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(RESEARCH ARTICLE)

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A comparative study on physical and mechanical properties of 100% cotton denim and blended cotton denim after industrial washing

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Abstract

This research work was conducted to examine the effects of two types of washing procedures e.g., stone enzyme wash, and bleach wash on the physical and mechanical properties of 95% cotton (CTN), 5% recycled CTN denim, and blended CTN denim containing 80% cotton, 18% polyester, 2% spandex. Two fabrics were dyed with medium brand shade indigo dyes. The fabric weight, EPI and PPI, tear strength, breaking strength, color fastness to accelerated laundering, color fastness to water, color fastness to perspiration, and color fastness to crocking were carried out to key changes of physical and mechanical properties in two fabrics. This study has demonstrated the changes in two fabrics before washing (A) and after washing (B) accordingly. In the case of color fastness results ratings were similar in both fabrics. In contrast, the color fastness to crocking or rubbing showed different results. This research was carried out to investigate the parameter variations and choose which fabric exhibits the best or not.

Keywords: Denim fabric; Industrial wash; Strength; Color fastness; Fabric weight

1. Introduction

Denim is one of the ubiquitous casual wears for all genders. This adaptable fabric dominated around the world. Dry, selvage, poly ramie denim, cotton denim, and blended types along with elastane have been available for production (1). One of the advantageous notions about denim production is low-quality loss during production and higher machine efficiency. It is the world's oldest fabric which is associated with jeans. An anthropological study conducted in many countries argued that denim fabric has the security capabilities than formal pants or trousers (2) . Denim lasts longer than other clothes. Some of the papers mentioned this wear as a Market Icon. The culture changes after using denim fabrics in day-to-day life (3). These eternal-looking jeans can be manufactured by application of indigo or non-indigo, sulfur dyes, etc.(4). But Denim wash has health hazards and can create pollution in water, air as well as soil, and human skin (5). After washing the denim garments significant changes may happen, especially in chlorine solution. Enzymatic treatment can change the mechanical and chemical performance of the fabric such as thickness (6).Light industrial softeners might not have a large environmental negative impact. The damaged looks of denim or jeans may be attractive to youngsters. Biochemical finish application during denim washing also has impacts on dimensional changes (7). The large number of washes or longer time duration reported by the papers may damage the surface smoothness of the denim fabrics (8). The resultant fabric appeared with high fading effects. Back staining is one of the problems in reducing the denim fabric's fastness. Chowdhury A reported his paper had bad effects on the environment of stone washing, acid, and alkaline wash required to neutralize the fabric or reduction of chemicals (9,10).

Nowadays several fading has been used to increase versatility (11) by using different kinds of machines and technology. Synthetic fibers (e.g., polyester, spandex, etc.) are usually stronger than cotton fiber but they show less affinity to dye than the cotton fiber due to synthetic fibers being hydrophobic. So naturally, the effects of washing on cotton fiber and synthetic fibers vary from each other (Akter et al., 2021). Cotton, polyester, and spandex are the familiar combinations

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of making blended denim fabric. This study was conducted to study the performance of 95% CTN and blended CTN variation buttress the several mechanical and chemical properties by perceiving the same washing procedure.

2. Material and methods

2.1. Materials

The sample fabrics were collected from Creative Collection Ltd. of Hamim Group. The weight of the samples was approximately 1.5 kg of each. The fabric specifications are given in Table 1.

Table 1 Fabric specifications

Number	Fabric Types	Fiber Compositions	Fabric Weight
01	3/1 Twill	(95% Cotton, 5% Recycled Cotton)	11.4 OZS/SQ.YD.
02	3/1 Twill	(80% Cotton, 18% Polyester, 2% Spandex)	10.6 OZS/SQ.YD.

2.2. Testing machineries

- GSM cutter-James H. Heal
- Tear testing machine-Elmendorf
- Tensile strength tester -TESTTEX
- Washing Machine-Belly
- Hydro Extractor -Belly
- Woven Dryer
- Electronic Balance- James H. Heal
- Electronic Crock meter- James H. Heal
- P^H meter

2.3. Chemicals and recipes

Chemicals used at different stages of this study are listed below:

Table 2 Utilized chemicals, functions, and recipes

S. L	Step	Chemical name	Chemicals functions	Weight	Water	Temp.	Run. Time
1	Desize	T.K.R	Lycra Protector	30 g	60 L	40 °C	5 min
2	Enzyme	Power-Finish	Enzyme	50 g	50 L	40 °C	45 min
		NTM	Anti-back staining agent	100 g			
		Pumice Stone	----------	2.5 kg			
3	Bleach	K.C.I	Bleaching Agent	50 g	60 L	50 °C	2 min
4	Neutralization	Lava con-max	Neutralizing agent	60 g	60 L	Cold	5 min
5	Cleaning	Soda-ash	Cleaning agent	60 g	60 L	50 °C	2 min
		NTM	Anti-back staining agent	120 g			
6	Tinting	Brown-GTL	Direct dye	0.1 g	50 L	50 °C	2 min
		Yellow - R.L	Direct dye	0.02 g			
7	Fixing	Lavafix- FF	Fixing agent	100 g	50 L	Cold	5 min
8	Softening/ PH control	C.W.S	Cationic softener	50 g	50 L	Cold	3 min
		Citric Acid	Neutralizer, pH controller	25 g			

2.4. Denim wash process sequence

The standard factory level denim process sequence utilized in this research to establish the comparison study of two types of samples has given step by step in below:

2.4.1. Desizing

Denim leg panels were treated with a desizing agent. This pretreatment was conducted in liquor containing T.K.R chemical which was a lycra protector. The material to liquor ratio for this process was 1:40 and the operation was carried out in a small-scale industrial belly washing machine. This treatment was carried out at 40 °C temperature for 5 minutes. After 5 minutes, the liquor was drained and rinsed the samples.

2.4.2. Stone Enzyme Wash

Desized denim leg panels were treated with Premagreen Powder Finish enzyme. This enzyme treatment was completed with stone and NTM (anti -back staining agent), at temperature 40 °C for 45 minutes. Then the treated denim leg panels were rinsed two times with clean water.

2.4.3. Bleach Wash

Desized denim leg panels were then treated using bleaching agent (KCI). This treatment was done at liquor ratio of 1:40, at temperature 50 °C for 2 minutes.

2.4.4. Neutralization

Lava con-max neutralizer was used to neutralize the leg panels and rinsed two times for 5 minutes in cold condition. It neutralizes the garments from alkaline condition and controls the pH value in wash bath after bleach wash.

2.4.5. Cleaning

After neutralization process, cleaning process completed with Soda Ash (sodium bi carbonate) and NTM (anti-back staining agent) at 50 °C for 2 minutes.

2.4.6. Tinting

Tinting process is done to obtain the standard color for med wash indigo. After the cleaning process direct dyes (Brown GTL & Yellow RL) were applied for tinting of the denim fabrics and rinsed.

2.4.7. Fixing

The denim leg panels were then treated with fixing agent (Lavafix-FF) at cold condition for 5 minutes to fix the color materials into the fabric.

2.4.8. Softening & pH Control

For improving the silky hand feel a softening agent C.W.S was executed. After that pH was controlled by adding citric acid.

2.4.9. Testing Methods

All the tests were completed at Creative Wash Limited – Laboratory of Ha-Meem Group. The standard methods of testing and procedure on the samples are given below: -

2.4.10. GSM

The samples were tested according to ASTM D3776 standard. First, the sample was conditioned for 4 hours. Then, the specimen was cut into 5 pieces by a GSM cutter, each containing a diameter of 11.3 cm. Then, specimens were weighed in grams by electronic balance. Then the weight was multiplied by 100. Finally, the result was by averaging 5 readings.

2.4.11. Shrinkage

The shrinkage of these samples was tested after washing. At first, samples cut 50 cm × 50 cm dimension. Then mark the fabric 35 cm × 35 cm, inside of the cut fabric for each type of fabric in length and width directions. For determining shrinkage%, the following formula was used-

Shrinkage% = (before wash – after wash)/before wash × 100%

2.4.12. Ends per Inch (EPI) & Picks per Inch (PPI)

The EPI and PPI of the fabric were calculated by one inch counting glass collected from the laboratory, observed, and calculated directly.

2.4.13. Color Fastness Crocking/Rubbing

The wet and dry samples were tested according to GB/T 3920 method in Electronic Crock meter". Specimen were rubbed a machine finger, covered with cotton rubbing cloth. 3 specimens were taken in both warp & weft directions. In the dry process, dry rubbing cloth was clamped and performed 10 times to and from movements with the finger on each specimen. For wet test, a 100% water soaked in water sample was rubbed by standard rubbing clothes for 10 cycles, then cloth was matched against grayscale and the results were obtained.

2.4.14. Tearing Strength

In this test, the ASTM D1424 standard was followed. The Elmendorf test testing machine was used which uses a falling pendulum to tear a fabric specimen. The dimension of the specimen 3 inch tall and 4 inch wide was taken in both warp and weft direction for this test. It was pre-notched with a 0.5-inch by 0.5-inch notch at the center of the top of the fabric specimen.

2.4.15. Breaking/Tensile Strength

The tensile strength test was done in accordance with ASTM D5034 standard (Grab method), the 5 specimens of 4 inches × 6-inch sizes (not the full width) were gripped in the jaw faces taken for both warp and weft direction of the fabric. Two sets of specimens were prepared, one in the warp direction and one in the filling (cross) direction. Tensile strength was measured in pounds (lbs.).

3. Results and discussion

3.1. EPI & PPI

The changes in EPI & PPI of tested samples before and after washing are demonstrated in **Figure 1**. Ends per inch (EPI) and Picks per inch (PPI) in 100% cotton decreased from 72 to 70 and 52 to 50. But in blended cotton EPI & PPI increased from 80 to 90 and 56 to 58 respectively. The yarn density, types of yarn in warp direction, and tension in producing the fabric have a larger impact on EPI and PPI variations. Enzymes hydrolyze the cotton fiber which assists the fabric to shrink and to rearrange the EPI and PPI (13).

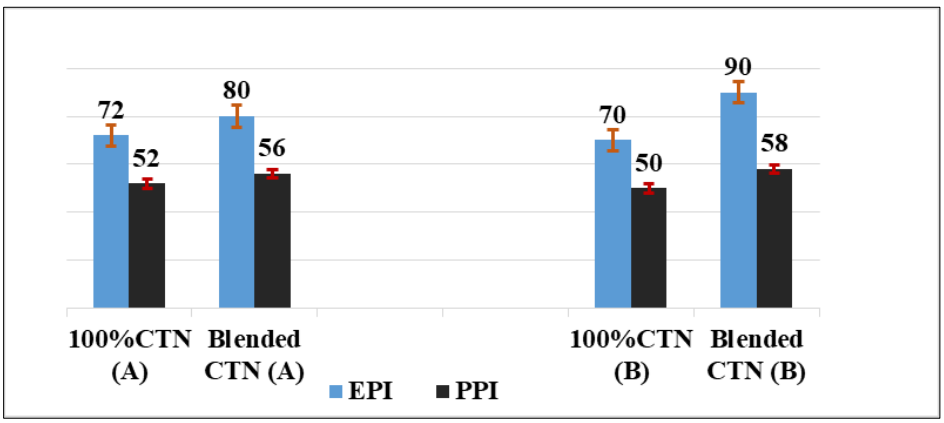

Figure 1 EPI and PPI changes on denim wash

3.2. Changes in appearance

The applied Sulphur and Indigo dyes in treated fabric faded illustrated after washing because of reducing the surface unfixed dyes. Furthermore, the denim fabrics turned into a medium indigo shade and changed the parameters of a

woven fabric (14). The fabric surface of blended cotton looks smoother and has a softer hand felt than 100% cotton denim after washing (15). Slubs yarns were more visible on the 100% cotton denim fabric.

Figure 2 Fabric appearance before after and wash

3.3. Fabric Weight

Fabric weight before and after washing is illustrated in **Figure 3**. The observed data has shown that fabric weight in 100 % CTN denim reduced from 11.4 to 10.5 oz/yd^2. On the other hand, the weight of blended CTN denim fabric increased from 10.6 to 11.0 oz/yd^2. The weight of the fabric can vary on yarn count, types of yarn, warp and weft density, and the applied chemicals that have been attributed to the fabric surface. The protruding fiber and color from the fabric surface were reduced by stone wash (13,15). In 100% CTN fabric the EPI and PPI were reduced **Figure 1**. Consequently, the fabric weight also decreased.

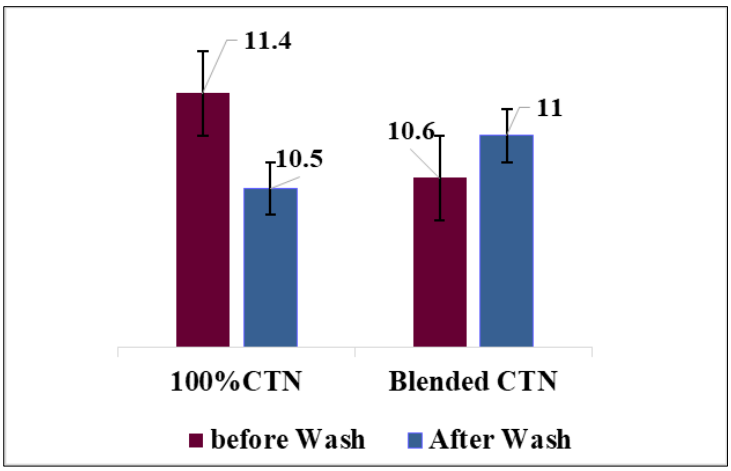

Figure 3 Wash effects on denim fabric weight

3.4. Tear Strength

The tearing strength of woven fabric depends on fiber types, yarn count, strength, twist factor, yarn density weave structure, etc. The density of EPI and PPI might reduce the strength also. Chemical uses like bleaching agents, enzyme ingredients, acid use in CTN fabric, and alkaline effects on manmade fiber can destroy the yarn strength resulting in a reduction of tensile and tear strength. Bleaching wash decomposes the CTN fibers in molecular stage chain breakings (16). As 100%CTN fabric has a high percentage since the tear strength. Figure 4 showed that tear strength was reduced from (7.7 to 4.5 lbs.). For blended CTN denim fabric, tearing strength loss was about 27.16% (8.1 to 5.9 lbs.) in the warp direction but surprisingly 5.12% (7.8 to 8.2 lbs.) increased in the weft direction. From the data, blended CTN fabric has higher strength due to the low CTN percentage of fiber.

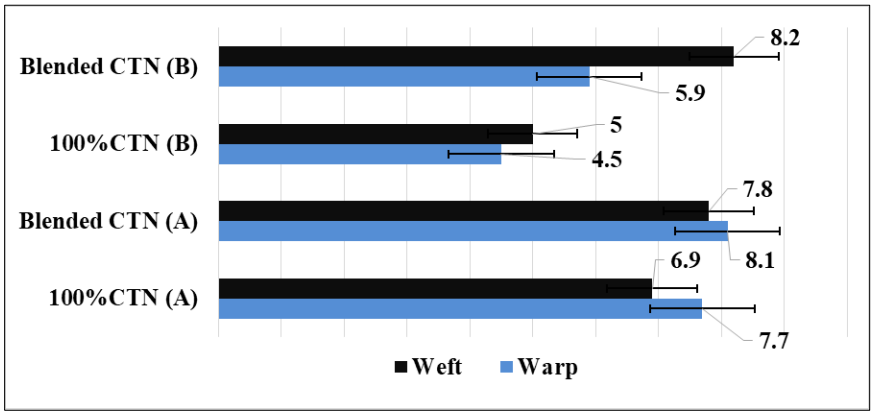

Figure 4 Tear strength of denim fabric (A) Unwashed (B) Washed

3.5. Breaking/Tensile Strength

The breaking strength mostly relies on yarn properties -yarn strength and yarn density, where a number of yarns are responsible for withstanding the forces exerted on the fabric. With the increasing number of EPI and PPI, uplifting the fabric-breaking strength (16). But minimize the breaking force whenever applied to the fabric by weft yarn if the induced force on the weft is vice versa (17). Hereby, the test results showed in **Figure 6** that the reduction of breaking strength for 100% CTN denim was about 33.8% (152.8 lbs. to 101.1 lbs.) in the warp direction and 26.06% (112.4 lbs. to 83.1 lbs.) in the weft direction. For blended CTN denim the loss was about 25.67% (148 to 110 lbs.) in the warp direction and 18.24% (137 to 112 lbs.) in the weft direction. The warp-wise breaking strength was higher than the weft-wise direction. Since it might be the result of yarn density which resists the breaking force shown in **Figure 1**& discussed in fabric weight portion. But comparatively, blended CTN shows somewhat better breaking strength the 100% CTN for the presence of manmade fibers.

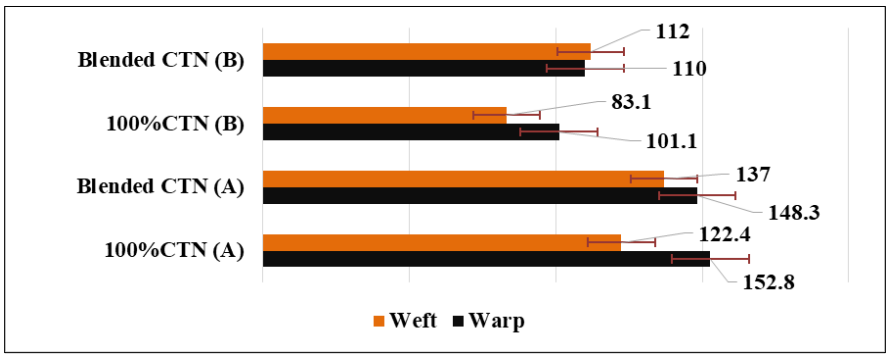

Figure 5 Breaking strength of unwashed and washed denim fabric

3.6. Shrinkage

Shrinkage of woven fabric has been done manually. Length and width of samples were taken before and after the wash followed by the same procedure for both fabric samples. After washing, yarn may soothe the mechanical forces. That's why almost every fabric shows shrinkage in either direction. The weave structure is the main parameter to change the

length and width of fabric shrinkage (18). The loosely made fabric has a greater chance to shrink or raise the fabric. Likewise, the test found that -

- Length wise shrinkage% for 100% CTN = (35-36)/35% = 2.85% increase
- Width wise shrinkage% for 100% CTN = (35-36.5)/35% = 4.28% increase
- Length wise shrinkage% for blended CTN = (35-31)/35% = -11.42% decrease
- Width wise shrinkage% for blended CTN = (35-33.5)/35% = - 4.28% decrease

Inconsequence of waviness of yarn in warp direction might allow fabric to increase and decrease in weft direction.

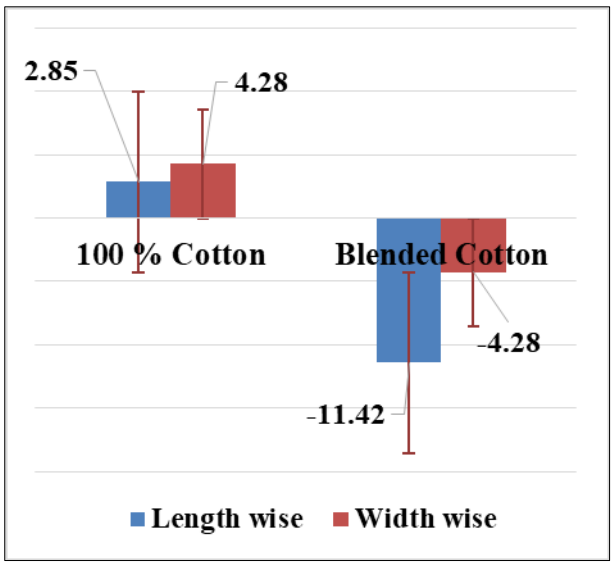

Figure 6 Length and width wise Shrinkage effects on denim fabric

3.7. Color fastness to accelerated laundering, water, and perspiration

100 % CTN and blended CTN fabric, in color fastness to accelerated laundering treatment has demonstrated. AATCC61-2A, 49 ^{0} C-2013.The AATCC recommended detergent, WOB detergent powder, and multi-fiber no 10 and 50 steel balls were used in the test. According to this method, samples were cross-checked to evaluate color change on the scale of 1 to 5. The test result has been given in the **appendix.** For the blended cotton denim fabric, the results demonstrated color change grade 4.0 and cross-staining to multi-fiber materials grade was 4.5 on average.

AATCC 107-2013 water fastness test method was used for fastness, and AW (Acetate, Cotton, Nylon, Polyester, Acrylic, and Wool) fabric composite was used as a reference sample against the tested sample. Both unwashed and washed samples exhibited similar results, color grade 4.0 and Color staining on multi-fiber AW average was 4.5.

In the color fastness test, the ISO 105-E04:2013 method was utilized. Color change and color staining grade were evaluated by grayscale grade 1-5 and AW multi-fiber (Acetate, Cotton, Nylon, Polyester, Acrylic, and Wool). Results illustrated a color change in the unwashed sample in both acidic and alkaline media 4.0 and color staining was measured an average of 4.5. The tested results demonstrated similar results in washing in blended cotton fabric (16). Colorfastness in laundering, water, and perspiration has demonstrated the same results for using a fixing agent after washing.

3.8. Color Fastness to Crocking/Rubbing

Colorfastness to crocking or rubbing completed under GB/T 3920-2008 test. The rating was cross-matched with a grayscale of 1-5. Results have found that the wet rubbing fastness test was lower than the dry rubbing fastness. However, the result in un-washed wet rubbed samples was shown less than the washed sample.

Fabric can withhold the color from the surface when the fabric is dry. Color may dislodge from color particles in wet conditions to break down the intermolecular attraction in water, fabric, and color chemicals under mechanical forces like rubbing against the hard surface applied on the fabric. In wet rubbed un-washed samples have shown lower fastness than the washed sample might have happened with unfixed dyes on the fabric surface. The bleaching chemical slowly attacks the outer layer of the fiber or fabric surface (16). It is also demonstrated in **Table 4** that the dark-shaded fabric

has shown comparatively lower than the medium-shaded and light-shaded colored fabric. The more unfixed dyes may be found on the fabric surface for medium to dark shade.

Table 3 Color fastness to rubbing of denim fabric samples

Sample	Composition	Rubbing test	Warp direction	Weft direction
Unwashed (A)	100% CTN	Dry	3-4	3-4
		Wet	1	1
	Blended CTN	Dry	4	4
		Wet	1	1
Washed (B)	100% CTN	Dry	4	4
		Wet	2	2
	Blended CTN	Dry	4	4
		Wet	2	2

Table 4 Color fastness for different grade dyes

Test	Dark shade	Medium Shade	Light Shade
Dry	3-4	4	4-5
Wet	2-2.5	3	3.5-4

4. Conclusion

The research has been conducted to disseminate the comparison between the 95% (CTN), 5% recycled CTN denim, and blended CTN denim containing 80% cotton, 18% polyester, and 2% spandex. The evaluation was done on the mechanical and physical properties of the fabrics by fabric weight, EPI and PPI, tear strength, breaking strength, color fastness to laundering, water, perspiration, and rubbing. Investigation showed that no remarkable discrepancy was found from in color fastness. However, this study concluded that EPI and PPI or yarn density greater the fabric weight, tear strength, breaking strength, and low shrinkage. The result showed that fabric weight increased in blended CTN denim fabric whereas fabric weight decreased in 100% cotton denim. Accompanied by the higher number yarns per unit length and yarn strength of the fabric increases the mechanical performance of the fabric. The blended CTN denim showed less breaking and tearing strength reduction caused by polyester being stronger than cotton after washing. Besides that, color fastness to rubbing properties slightly improved in both fabrics. The blended cotton denim performed better than 100% cotton denim after washing in terms of weight and strength loss.

Limitations

This research work has some limitations are given below: -

- Dimensional stability, spirality, stretch and growth, SEM (Scanning Electron Microscopic) image could help us understand the difference in depth.
- It would have been great if denim fabrics containing higher portions of synthetic fibers could be tested and compared to the 100% CTN denim that was not tested.

Compliance with ethical standards

Acknowledgments

First, a humble thanks for cooperation with us given to Creative Wash Limited providing and allowing us to do tests in their laboratory. And provided all sample requirements and necessary materials. Next, a gratitude to all laboratory

executives especially to the Nusrat Jahan, Laboratory in charge who helped a lot to complete the work without hindrance.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

In accordance with the author's consent, there is no conflict of interest and nothing to disclose. Also, informed consent has also been taken from Creative collection Ltd. of Hamim Group authority.

References

[1] Annapoorani SG. Introduction to denim. In: Sustainability in Denim. Elsevier Inc.; 2017. p. 1–26.

[2] Miller D, Woodward S. Manifesto for a study of denim. Social Anthropology. 2007 Oct; 15(3):335–51.

[3] Miller D. Denim. Consumption Markets and Culture. 2015 Jul 4; 18(4):298–300.

[4] Paul R. Denim and jeans: An overview. In: Denim: Manufacture, Finishing and Applications. Elsevier Ltd; 2015. p. 1–11.

[5] Periyasamy AP, Militky J. Denim processing and health hazards. In: Sustainability in Denim. Elsevier Inc.; 2017. p. 161–96.

[6] Jucienė M, Dobilaitė V, Kazlauskaitė G. Influence of Industrial Washing on Denim Properties. Vol. 12, MEDŽIAGOTYRA). 2006.

[7] Murshida Khatun M, Haq UN. Effects of Biochemical Wash on 100% Cotton Denim Apparel. American Journal of Chemical Engineering Special Issue: Advanced Chemical and Biochemical Technology for Biofuels [Internet]. 2017;5(1):6–14. Available from: http://www.sciencepublishinggroup.com/j/ajche

[8] Tarhan M, Sarıışık M. A Comparison Among Performance Characteristics of Various Denim Fading Processes. Textile Research Journal. 2009; 79(4):301–9.

[9] Amutha K. Environmental impacts of denim. In: Sustainability in Denim. Elsevier Inc.; 2017. p. 27–48.

[10] Choudhury AKR. Environmental impacts of denim washing. In: Sustainability in Denim. Elsevier Inc.; 2017. p. 49–81.

[11] Arjun D, Hiranmayee J, Farheen & MN. TECHNOLOGY OF INDUSTRIAL DENIM WASHING: REVIEW.

[12] Akter N, Repon MR, Mikučionienė D, Jalil MA, Islam T, Karim MR. Fabrication and characterization of stretchable denim fabric using core spun yarn. Heliyon. 2021 Dec 1; 7(12).

[13] Khalil E, Sarkar J, Rahman M, Solaiman M. Influence of Enzyme And Silicone Wash On The Physico-Mechanical Properties Of Non-Denim Twill Garments. INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH [Internet]. 2014; 3(10). Available from: www.ijstr.org

[14] editor_in_chief,+ej-eng_2638_updated+on+02-12-2021.

[15] Sarkar J, Khalil E. Effect of Enzyme Washing Combined With Pumice Stone on the Physical, Mechanical and Color Properties of Denim Garments. International Journal of Research in Advent Technology. 2014; 2(9).

[16] Hasan MdZ, Asif AKMAH, Razzaque A, Hasan MdR, Sur S, Faruque MdO. An Experimental Investigation of Different Washing Processes on Various Properties of Stretch Denim Fabric. Journal of Materials Science and Chemical Engineering. 2021; 09(01):1–15.

[17] Telli A, Babaarslan O. The effect of recycled fibers on the washing performance of denim fabrics. Journal of the Textile Institute. 2017 May 4; 108(5):812–20.

[18] Sarmin Khatun M, Sohel Adnan Bhuiyan M, Hossain F, Munni A, Sultana S, Author C. Analysis the Effect of Weave Structure, Fabric Width and Fabric Weight on Skewness and Shrinkage of Denim Fabric. 5(5):31–6. Available from: www.iosrjournals.org

Appendix: Blended CTN test results and 100% CTN

HA-MEEM GROUP

INH-221100002

Creative Wash Limited – Lab

Nishat Nagar, Tongi, Gazipur, Bangladesh

Test Report

Report Number: INH-221100002	**Buyer Name: Self Reference**

Status	**DATA only**
Comments	

Sample Description	
Customer Name	Central Technical Team.
Sample Color	(A)Un Wash (B)Wash
Sample Type	Denim
No. of Sample	02 pcs fabric + 02 pcs leg tube
Care Label	
End uses	
Style Number	Development
Fiber Composition	80% Cotton 18% Polyester 2% Spandex
P.O Number	
Wash/Finish/Dye Type	
Date In	25 October, 2022
Expected Date Out	26 October, 2022
Date Out	03 November, 2022
Retest (Yes/No)	No
Previous report Number	N/A
Contact Person Name	Mr. Asad
Contact Person Address	Central Technical Team.
Report Prepared By	Anisur Rahman

Test Performance & Result: The test performed accordance with the applicant's request refers to the following pages.

For and on behalf of

Creative wash Limited-Lab

Nusrat Jahan

Lab Incharge

Page 1 of 5

HA-MEEM GROUP

INH-221100002

Creative Wash Limited – Lab

Nishat Nagar, Tongi, Gazipur, Bangladesh

Test Report

Test Result Summary

TEST PROPERTY	A	B	COMMENTS
Fabric Weight	D	D	
Tearing Strength of Fabric	D	D	
Tensile Strength of Fabric	D	D	
Color Fastness to Accelerated Laundering	D	D	
Color Fastness to Water	D	D	
Color Fastness to Perspiration	D	D	
Color Fastness to Crocking	D	D	

Remark: P= PASS, F= FAIL, D=DATA, X=NOT TESTED.

HA-MEEM GROUP

INH-221100002

Creative Wash Limited – Lab

Nishat Nagar, Tongi, Gazipur, Bangladesh

Test Report

1. Fabric Weight [ASTM D3776-09A (R2017), OPTION –C]:

Sample	Result (g/m²)	Result (oz/yd²)	Requirement	Tolerance	Remarks
A	358	10.6	Report Actual	-	DATA
B	372	11.0	Report Actual	-	DATA

[Due to Insufficient fabric we are not able to maintain specimen number as per method]

2. Tearing Strength Elmendorf Apparatus [ASTM D 1424 -09 (R2013]:

Sample	Result (lbs)		Requirement (lbs)	Remarks
A	Warp	8.1	-	DATA
	Weft	7.8	-	
B	Warp	5.9	-	DATA
	Weft	8.2	-	

[Due to Insufficient fabric we are not able to maintain specimen number as per method]

3. Breaking Strength of Textile Fabrics -Grab Method (ASTM D5034:2013):

Sample	Result (lbs)		Requirement (lbs)	Remarks
A	Warp	148.3	-	DATA
	Weft	137.0	-	
A	Warp	110.0	-	DATA
	Weft	112.0	-	

[Due to Insufficient fabric we are not able to maintain specimen number as per method]

4. Color Fastness to Accelerated Laundering (AATCC 61-2A, 49 DEGRE CELSIUS-2013):
[AATCC DETERGENT, WOB POWDER, MULTIFIBRE NO. 10, 50 STEEL BALLS]

Sample	Result			Requirement	Remarks
A	Color Change	4.0		-	DATA
	Cross staining	-		-	
	Color Staining on Multifibre No-10	Acetate	4.5	-	
		Cotton	4.5		
		Nylon	4.5		
		Polyester	4.5		
		Acrylic	4.5		
		Wool	4.5		
B	Color Change	4.0		-	DATA
	Cross staining	-		-	
	Color Staining on Multifibre No-10	Acetate	4.5	-	
		Cotton	4.5		
		Nylon	4.5		
		Polyester	4.5		
		Acrylic	4.5		

Page 3 of 5

HA-MEEM GROUP

INH-221100002

Creative Wash Limited – Lab

Nishat Nagar, Tongi, Gazipur, Bangladesh

Test Report

		Wool	4.5		

5. **Color Fastness to Water: (AATCC 107 – 2013)**

Sample	Result			Requirement	Remarks
A	Color Change	4.0		-	DATA
	Cross staining	-		-	
	Color Staining on Multifibre No-10	Acetate	4.5	-	
		Cotton	4.5		
		Nylon	4.5		
		Polyester	4.5		
		Acrylic	4.5		
		Wool	4.5		
B	Color Change	4.0		-	DATA
	Cross staining	-		-	
	Color Staining on Multifibre No-10	Acetate	4.5	-	
		Cotton	4.5		
		Nylon	4.5		
		Polyester	4.5		
		Acrylic	4.5		
		Wool	4.5		

6. **Color Fastness to Perspiration (ISO 105-E04:2013):**

Sample	Result			Requirement	Remarks
A		Acid	Alkaline	-	DATA
	Color Change	4	4		
				-	
	Color Staining on Multi fiber DW				
	Acetate	4.5	4.5		
	Cotton	4.5	4.5		
	Nylon	4.5	4.5		
	Polyester	4.5	4.5		
	Acrylic	4.5	4.5		
	Wool	4.5	4.5		
Sample	**Result**			**Requirement**	**Remarks**
B		Acid	Alkaline	-	DATA
	Color Change	4	4		
				-	
	Color Staining on Multi fiber DW				
	Acetate	4.5	4.5		
	Cotton	4.5	4.5		

HA-MEEM GROUP

INH-221100002

Creative Wash Limited – Lab

Nishat Nagar, Tongi, Gazipur, Bangladesh

Test Report

	Nylon	4.5	4.5		
	Polyester	4.5	4.5		
	Acrylic	4.5	4.5		
	Wool	4.5	4.5		

7. **Color Fastness to Crocking: (GB/T 3920-2008)**

Sample	Result			Requirement	Remarks
		Warp	Weft		
A	Dry	4	4	-	DATA
	Wet	1	1	-	
		Warp	Weft		
B	Dry	4	4	-	DATA
	Wet	2	2	-	

Note:

1. Test result and evaluation are only related to tested items and performed method. Detailed information regarding measurement uncertainties are available on request if applicable.
2. This report is limited to the test samples identified herein and does not indicate or represent the statistical quality of the lot from which the test sample was taken.
3. This report is prepared on basis of the customer/buyer instructions and/or information and the sample supplied by you.

******* End of Report *******

HA-MEEM GROUP

INH-221100001

Creative Wash Limited – Lab

Nishat Nagar, Tongi, Gazipur, Bangladesh

Test Report

Report Number: INH-221100001	Buyer Name: Self Reference

Status	DATA only
Comments	

Sample Description	
Customer Name	Central Technical Team.
Sample Color	(A)Un Wash (B)Wash
Sample Type	Denim
No. of Sample	02 pcs fabric + 02 pcs leg tube
Care Label	
End uses	
Style Number	Development
Fiber Composition	100% Cotton
P.O Number	
Wash/Finish/Dye Type	
Date In	25 October, 2022
Expected Date Out	26 October, 2022
Date Out	03 November, 2022
Retest (Yes/No)	No
Previous report Number	N/A
Contact Person Name	Mr. Asad
Contact Person Address	Central Technical Team.
Report Prepared By	Anisur Rahman

Test Performance & Result: The test performed accordance with the applicant's request refers to the following pages.

For and on behalf of

Creative wash Limited-Lab

Nusrat Jahan

Lab Incharge

HA-MEEM GROUP

INH-221100001

Creative Wash Limited – Lab

Nishat Nagar, Tongi, Gazipur, Bangladesh

Test Report

Test Result Summary

TEST PROPERTY	A	B	COMMENTS
Fabric Weight	D	D	
Tearing Strength of Fabric	D	D	
Tensile Strength of Fabric	D	D	
Color Fastness to Accelerated Laundering	D	D	
Color Fastness to Water	D	D	
Color Fastness to Perspiration	D	D	
Color Fastness to Crocking	D	D	

Remark: P= PASS, F= FAIL, D=DATA, X=NOT TESTED.

HA-MEEM GROUP

INH-221100001

Creative Wash Limited – Lab

Nishat Nagar, Tongi, Gazipur, Bangladesh

Test Report

1. Fabric Weight [ASTM D3776-09A (R2017), OPTION –C]:

Sample	Result (g/m²)	Result (oz/yd²)	Requirement	Tolerance	Remarks
A	387	11.4	Report Actual	-	DATA
B	356	10.5	Report Actual	-	DATA

[Due to Insufficient fabric we are not able to maintain specimen number as per method]

2. Tearing Strength Elmendorf Apparatus [ASTM D 1424 -09 (R2013]:

Sample	Result (lbs)		Requirement (lbs)	Remarks
A	Warp	7.7	-	DATA
	Weft	6.9	-	
B	Warp	4.5	-	DATA
	Weft	5.0	-	

[Due to Insufficient fabric we are not able to maintain specimen number as per method]

3. Breaking Strength of Textile Fabrics -Grab Method (ASTM D5034:2013):

Sample	Result (lbs)		Requirement (lbs)	Remarks
A	Warp	152.8	-	DATA
	Weft	112.4	-	
A	Warp	101.1	-	DATA
	Weft	83.1	-	

[Due to Insufficient fabric we are not able to maintain specimen number as per method]

4. Color Fastness to Accelerated Laundering (AATCC 61-2A, 49 DEGRE CELSIUS-2013):
[AATCC DETERGENT, WOB POWDER, MULTIFIBRE NO. 10, 50 STEEL BALLS]

Sample	Result			Requirement	Remarks
A	Color Change	4.0		-	DATA
	Cross staining	-		-	
	Color Staining on Multifibre No-10	Acetate	4.5	-	
		Cotton	4.5		
		Nylon	4.5		
		Polyester	4.5		
		Acrylic	4.5		
		Wool	4.5		
B	Color Change	4.0		-	DATA
	Cross staining	-		-	
	Color Staining on Multifibre No-10	Acetate	4.5	-	
		Cotton	4.5		
		Nylon	4.5		
		Polyester	4.5		
		Acrylic	4.5		

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Test Report

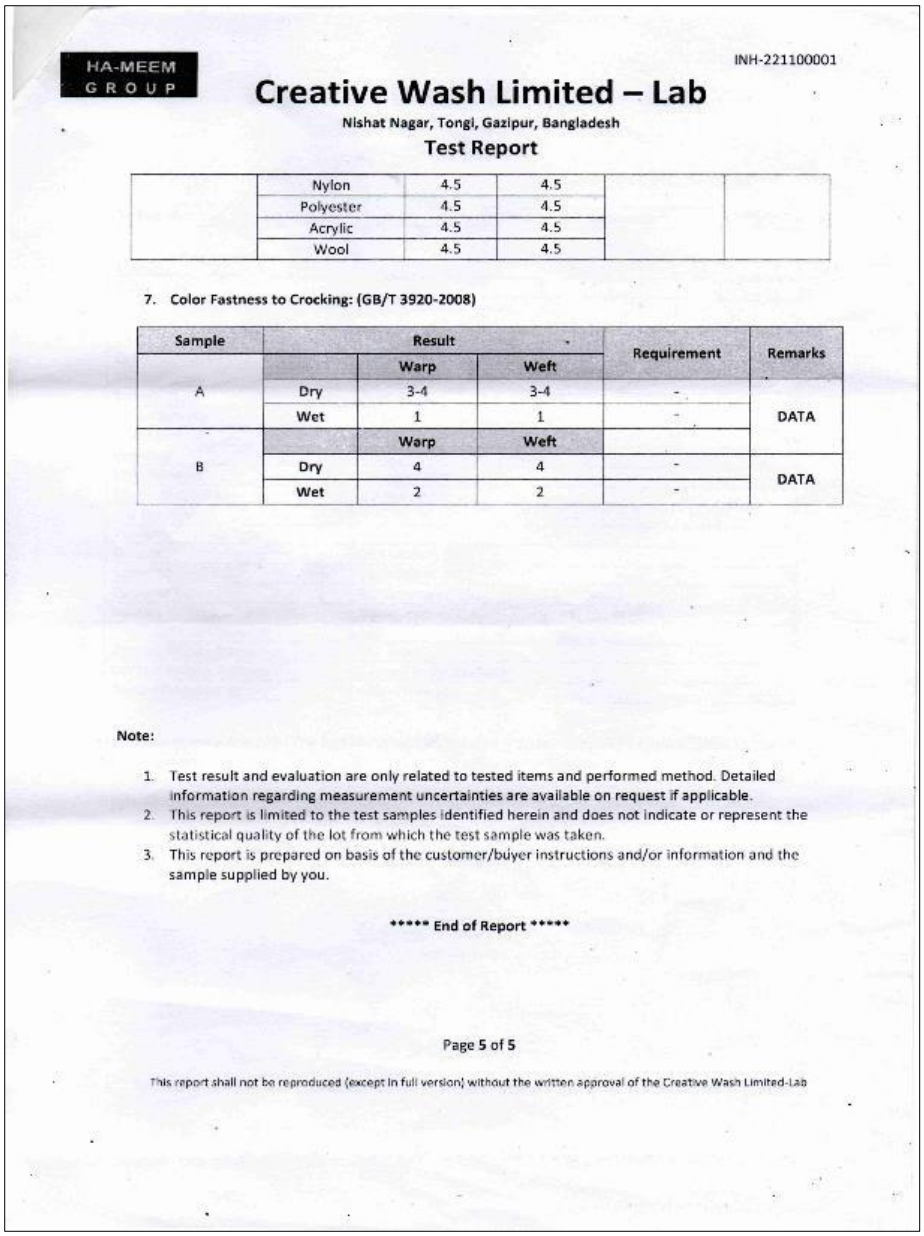
		Wool	4.5		

5. **Color Fastness to Water: (AATCC 107 – 2013)**

Sample	Result			Requirement	Remarks
A	Color Change	4.0		-	DATA
	Cross staining	-		-	
	Color Staining on Multifibre No-10	Acetate	4.5	-	
		Cotton	4.5		
		Nylon	4.5		
		Polyester	4.5		
		Acrylic	4.5		
		Wool	4.5		
B	Color Change	4.0		-	DATA
	Cross staining	-		-	
	Color Staining on Multifibre No-10	Acetate	4.5	-	
		Cotton	4.5		
		Nylon	4.5		
		Polyester	4.5		
		Acrylic	4.5		
		Wool	4.5		

6. **Color Fastness to Perspiration (ISO 105-E04:2013):**

Sample	Result			Requirement	Remarks
A		Acid	Alkaline	-	-
	Color Change	4	4		
	Color Staining on Multi fiber DW			-	DATA
	Acetate	4.5	4.5		
	Cotton	4.5	4.5		
	Nylon	4.5	4.5		
	Polyester	4.5	4.5		
	Acrylic	4.5	4.5		
	Wool	4.5	4.5		
Sample	**Result**			**Requirement**	**Remarks**
B		Acid	Alkaline	-	DATA
	Color Change	4	4		
	Color Staining on Multi fiber DW			-	
	Acetate	4.5	4.5		
	Cotton	4.5	4.5		



HA-MEEM GROUP

INH-221100001

Creative Wash Limited – Lab

Nishat Nagar, Tongi, Gazipur, Bangladesh

Test Report

	Nylon	4.5	4.5		
	Polyester	4.5	4.5		
	Acrylic	4.5	4.5		
	Wool	4.5	4.5		

7. **Color Fastness to Crocking: (GB/T 3920-2008)**

Sample		Result		Requirement	Remarks
		Warp	Weft		
A	Dry	3-4	3-4	-	DATA
	Wet	1	1	-	
		Warp	Weft		
B	Dry	4	4	-	DATA
	Wet	2	2	-	

Note:

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***** End of Report *****

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Author's short Biography

	**Arnab Basak**, he has been working in City University as an Assistant Professor for 10 years at Textile Engineering Department. Previously, he worked as a junior executive at reputed factory in Bangladesh. He coordinated in the results and supervised the laboratory personal to obtain the minimal imperfection for this research work.
	**Suman Chandra Paul**, I have worked as production executive in renowned weaving mill for 2.5 years in Bangladesh and then I have joined in the City University as a Lecture in Department of Textile Engineering. This publication, I have contributed myself as interpreting, critical thinking of results and writing the paper.
	**Baizid Rahman**, he has been on faculty of Textile Engineering Department at City University for 10 years from now as Assistant professor. Earlier he worked as quality control officer in a reputed spinning mill in Bangladesh. After that he joined as lecturer in Textile Engineering department at Atish Depankar University of Science and Technology. He has been researcher on environmental textiles. In this thesis paper he contributed himself as interpreting the results and coordinating the results