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# Effects of Biochemical Wash on 100% Cotton Denim Apparel

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**Abstract:** The demand of chemical treatment on denim fabric to create a new look is increasing day by day. Now- a -days biochemical wash has become a trendy choice to customer. Manufacturers are in a rush to fulfill the demand of customer. They also are to take in consideration the quality of the product after the treatment. So This paper represents and compares the effect of biochemical wash on woven denim fabrics by means of GSM (gram per square meter) measurement, shrinkage test, count measurement, EPI & PPI measurement, comparison of color depth, air permeability test, rubbing test & hand feel test. Acid enzyme was used as a biochemical for the treatment. Treatment increases the GSM of woven denim apparels. Dimensional change is occurred due to enzyme wash. Lengthwise shrinkage can be ignored but widthwise shrinkage should be taken in concern. There is little effect on EPI & PPI due to enzyme wash on woven denim apparels. Enzyme wash decreases the depth of color on woven denim apparel. Air permeability also becomes lower due to treatment. Finally with the increase of time hand feel i.e. the apparels become softer due to enzyme wash.

**Keywords:** Denim, Biochemical Wash, Air Permeability, GSM

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## 1. Introduction

Washing is very popular finishing treatment to create fashionable and customer demandable outlook. Creating fashion in the denim is the most popular thinking in the clothing industry. Especially the term washing is used for sewn garments. So the effect is observed very carefully after washing to hold the sewn garments quality accurately. In this time denim is most fashionable garment to attract the customer [5]. Industrial washing is very important applied finishing methods on fabric or apparel. Different washing methods can be applied for denim fabric finishing. Such as bleach wash, stone wash, acid wash, detergent wash, silicon washes etc. Enzyme wash is done on the garments made from heavy fabrics like denim [19].

Enzymatic treatment is eco- friendly and it is very much effective to produce sustainable denim garment [21]. Eco-friendly sustainable garment design is the new challenge for garment designers and producers, because the consumers are

concerned in eco-fashion in the last decade [4]. Enzymes are applied mainly to get a cleaner fabric surface with less fuzz, to reduce tendency to pill formation and to smooth the surface [9]. Because of yarn dyed fabric denim is very stiff fabric as the size materials are not removed during manufacturing process [2]. So finishing treatment is mandatory for denim fabric to improve the comfort. Denim is a cotton and twill weave fabric that uses colored warp and white weft yarn and this fabric is used for jeans, work clothes and casual wear [6]. Denim garment (jeans) washing is known as the widely used finishing treatment that has vast usage in textile sectors because of creating special appearance and making fashionable and wear comfortable garments of the present day world and commonly used. Popularity of garments washing specially on denim garments in the world market has been increasing day by day [3]. Bangladesh is a textile industry based country. Denim

garments (trousers) are being produced in 1500 factories in Bangladesh (Approximately). Bangladesh has earned about 82% foreign currency from ready-made garments sector in 2015-2016 FY. Many researchers have investigated the effects of washing technology especially on denim for the last many years [7]. In our paper we have tried to represent the results of some testing made on biochemically treated denim [8]. It is our expectation that our research work will help the technologist to fulfill the demand of quality of the customer.

## 2. Materials and Methods

100% cotton standard denim garments (trousers) were used as a sample to carry out the experiment. All the samples were provided from the apparel lab of Bangladesh University of Business and Technology (BUBT, Dhaka, Bangladesh).

For the chemical treatment we used the sample washing machine of finishing lab (BUBT, Dhaka, Bangladesh). All types of testing were done in the Textile Testing and Quality Control lab of BUBT (Dhaka, Bangladesh).



Sample washing machine



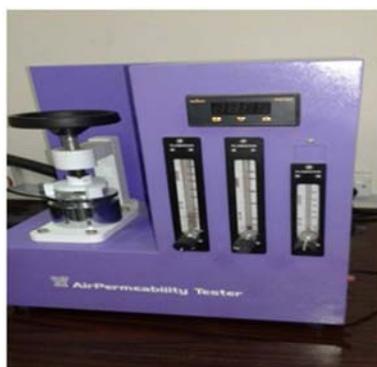
Dryer machine



Beesley's Balance



GSM cutter



Air permeability tester



Color Matching Cabinet

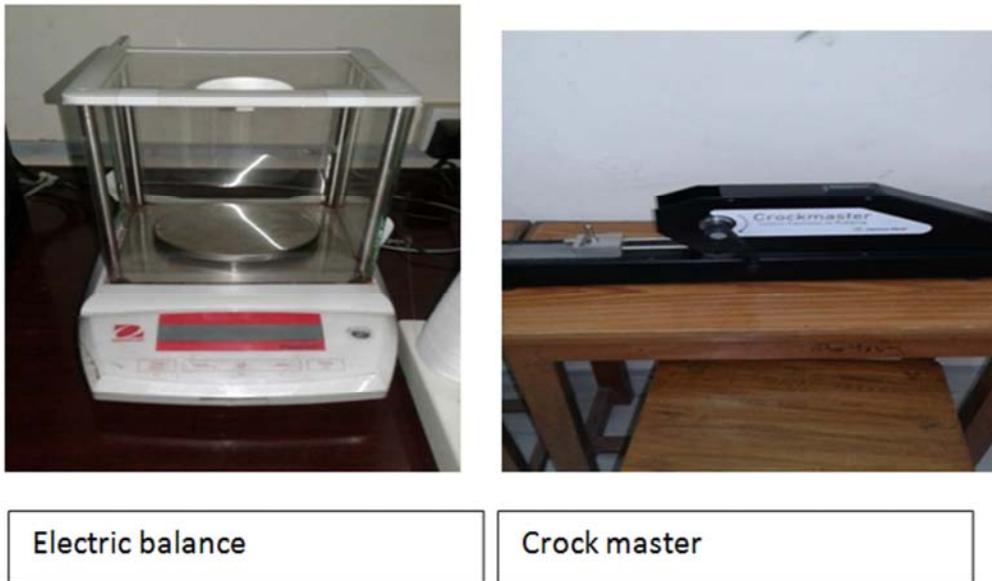


Figure 1. Machineries used in the research work.

ASTM D 1776 method was used for conditioning the sample [10]. ASTM D 3776 method was used for GSM measurement [11]. AATCC test method 96 was used for shrinkage test [12]. ISO 7211/4: 1984 method was used for count measurement. AATCC test method 61 was used for color fastness measurement [13]. IS 11056 (Bureau of Indian Standards, 1980) method was used for air permeability measurement. Hand feel property has been measured from matter of experience.

### 3. Results and Discussion

#### 3.1. GSM (Gram/Meter<sup>2</sup>) Measurement

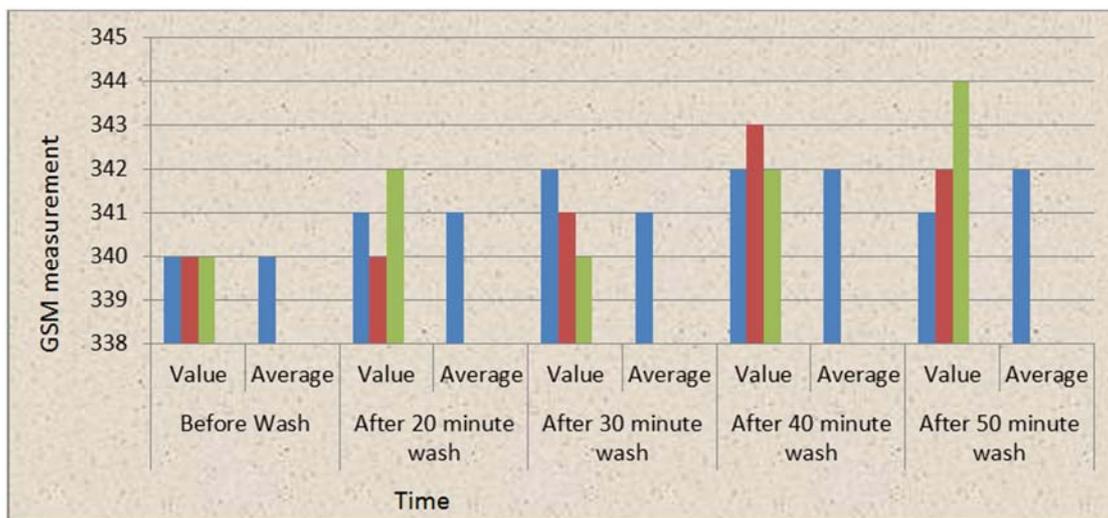


Figure 2. Bar charts of GSM measurement.

Denim is a hard fabric because of manufacturing and its weight is more than the usual fabric [1]. Enzyme washing increases the weight of woven denim apparels. We know all of the tests are remain within the limit. More difference in observation 2, the weight increase % is  $(341-340)/340 \times 100 = 0.29\%$ . It has been explored that due to long time enzyme washing the weight increased. It means the enzyme wash has a great effect in case of increasing the weight of denim. From the experiment we have found that shrinkage was occurred both lengthwise and widthwise. This property of denim increases the weight in unit area (GSM).

#### 3.2. Shrinkage Test

Graphical Comparison of lengthwise shrinkage measurement

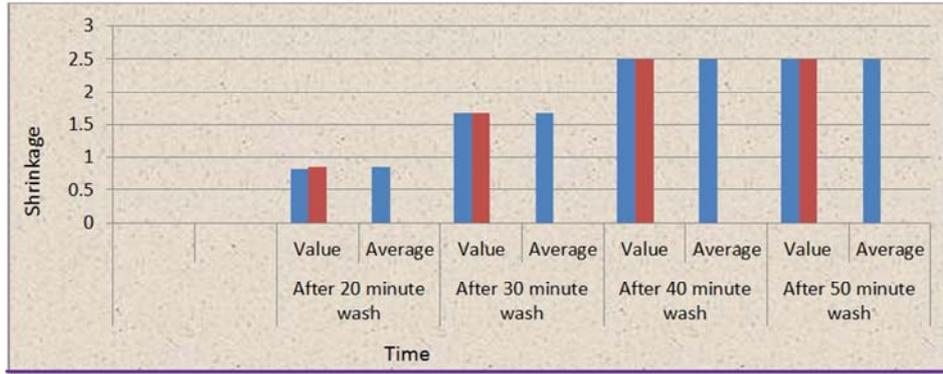


Figure 3. Bar charts of lengthwise Shrinkage measurement.

Graphical Comparison of widthwise shrinkage measurement

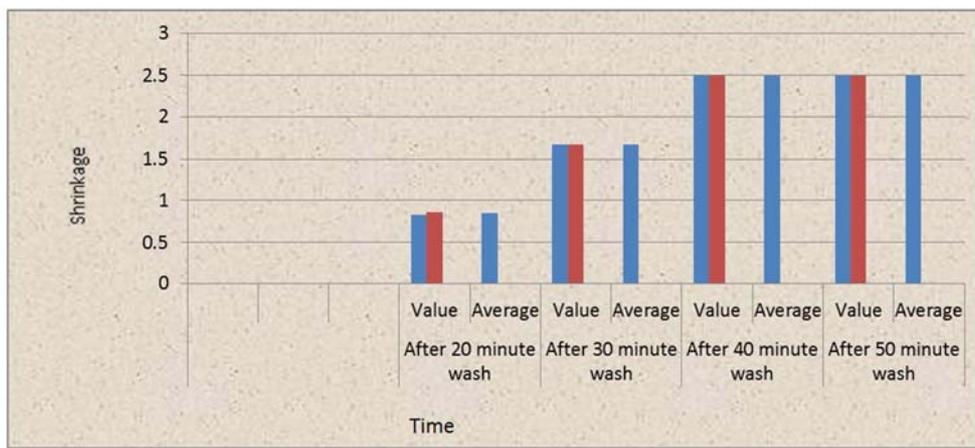


Figure 4. Bar charts of widthwise Shrinkage measurement.

We know that the yarn will swell according to the fiber used and the amount of twist. This yarn swelling forces the threads to bend more as they interlace and as an increase in yarn crimp. Since the yarn does not get any longer the cloth must shrink and the fabric becomes thicker [21]. From the result it was explored that dimensional change is occurred due to enzyme wash. In the lengthwise the shrinkage% is 4.17% that means length is decreased in a small amount due to washing. On the other hand, the shrinkage% in widthwise is 2.515% that means is width decreased but less than length wise. It means the effect of enzyme wash is much observed in length wise.

3.3. Count Measurement

Graphical Comparison of warp count measurement

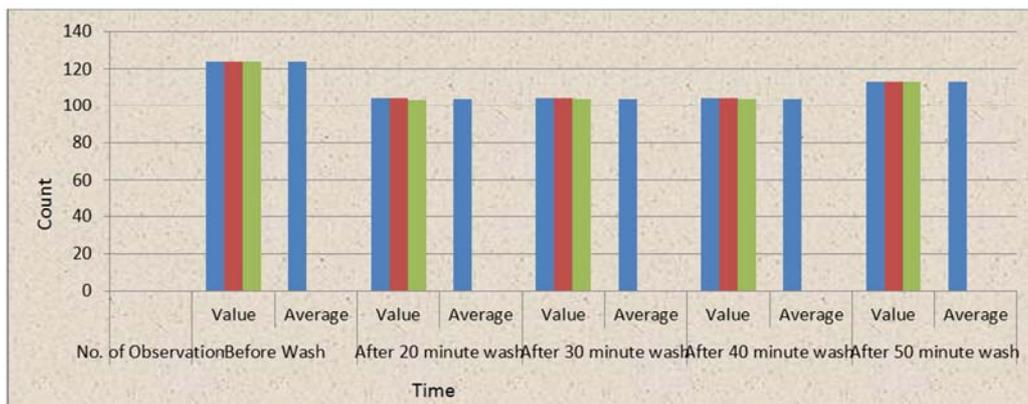
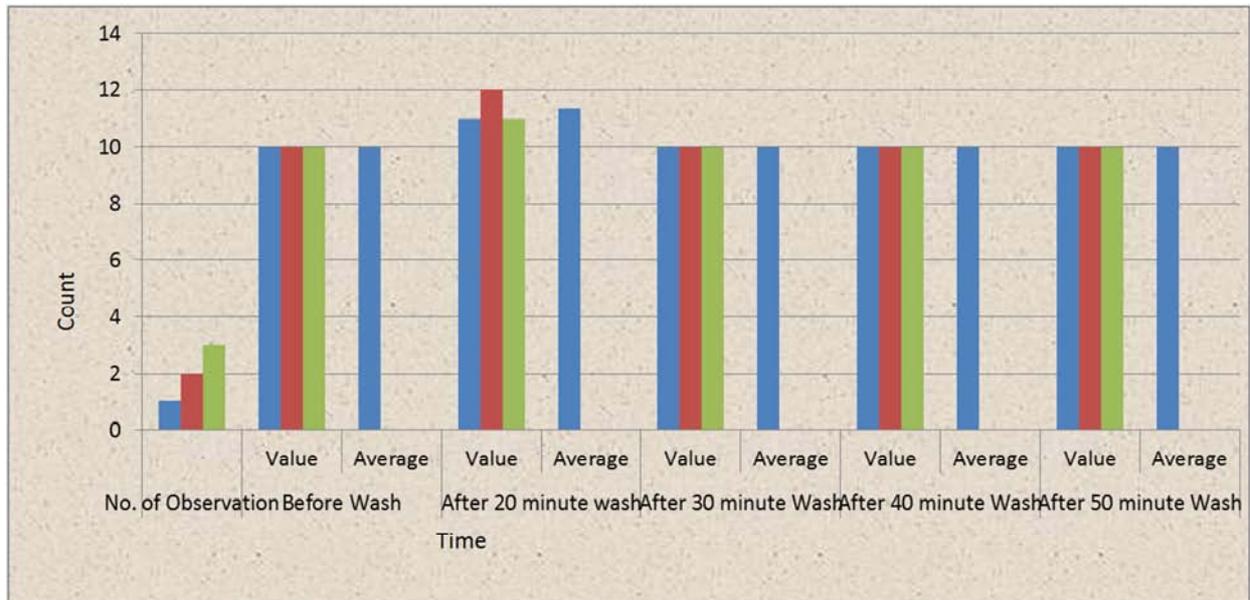


Figure 5. Bar charts of warp Count Measurement.

*Graphical comparison of weft count measurement*

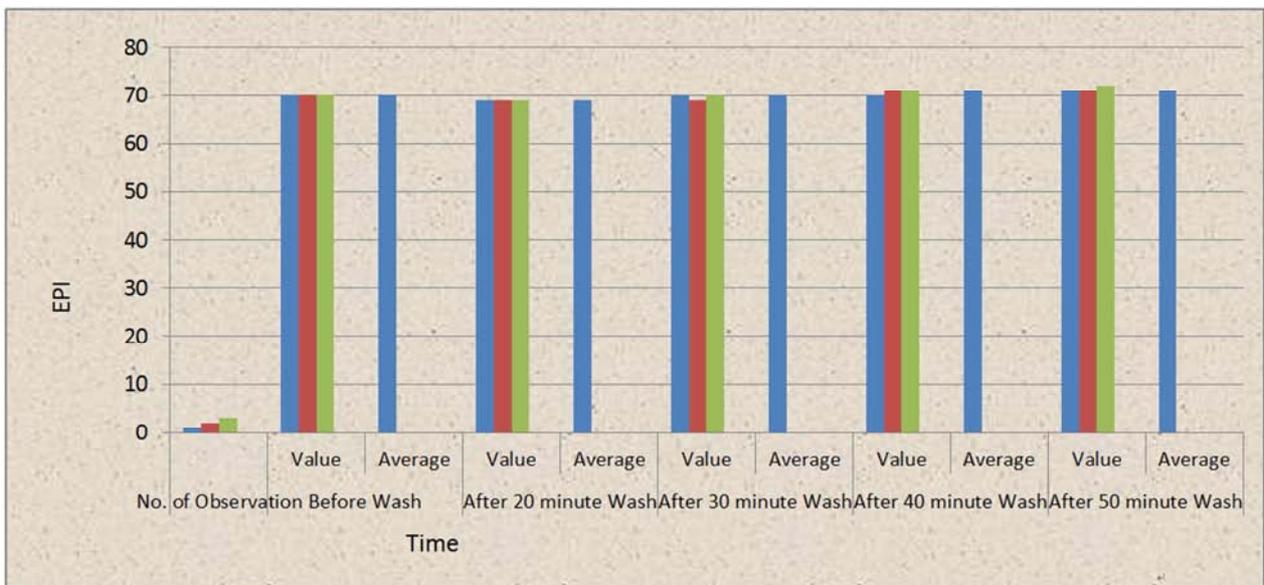


*Figure 6. Bar charts of weft Count Measurement.*

It has been noticed that enzymatic treatment has a little effect in count. As the denim is 100% cotton, count is measured in English count Ne. It is cleared that there is a difference in warp way and weft way count. Warp way count is lower than weft way count that means weft way yarn is finer than warp way yarn. Due to washing size materials are removed and the yarns become finer. That's why count increases after washing. Denim becomes soft after washing. It means enzyme wash has very little effect in count.

**3.4. EPI and PPI Measurement**

*Graphical comparison of EPI measurement*



*Figure 7. Bar charts of EPI measurement.*

*Graphical Comparison of PPI measurement*

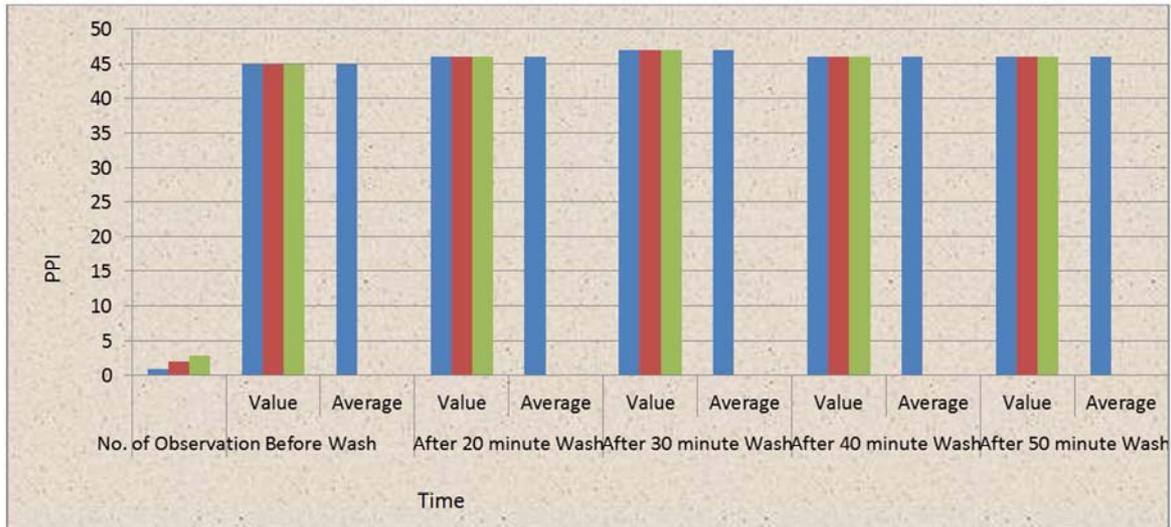


Figure 8. Bar charts of PPI measurement.

It was revealed that enzyme washing has a little effect in EPI and PPI of woven denim apparel. It is further noted that due to different duration of washing EPI, PPI was little changed.

3.5. Comparison of Color Depth

Graphical comparison of color depth

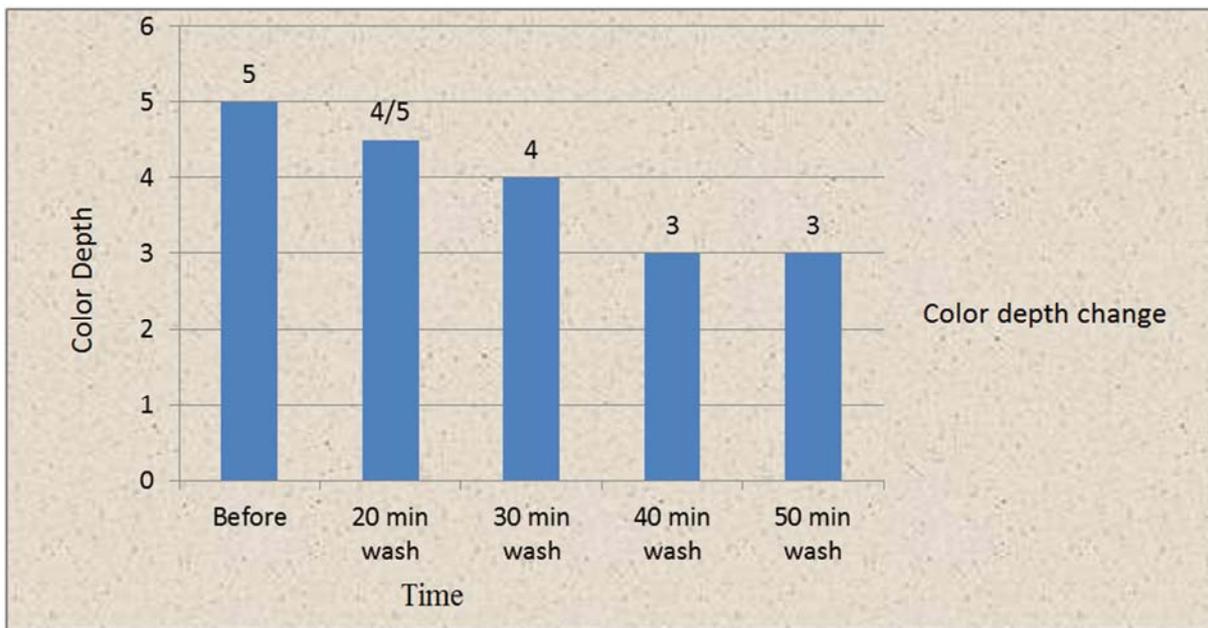


Figure 9. Bar charts of color depth.

It was investigated from the research work that there was a huge change in color depth due to biochemical treatment on woven denim apparels. When duration of treatment increases, shade becomes lighter even temperature and concentration remain same at the whole process. It means enzyme wash lighten the color with the increased time duration. Color is a very important factor for any apparel.

3.6. Air Permeability Test

Graphical comparison of air permeability test

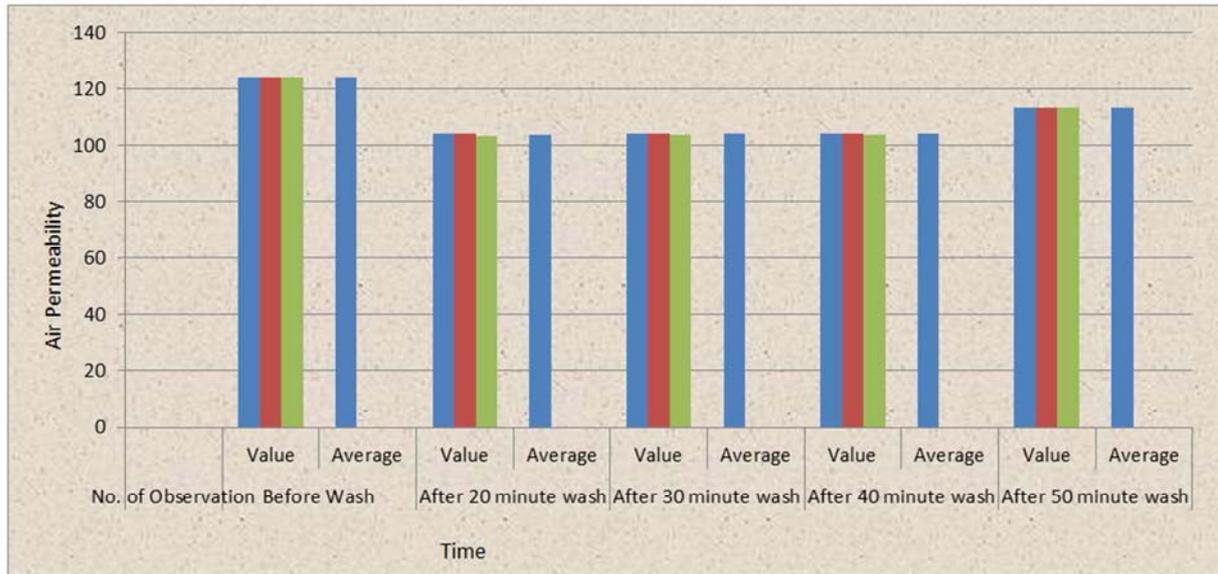


Figure 10. Bar charts of Air permeability test.

The air permeability of a fabric is the volume of air measured in cubic centimeters passed per second through 1 cm<sup>2</sup> of the fabric at a pressure of 1 cm of water [22]. The air permeability of the treated sample was measured according to IS 11056 (Bureau of Indian Standards, 1984) [23]. Changes of air permeability of fabrics depend of various factors.

It was investigated from the experiment that there was a change in air permeability due to enzyme wash on woven denim apparels. During the biochemical treatment the size materials of fabrics were removed as denim is the yarn dyed fabric. As a result the air permeability was increased in a small extent. But when the duration of the treatment increases the percentage of the shrinkage also increases. This process decreases air permeability of the denim even temperature and concentration remains same at the whole process.

3.7. Rubbing Test

Graphical comparison (For Dry Sample) of color fastness to rubbing test

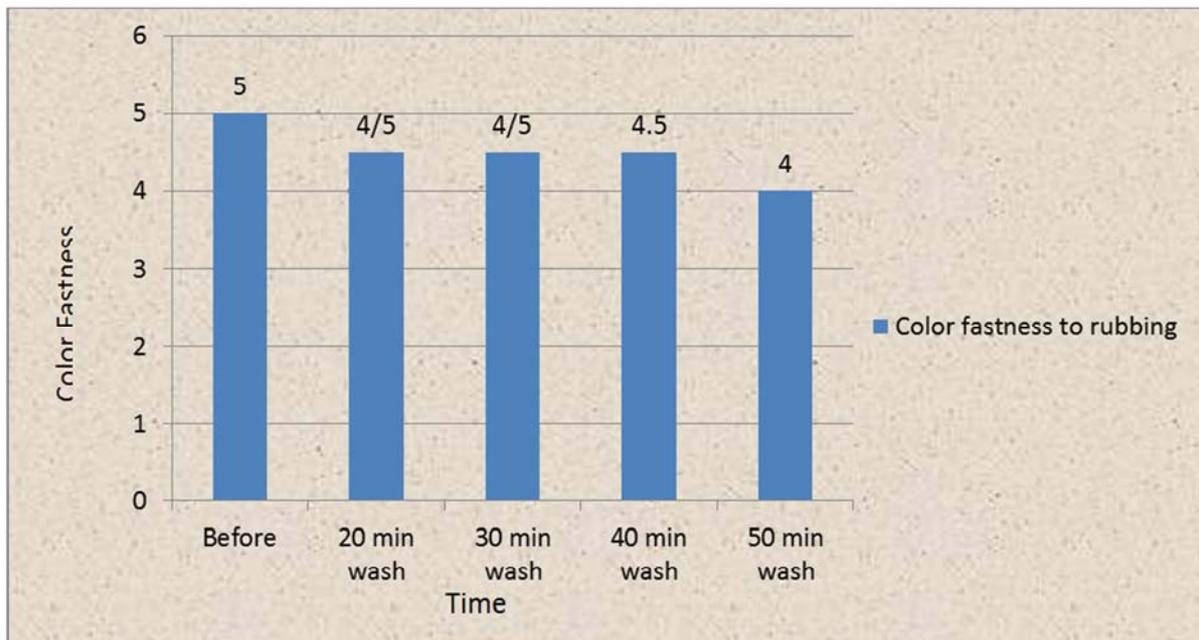


Figure 11. Bar charts of rubbing test (dry).

Graphical comparison (for Wet Sample) of color fastness to rubbing test

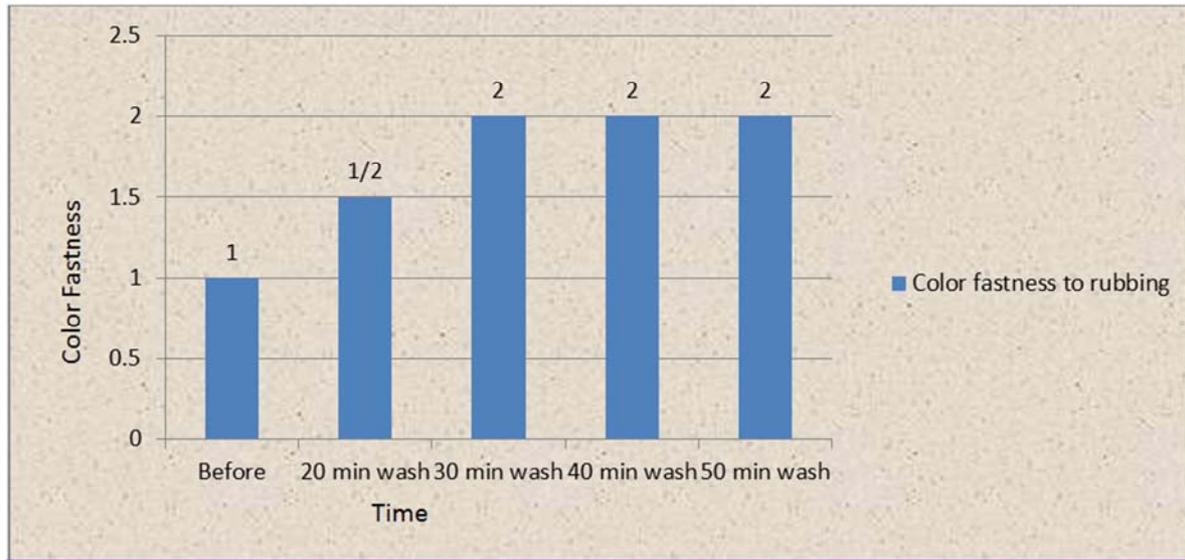


Figure 12. Bar charts of rubbing test (wet).

Color fastness is a measure of how permanent a color is on the fabric. Color fastness to rubbing is basic test for denim as jeans is durable garments. To assess the rubbing fastness we followed the AATCC test method 61. James Heal grey scale assessing for staining was used for visual assessment. It has been found from the experiment that fastness to rubbing was increased significantly after the treatment. So biochemical treatment is very effective to improve the color fastness to rubbing.

### 3.8. The Results of Hand Feel Testing

Before wash garments: Rough surface

After 20 minutes wash garments: Smooth surface.

After 30 minutes wash garments: smoother surface.

After 40 minutes wash garments: smoother surface than 30 min wash.

After 50 minutes wash garments: smoother surface than 40 min wash.

From the hand feeling test, it has been observed that with the increase of time hand feel properties are improved. Because softening agent render the surface of the fiber smoother, resulting in a supple handle of the materials [24]. Increased time duration has given much smoother apparel. So to get more soft and comfortable apparel enzyme wash can be a better option. Without enzyme wash the apparel will be very stiff and harsh. The hand feel property will be very poor. Customer satisfaction cannot be achieved without soft and smooth hand feel property.

## 4. Conclusion

Biochemical treatment or enzymatic treatment increases the weight of woven denim apparels in unit area. Dimensional change is occurred due to treatment. Enzymatic treatment has a little effect in count. As the denim is 100% cotton, count is measured in English count Ne. It is cleared that there is a difference in warp way and weft way count.

Warp way count is lower than weft way count that means weft way yarn is finer than warp way yarn. Due to treatment size materials are removed and the yarns become finer. That's why count increases after treatment. Denim becomes soft after washing. There was a huge change in color depth due to biochemical wash on woven denim apparels. When duration of washing increases, shade becomes lighter even temperature and concentration remain same at the whole process. It was investigated from the work that there was a change in air permeability due to enzyme wash on woven denim apparels. When duration of treatment increases air permeability become lower even temperature and concentration remain same at the whole process. Finally the better hand feel property is achieved with greater duration of garment washing. So biochemical treatment develops various better qualities in the apparel.

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