processes such as calendaring this stretch was increased
93 and temporarily set in the fabric. The fabric is then in a state of dimensional instability. Subsequently when
94 the denim garment was thoroughly wetted in enzymatic or bleach washing, it tended to revert its more stable
95 dimensions which results in the contraction of the yarns. This effect is usually greater in the warp direction
96 than in the weft direction. This is known as relaxation shrinkage. Due to relaxation shrinkage, PPI (picks per
97 inch) was increased than untreated denim fabrics, as a result fabric weight loss is slightly minimized. Although
98 decomposition occurred in hypochlorite bleach washing, at the same time relaxation shrinkage happened, and
99 the GSM fabric weight loss of denim garments were minimized slightly.

6 IV. Conclusion

100
101 In this project work we study about the different washing effect on physical & mechanical properties on the
102 denim fabric. It can be seen that, treatment of denim fabric significantly decrease in GSM, tensile strength and
103 this decrease was higher at higher in bleach process from enzymatic washing process. During washing, cellulose
104 hydrolyzed cotton. First, it attacked on projecting fibers (micro-fibrils) on surface, then attacked on yarn portion,
105 hydrolyzed them slowly and upon time penetrated inside the fabric. The result of this reaction is that the primary
106 wall (outer layer) of the cotton fiber is loosened and broken down quicker with the frictional action (mechanical
forces) of rotating

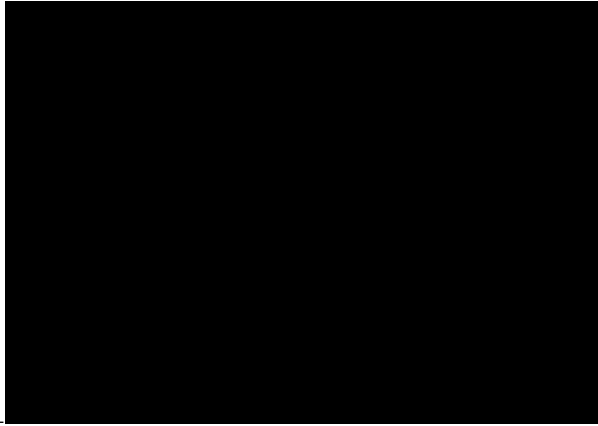


Figure 1: Figure 1 :



Figure 2:

107

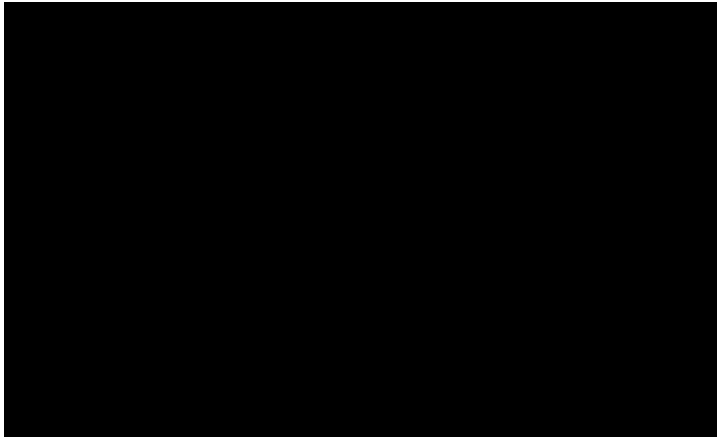


Figure 3: e.

1

1.	M:L	1:10	2.	Water	100 L
3.	Detergent (ID eco)	60 gm	4.	Soda Ash (HTS)	100 gm
5.	Temperature	60? C	6.	Time	15 min
7.	Rinse	2 times			

Figure 4: Table 1 :

2

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Figure 5: Table 2 :

3

GSMB50	355	360	365	370	385	380					
	375										
Raw Denim							Operation	Operation	Operation	Operation	Operation
							1	2	3	4	5
											6

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 Global Journal of Researches in Engineering () Volume XVI Issue IV Version I 17 Year 2016 J © 2016 Global
 Journals Inc. (US) a. Effect of different wash on Fabric GSM Graph 1: Effect of different wash on fabric GSM]

Figure 6: Table 3 :

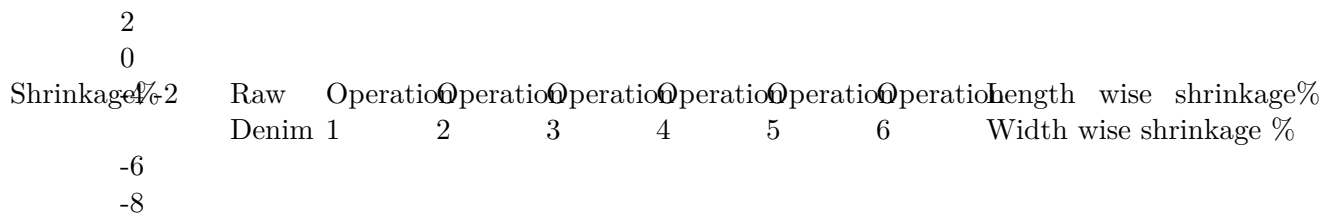


Figure 7:

