

Analysis Of Different Types Of Washing Effect On Denim Fabric Using Different Concentration Or Parameters And Find Out The Best Concentration Or Parameter Which Gives Best Aesthetics Look & Also Evaluate The Strength Of Denim Goods According To The Physical & Wet Test Result

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Abstract— Denim garments is the most preferred of today's youth. The objective of this research is to provide an extensive overview of enzyme wash, bleach wash, acid wash for garments and find out best physical & chemical test result. The research paper are written for the garments washing professional for detailed casing information. In this research use indigo dyed denim garments and five parameter of Lava cell NHC Cold (1 g/l, 1.5 g/l, 2 g/l, 2.5 g/l and 3 g/l) for enzyme wash, five parameters of Sodium hypochlorite (1 g/l, 1.5 g/l, 2 g/l, 2.5 g/l and 3 g/l) for bleach wash and five parameters of Potassium permanganate (2 g/l, 5 g/l, 10 g/l, 15 g/l and 20 g/l) for acid wash. After Enzyme wash, Bleach wash and Acid wash tasted all of sample according to ISO 105C06:2010 (Color fastness to Washing), ISO 105X12 (Color fastness to rubbing dry/wet), ASTM-D1425 (Tear Strength Warp/Weft). The research test result shows for enzyme wash sample no 5 give better performance and aesthetic look is better than other sample. For Bleach wash after test result sample no 5 shows color fastness to light, appearance after wash and color fastness to rubbing (Dry/Wet) performance better than other 4 samples. After GSM and tear strength test sample no 1 shows best performance than other 4 samples. But in the case of Acid wash after test we got sample no 5 color fastness to light, appearance after wash and color fastness to rubbing (Dry/Wet) performance better than other four samples. After GSM and tear strength test sample no 1 shows best performance than other 4 samples. But sample no 4 shows average result and sample no 5 shows very poor result for tearing test. Because high concentration of Potassium permanganate damage the fabric strength. That's why in case of Bleach wash and Acid wash try to use medium concentration of Sodium hypochlorite (NaClO) and Potassium permanganate (KMnO₄).

Keywords— Sustainable denim washing, Denim Washing, Denim Jeans, Denim Processes, Denim quality, Quality Testing.

I. INTRODUCTION

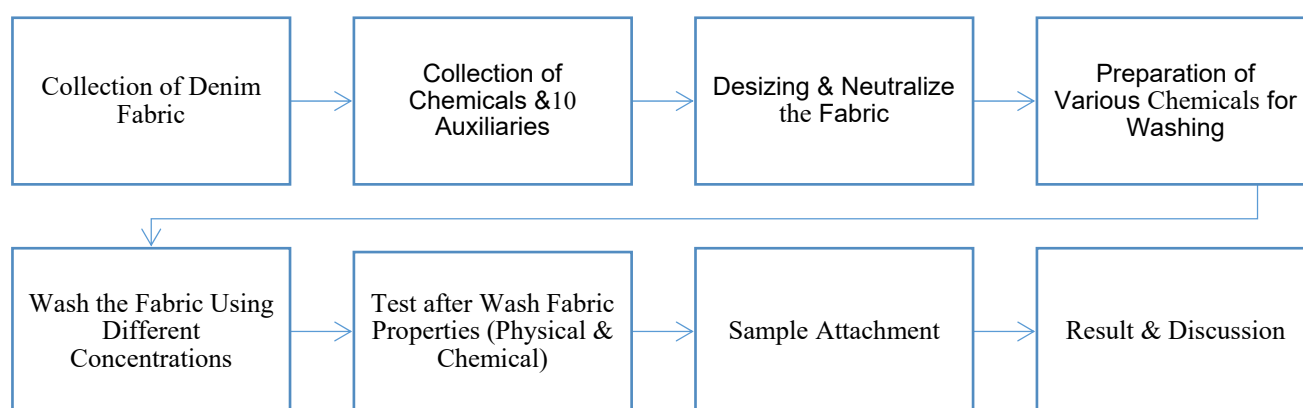
Denim washing is gradually entering the list of vital procedures of fulfilling the needs of the world's evolving fashion industry [1]. Denim is a woven fabric that is highly durable, stiff, and long-lasting. Denim is a cotton twill fabric with a colored warp and a white weft yarn that is commonly used in jeans, work clothing, and casual wear [2] [3] [4].

Industrial Garments Washing is one of the major important parts for Textile sector. By industrial garments washing, we can remove dust, dirt and infections material. For improving special look on garments as per fashion requirement [5] [6] [7]. The main step in the garment finishing process in washing, Enzyme Wash, Bleach Wash, Acid Wash these type of finishing treatment that is used to make stitched clothes more appealing, stylish, Fashionable, soft, and comfy while also increasing value [8] [9] [10].

One of the most significant value added operations in the washing facility to fulfill customer criteria is denim Jeans finishing. It is done by enzyme wash, bleach wash and acid wash. According to fashion trend and customer demand buyers ask for garment washing [11] [12].

Denim's unique characteristics, such as its adaptability and strength, have made it popular, particularly among young people [13]. For the washing apparel buyers mention exactly what types of washing they need for the order. For example, Tom Tailor buyer asked for washes like Vintage wash, Cloud wash, softener wash or Acid wash. Each wash has different types of appearance on the fabric surfaces. Wash types mainly depends on the product types. For denim product heavy enzyme is required where for knitted Tee light softener wash may be okay. For different types of design need different types of wash like Potassium Permanganate (KMnO_4) is a strong oxidizing agent used to make vintage look [14] [15].

II. OUTLINE OF THE PROJECT WORK IS GIVEN BELOW



III. EXPERIMENTAL

3.1. Materials

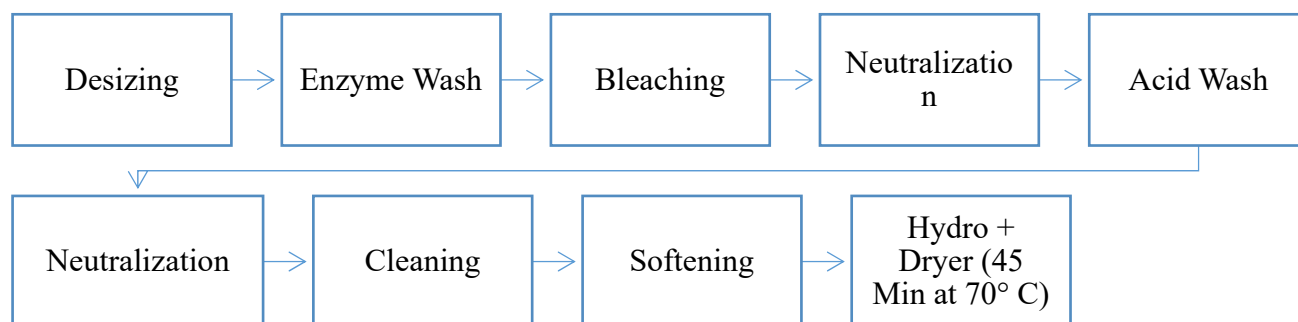
99% Cotton & 1% Spandex indigo dyed denim apparel was used for this experiment. The fabric 3/1 warp-faced twill design respectively and weight 10.62 OZ or GSM 360.

3.2. Chemicals

- Soda Ash (Na_2CO_3)
- Anti-Back Staining
- Lava Cell NHC Cold (Powder Enzyme)
- KCl Bleaching Powder (NaClO)
- Sodium met bisulfite ($\text{Na}_2\text{S}_2\text{O}_5$)

- Potassium permanganate (KMnO₄)
- Lava Cone PAP (PP Activator)
- Hydrogen peroxide (H₂O₂)
- Cross color Miro (Detergent)
- Acetic Acid (CH₃COOH)
- Softening Agent

3.3. Flow Chart of Washing



Recipe For sample 01

Desizing:

Soda Ash(Na₂CO₃)-2g/l

Anti Back Staining- 1g/l

Time: 10 Min

Tem: 50° C

M:L : 1:08

Enzyme Wash:

Lava Cell NHC Cold (Powder Enzyme)-1g/l

Anti-Back Staining- 1g/l

Time: 30 Min

Tem: 40° C

M:L : 1:08

Bleaching:

KCl Bleaching Powder (NaClO)-1g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Neutralization:

Sodium Meta Bisulphate-2 g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Acid Wash:

Potassium permanganate (KMnO₄)-2g/l

Lava Cone PAP- 1g/l

Sponge ball- 200 pcs

Water: 1 ltr

Time: 5 Min

Tem: RT

M:L : 1:08

Neutralization:

Sodium Meta Bisulphate- 2g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Cleaning:

Hydrogen peroxide -2g/l

Cross color Miro- 1g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Softening:

Wetsoft -700 - 2g/l

Acetic Acid -0.5 g/l

Time: 5 Min

Tem: RT

M:L : 1:08

Hydro + Dryer (45 Min at 70° C)

Recipe For sample 02

Desizing:

Soda Ash(Na₂CO₃)-2g/l

Anti Back Staining- 1g/l

Time: 10 Min

Tem: 50° C

M:L : 1:08	Crosscolor Miro- 1g/l	M:L : 1:08
Enzyme Wash:	Time: 5 Min	Acid Wash:
Lava Cell NHC Cold (Powder Enzyme)-1.5 g/l	Tem: 40° C	Potassium permanganate (KMnO ₄)-10 g/l
Anti-Back Staining- 1 g/l	M:L : 1:08	Lava Cone PAP- 5g/l
Time: 30 Min	Softening:	Sponge ball- 200 pcs
Tem: 40° C	Wetsoft -700 - 2g/l	Water: 1 ltr
M:L : 1:08	Acetic Acid -0.5 g/l	Time: 5 Min
Bleaching:	Time: 5 Min	Tem: RT
KCl Bleaching Powder (NaClO)-1.5 g/l	Tem: RT	M:L : 1:08
Time: 5 Min	M:L : 1:08	Neutralization:
Tem: 40° C	Hydro + Dryer (45 Min at 70° C)	Sodium Meta Bisulphaite-2 g/l
M:L : 1:08	Recipe For sample 03	Time: 5 Min
Neutralization:	Desizing:	Tem: 40° C
Sodium Meta Bisulphaite-2 g/l	Soda Ash (Na ₂ CO ₃)-2g/l	M:L : 1:08
Time: 5 Min	Anti-Back Staining- 1g/l	Cleaning:
Tem: 40° C	Time: 10 Min	Hydrogen peroxide -2g/l
M:L : 1:08	Tem: 50° C	Crosscolor Miro- 1g/l
Acid Wash:	M:L : 1:08	Time: 5 Min
Potassium permanganate (KMnO ₄)-5 g/l	Enzyme Wash:	Tem: 40° C
Lava Cone PAP- 2.5 g/l	Lava Cell NHC Cold (Powder Enzyme)-2 g/l	M:L : 1:08
Sponge ball- 200 pcs	Anti-Back Staining- 1 g/l	Softening:
Water: 1 ltr	Time: 30 Min	Wetsoft -700 - 2g/l
Time: 5 Min	Tem: 40° C	Acetic Acid -0.5 g/l
Tem: RT	M:L : 1:08	Time: 5 Min
M:L : 1:08	Bleaching:	Tem: RT
Neutralization:	KCl Bleaching Powder (NaClO)-2 g/l	M:L : 1:08
Sodium Meta Bisulphaite-2 g/l	Time: 5 Min	Hydro + Dryer (45 Min at 70° C)
Time: 5 Min	Tem: 40° C	Recipe For sample 04
Tem: 40° C	M:L : 1:08	Desizing:
M:L : 1:08	Neutralization:	Soda Ash (Na ₂ CO ₃)-2 g/l
Cleaning:	Sodium Meta Bisulphaite-2 g/l	Anti-Back Staining- 1g/l
Hydrogen peroxide -2g/l	Time: 5 Min	Time: 10 Min
	Tem: 40° C	Tem: 50° C

M:L : 1:08

Enzyme Wash:

Lava Cell NHC Cold (Powder Enzyme)-2.5 g/l

Anti-Back Staining- 1 g/l

Time: 30 Min

Tem: 40° C

M:L : 1:08

Bleaching:

KCl Bleaching Powder (NaClO)-2.5 g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Neutralization:

Sodium Meta Bisulphate-2 g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Acid Wash:

Potassium permanganate (KMnO₄)-15 g/l

Lava Cone PAP- 7.5 g/l

Sponge ball- 200 pcs

Water: 1 ltr

Time: 5 Min

Tem: RT

M:L : 1:08

Neutralization:

Sodium Meta Bisulphate-2 g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Cleaning:

Hydrogen peroxide -2g/l

Crosscolor Miro- 1g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Softening:

Wetsoft -700 - 2g/l

Acetic Acid -0.5 g/l

Time: 5 Min

Tem: RT

M:L : 1:08

Hydro + Dryer (45 Min at 70° C)

Recipe For sample 05

Desizing:

Soda Ash (Na₂CO₃)-2g/l

Anti-Back Staining- 1g/l

Time: 10 Min

Tem: 50° C

M:L : 1:08

Enzyme Wash:

Lava Cell NHC Cold (Powder Enzyme)-3 g/l

Anti-Back Staining- 1 g/l

Time: 30 Min

Tem: 40° C

M:L : 1:08

Bleaching:

KCl Bleaching Powder (NaClO)-3 g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Neutralization:

Sodium Meta Bisulphate-2 g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Acid Wash:

Potassium permanganate (KMnO₄)-20 g/l

Lava Cone PAP- 10g/l

Sponge ball- 200 pcs

Water: 1 ltr

Time: 5 Min

Tem: RT

M:L : 1:08

Neutralization:

Sodium Meta Bisulphate-2 g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Cleaning:

Hydrogen peroxide -2g/l

Crosscolor Miro- 1g/l

Time: 5 Min

Tem: 40° C

M:L : 1:08

Softening:

Wetsoft -700 - 2g/l

Acetic Acid -0.5 g/l

Time: 5 Min

Tem: RT

M:L : 1:08

Hydro + Dryer (45 Min at 70° C)

IV. RESULT AND DISSUCTION

4.1. After Enzyme wash the effect variation obtained stated below:

Sample No:	Enzyme (g/l)	Sample Representation
01	1	
02	1.5	

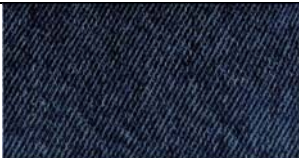
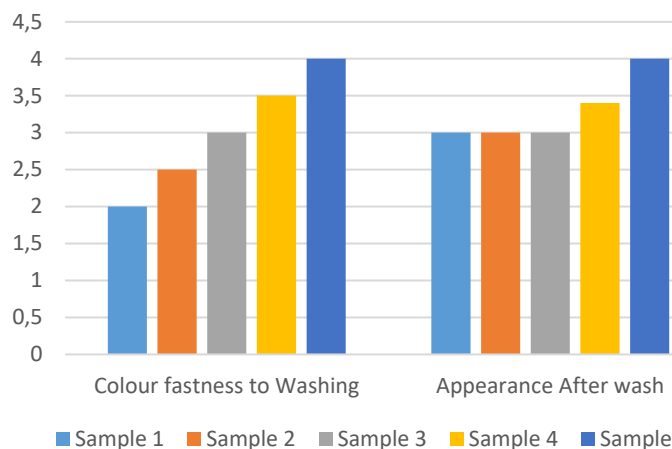
03	2	
04	2.5	
05	3	

Table 1: Physical & Wet Test result of Enzyme wash

Test Names	Color fastness to Washing ISO 105C06:2010	Color fastness to rubbing (Dry) (ISO 105X12)	Color fastness to Rubbing (Wet) (ISO 105X12)	Appearance After wash	GSM (gm/m2)	Tear Strength (Warp) ASTMD-1425	Tear Strength (Weft) ASTMD-1425
Sample No							
01	2	2	2	3	358.5	55 N	57 N
02	2-3	2-3	2	3	358.6	54.5 N	57 N
03	3	3	2-3	3	358.3	54 N	55 N
04	3-4	3-4	3	3-4	357.2	53.5 N	54.7 N
05	4	4	3-4	4	356.8	52.6 N	53.4 N

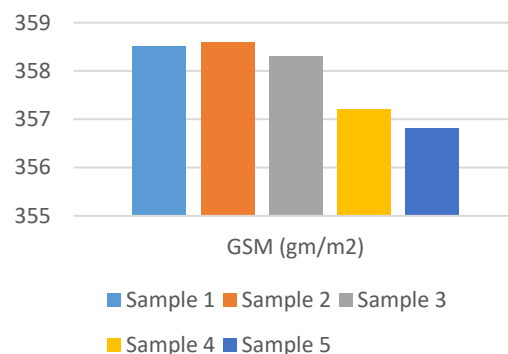
Colour Fastness to Washing & Appearance After wash



According to this chart color fastness to washing for Enzyme wash sample 1 & 2 shows poor properties and sample 4 & 5 shows optimum result & for appearance after wash this work shows first 3 samples are average range and 5 number sample is good as standard chart. That means if we want to do enzyme wash same kind of fabric, we should follow procedure as 5th sample.

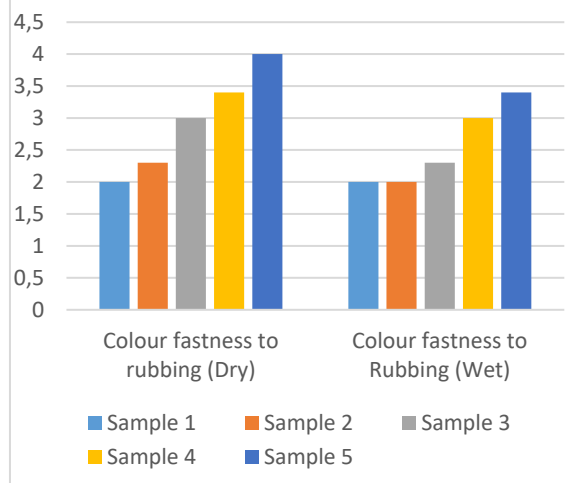
5 number sample is good as standard chart. For the wet rubbing test, we get for first 3 samples are poor range and 4 average & 5 number sample is average to good as standard chart.

GSM



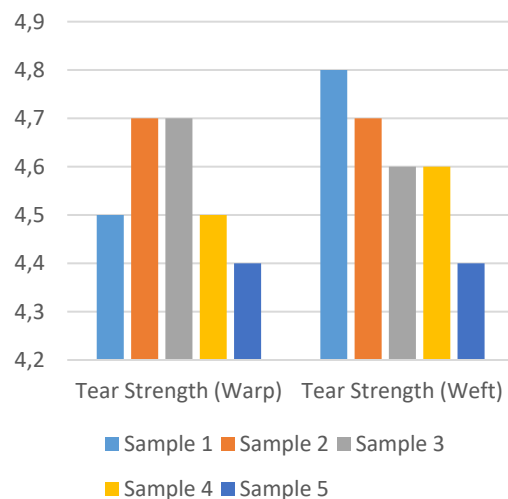
GSM properties is not that much affected as the increment of concentration is less. But among them sample 1 shows the best result and sample 3 is moderate and sample 5 shows poor result though every sample contains the standard GSM which is in acceptable range.

Colour Fastness to Rubbing



Above this graph shows after testing color fastness to Rubbing for Enzyme wash, For the dry rubbing test we get for first 2 samples are poor range and 3,4 average to good &

Tear Strength



Above this graph shows tear strength for warp & weft sample they all are good to excellent but for warp tear strength 2 & 3 number samples are better than another 3 sample and for weft tear strength 1 & 2 are better than rest of three sample.

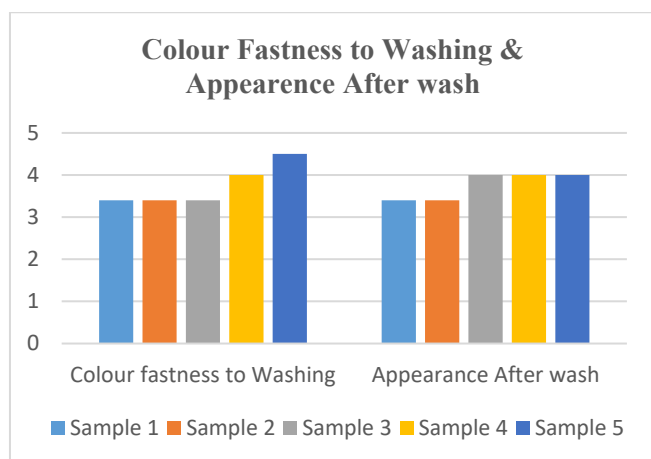
4.2. After Bleach wash the effect variation obtained stated below:

Sl. No:	Bleach (g/l)	Sample Representation
01	1	
02	1.5	

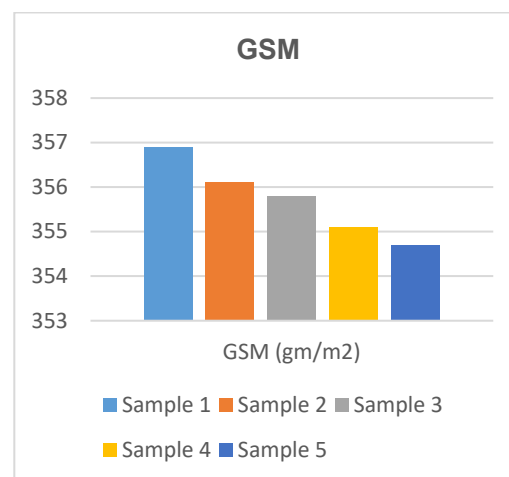
03	2	
04	2.5	
05	3	

Table 2: Physical & Chemical Test result of Bleach wash

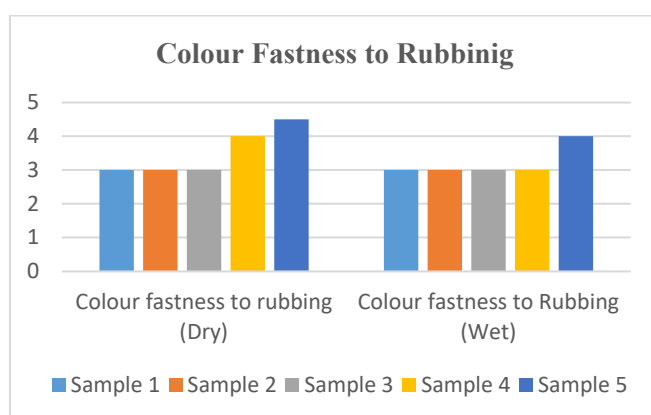
Test Names	Color fastness to Washing ISO 105C06:2010	Color fastness to rubbing (Dry) (ISO 105X12)	Color fastness to Rubbing (Wet) (ISO 105X12)	Appearance After wash	GSM (gm/m2)	Tear Strength (Warp) ASTMD-1425	Tear Strength (Weft) ASTMD-1425
Sample No							
01	3-4	3	3	3-4	356.9	55 N	56 N
02	3-4	3	3	3-4	356.1	54.57 N	56 N
03	3-4	3	3	4	355.8	54.1 N	55 N
04	4	4	3	4	355.1	53.7 N	54.6 N
05	4-5	4-5	4	4	354.7	53 N	53.9 N



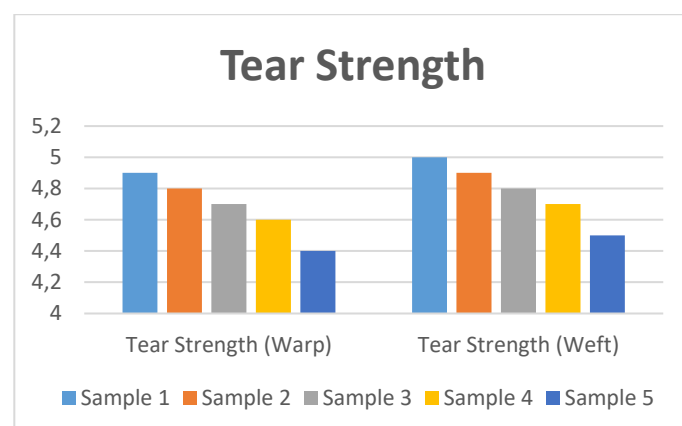
According to above this graph color fastness to washing for Bleach wash, we get for first 3 samples are average to good range and rest 2 samples are good as standard chart & for appearance after wash we get for first 2 samples are average range and sample 3, 4, 5 number sample is good according to standard chart. That means if we want to bleach wash same kind of fabric, we should follow procedure as 4th or 5th sample.



Above this graph shows in case of bleach wash less amount of increment of Sodium hypochlorite gsm change more than compared to enzyme wash. But among them sample 1 shows the best result and sample 3 is moderate and sample 5 shows poor result though every sample contains the standard GSM which is in acceptable range.

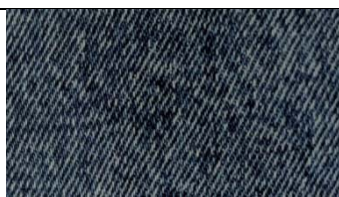


Above this graph shows after testing color fastness to Rubbing for Bleach wash, for the dry rubbing test we get for first 3 samples are average range and 4 number sample is good and 5 number is good to excellent as standard chart. For the wet rubbing test we get for first 4 samples are average range and 5 number sample is good as standard chart.



This graph shows tear strength for warp & weft sample they all are good to excellent but for warp tear strength 1 number samples are better than another 4 sample and for weft tear strength 1 is better than rest 4 samples. Sample number 5 tear strength very poor because high concentration of Sodium hypochlorite (NaClO) damage the fabric strength.

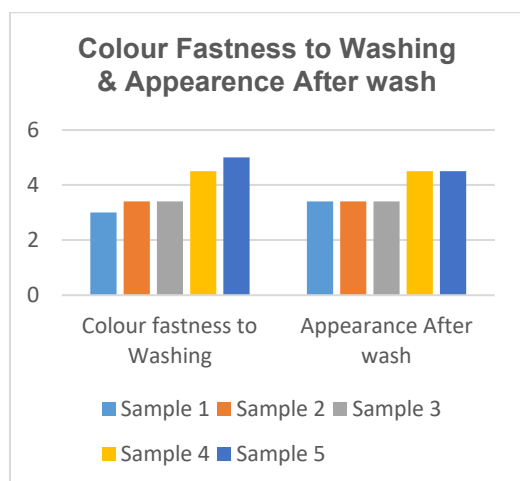
4.3. After Acid wash the effect variation obtained stated below:

Sl. No:	KMnO ₄ (g/l)	Sample Representation
01	2	
02	5	
03	10	

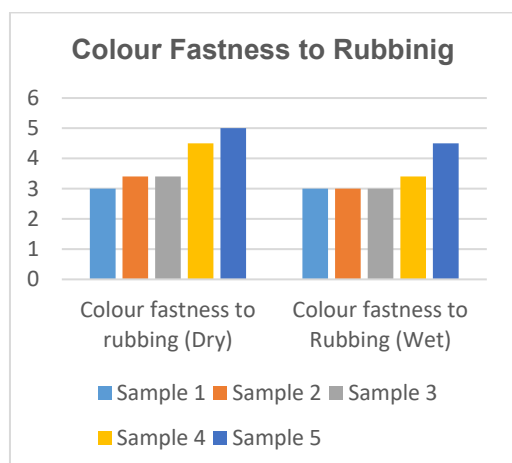
04	15	
05	20	

Table 3: Physical & Wet Test result of Acid wash

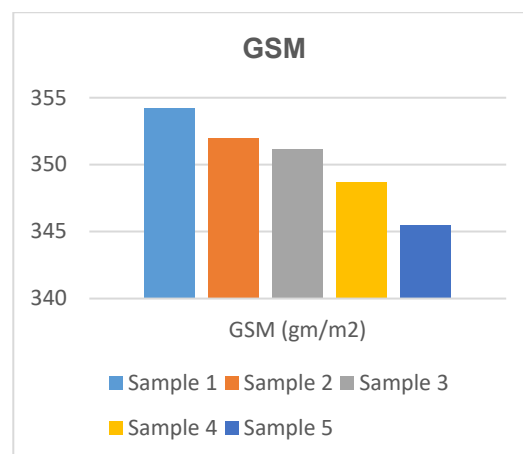
Test Names	Color fastness to Washing ISO 105C06:2010	Color fastness to rubbing (Dry) (ISO 105X12)	Color fastness to Rubbing (Wet) (ISO 105X12)	Appearance After wash	GSM (gm/m ²)	Tear Strength (Warp) ASTMD-1425	Tear Strength (Weft) ASTMD-1425
Sample No							
01	3	3	3	3-4	354.2	52 N	55 N
02	3-4	3-4	3	3-4	352	51 N	53 N
03	3-4	3-4	3	3-4	351.2	50 N	53.3 N
04	4-5	4-5	3-4	4-5	348.7	49.1 N	52 N
05	5	5	4-5	4-5	345.5	47 N	49.1 N



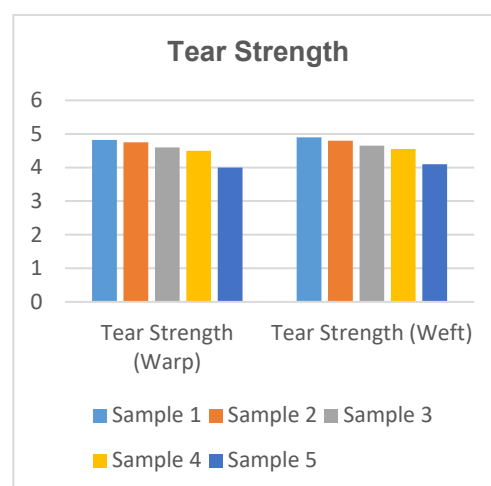
According to this graph color fastness to washing for Acid wash sample 1, 2 & 3 shows are average properties sample 4 & 5 shows optimum result & for appearance after wash we get for first 3 samples are average range and 4th & 5th number sample is good as standard chart. That means if we want to do Acid wash on same kind of fabric, we should follow procedure as sample 4 or 5.



Above this graph shows after testing color fastness to Rubbing for Acid wash, dry rubbing test shows first sample is average range and 2 & 3 number samples are average to good and 4 number is good to excellent and 5 number is excellent as standard chart. For the wet rubbing test we get for first 3 samples are average range 4 number sample is average to good and 5 number sample is good to excellent as standard chart.



This graph shows GSM properties is affected as the increment concentration of potassium permanganate. The sample 1 shows the best result and sample 2 & 3 is moderate and sample 5 shows poor result. That's why for acid wash medium concentration is better.



Above this, graph shows tear strength for warp & weft sample they all are good to excellent but for warp tear strength 1 number samples are better than another 4 sample and for weft tear strength 1 is better than rest 4 samples. We know high concentration of Potassium permanganate (KMnO_4) damage fabric strength that's why sample number 5 performance poor than other. When we will do acid wash, try to avoid high concentration of Potassium permanganate (KMnO_4) or use white paste or PP replacement chemical instead of KMnO_4 .

V. CONCLUSION

Washing gave different look to the garments. Garments washing are mainly done after stitching wash types actually depends on the product matures and usages used on consumer demand and fashion trend buyer will fix the washing type of any product. It is a new technology by which outlook, size comfort ability and fashion of a garment are changed and modified this technology was first appeared in Bangladesh in 1988.

Above these test result and visual effect we find out for enzyme wash sample number five is better and for bleach wash sample number five is more attractive but sample no 4 give optimum result and for Acid wash sample number five visual effect more attractive. However, sample no 4 overall performance better than sample five. For bleach wash and acid wash we always try to use medium concentration because high concentration damage the fabric strength like acid wash and Bleach wash sample no 5 tearing strength poor than other samples.

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