

Effect of Enzyme Washing on Properties of Denim Fabric

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Abstract - Nowadays, denim jeans are one of the most well-liked clothing items, which are loved by many people around the globe. To create special appearance, style and comfort to wear washing is done to denim fabrics. Denim fabric has been processed by enzyme washing method using different amount of enzymes. In order to analyze the effect of enzyme washing on denim properties like tensile strength, stiffness, drape and color change has been measured. It can be observed that the amount of enzyme made the influence on change of denim fabric parameters

Key words: Denim, cellulase enzyme, tensile strength, stiffness.

1. INTRODUCTION

Denim - one of the world's oldest fabrics - is most commonly associated with jeans. Today, denim jeans are one of the most popular clothing items, which are loved by many people around the globe regardless of the gender, culture, climate conditions, seasons, and social occasions. It consists of dyed warp and grey weft. Most of the Denim fabric construction is either 2/1 or 3/1 construction of either left or right handed twill. Denim is especially strong, stiff and hard wearing cloth.

Denim garment (Jeans) washing is one of the commonly used finishing methods to create special look, making stylish and wear comfortable garments of the present day world. Without finishing treatments, denim garment is uncomfortable to wear, due to its weaving and dyeing effects. For this it basically needs a finishing treatment to make it softer, smooth and comfortable to wear performance.

To meet rapid change in demands of customers, technologists are trying to impart new designs and fashion on denim garments by means of different types of washing methods. The most commonly used denim washing methods are enzyme wash, bleach wash, acid wash, normal wash, stone wash, etc.

The objective present study is to study effect of different amount of enzyme wash on tensile strength, stiffness and drapability of denim fabric.

2. MATERIALS AND METHODS

2.1 Materials

Indigo dyed denim fabric was used in this study, which consist of 100% cotton twill weave 3/1 construction 58X50/10X10. Fabric was enzyme washed using bio polish cellulase enzyme.

2.2 Methods

2.2.1 Desizing.

Rinse wash is done to remove all the sizing ingredients present on the surface of the fabric and to make the fabric more absorbent. This treatment was conducted in liquor containing wet agent, anti-back stainer and lubricant and material to liquor ratio of 1:5 in a washing machine at 50° C for 20 minutes. Then fabric is washed with hot water followed by cold water wash.

2.2.2 Enzyme wash

Desized denim fabric was treated with bio-polishing cellulase enzyme. This process was conducted in liquor containing acetic acid to maintain required pH of 4.5. The enzyme treatment was carried at different amount of cellulase enzyme (50gm, 100gm and 150gm), temperature of 40-60° C and treatment time of 40-50 minute. The denim fabric is then washed and softened with cationic softener at cold for 10-15 minute. Enzyme treated fabric was squeezed in a hydro extractor machine to remove excess water and then dried in a drier for 30-45 minute. Enzyme washed denim fabric was tested for tensile strength, tearing strength, stiffness and drapability.

3. TESTING AND ANALYSIS

Treated fabric was conditioned at 65 % RH and at 20°C for 24 hours before testing. Tensile strength was determined by the US Standard Grab test method according to ASTM D 5034. Stiffness was measured from the bending stiffness in fabric by Shirley stiffness tester according to ASTM D 1388. Changes in the original color shade of the fabric was rated using Grey scale for color change according to AATCC evaluation procedure. Fabric drapability is also measured according to BS5058.

4. RESULTS AND DISCUSSIONS

The tensile strength, stiffness, drape and change in color shade properties of enzyme treated with different amount of enzyme was measured. Results obtained are shown in table 1.

Table 1: Effect of amount of Enzyme on treated Denim fabric

Amount of Enzyme (gm)	Tensile Strength (lbs)		Stiffness (cm)		Drape Coeff. (%)	Color Shade (rating)
	Warp	Weft	Warp	Weft		
0	270	175	3.63	2.93	0.79	5
50	256	154	3.14	2.62	0.73	4/5
100	247	150	3.05	2.51	0.71	4
150	241	147	2.95	2.29	0.70	4

From the observation it has been found that enzyme wash treatment decreases the tensile strength of the denim and this decrease was more at higher amount of use of enzyme. It is assumed that cellulase enzyme degraded cotton under the conditions used. Cellulase enzyme first attacked on projecting fibers (micro-fibrils) having fabric surface, then attacked on yarn portion, hydrolyzed them slowly. After that it attacked on secondary wall. As a result, cotton fiber loosened and broken down quicker with the frictional forces of rotating cylinder of the washing machine.

The stiffness of the denim fabric both in the warp and weft way was measured from the bending length by Shirley stiffness tester. The stiffness of the denim reduced at 50gm enzyme significantly, and the decrease was more prominent at higher amount of enzyme. After treatment with cellulase enzyme, the sizes (starch) of warp yarns were removed. As a result bending length was less and softness was increased.

The effect of enzyme wash on drapeability of denim fabric is also measured. As the amount of enzyme increases the drape coefficient values also decreases. It indicates that the improvement in fabric drapeability.

Denim hydrolysis by measuring the color fading from denim garments was observed. The results reveal that increasing the amount of enzyme has slight effect on color shade change.

5. CONCLUSIONS

The properties of the denim fabric are influenced by the washing with cellulase enzyme. The tensile strength of fabric has been reduced due to enzyme washing. Stiffness of denim fabric has been reduced after washing, which results in the increase of fabric softness and fabric drapeability. Enzyme wash actually hydrolyzes the hairiness from the fabric surface and assist in color fading of the treated fabric. It is also noted that pre-washed denim samples are almost stiff and harder than the enzyme treated cotton denim fabric.

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