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ABSTRACT

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Garments washing is a technology by which outlook, comfort ness (soft feeling), fashion of garments are changed or modified and given old garments effect. Various types of chemicals and materials may need to do the specific wash. In this research work different types of washing effect (Bleach wash, Enzyme wash, stone wash, caustic wash and super white wash) on denim garments have been studied. Different properties of denim garments like fabric strength, fabric weight loss, colorfastness to washing, rubbing fastness, colorfastness to light and dimensional stability were investigated and compared with each other before after washing process. When the result was examined it was found that during stone wash fabric strength remain same after washing but considerable amount of strength loss occurred in enzymatic and bleach wash. All the samples from different garments wash showed good colorfastness to wash and light except stone wash. Fabric weight loss was found lowest in stone wash in comparing with bleach and enzyme wash.

Key words: garments washing, bleach, stone and enzymatic washes, colorfastness to wash, rubbing and light

INTRODUCTION

Garments' washing is an important part of garments manufacturing. By which outlook, comfort ability and fashion of garments is changed or modified and old garments effect can be produced (International Organization for Standardization (ISO) 1993). That's why now a day's the importance and demand of garments washing is increasing day by day. Chemical washes include denim bleaching, enzyme washing, and acid washing. Denim bleaching is a way to discolor the denim in specific places. The severity of the bleaching depends on the strength of the bleach, temperature, and length of time the treatment is on the denim. It is usually best for the treatment to be strong and quick. Enzyme washing is an environmentally friendly wash for denim. Organic enzymes are put onto the denim and eat away at the cellulose in the cotton. Enzyme washing produces several effects such as making seams, pockets, and hems more noticeable and a salt and pepper color. Several researches have already done regarding garments washing. Montazer and Maryan studied on different stone and Bio-stone Washing of Denim garments (International Organization for Standardization (ISO) 1994). They found that neutral cellulases produced a fabric with higher lightness and increasing of enzyme adding to back staining. Denim treatment with 100% o.w.f pumice stone alone wasn't effective. However, combination of 100% pumice stone with cellulases showed a good washing effect. This research work involves different types of washing effect (Bleach wash, Enzyme wash, stone wash, caustic wash and super white wash) on denim garments. Fabric strength, fabric weight loss, colorfastness to washing, rubbing fastness and colorfastness to light were investigated and compared with each other before after washing process. Objectives of this work are analyze the process of washing, such as, Stone, Enzyme, Acid and Bleach wash, analyze the effect of different washing, and compare which washing is more preferable for garments washing, analyze the use of different chemical on garments washing and compare the effect of chemical on garments, determine the fabric strength and weight loss of different washed garments, analyze the color fastness to wash, color fastness to rubbing, colorfastness to light in different garments washing and create new fashion outlook.

MATERIALS AND METHODS

Denim

Denim fabric (black jean) used, 100% cotton with 2/1 weave construction and weft and warp No of 15 Nm with Z twist, weft density of 20/cm, warp density of 26/cm and fabric wt 270 gm/m².

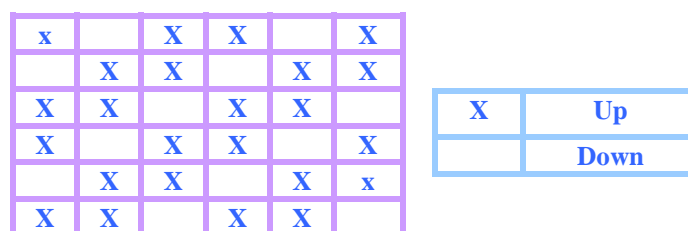
Denim fabric analysis

Fig. 1. Design of denim fabric



Fig. 2. Denim fabric sample panel

Washing procedure

In this work five washed sample was prepared with different washing effects such as Bleach, Caustic, super white, stone and enzymatic wash (Tyndall 1994).

Machineries used in this work

1. Garments washing machine
2. Hydro extractor machine
3. Drying machine(tumble dryer)
4. Boiler
5. Sample washing machine

Here different garments wash procedures are given below:

Bleach wash

Pre-treatment is done with 1.5 kg (3 gm/liter) desizing agent at 60⁰C temperatures for 15mins. Then bleaching is done with 2 kg (2%) caustic soda, 2 kg (2%) soda ash, 2.5 liter (5 ml/liter) hydrogen peroxide and 1.25 liter (2.5 ml/liter) at temperature 80⁰C for 70 minutes. Then a hot wash is continued at 60⁰C for 5 minutes to remove the surface adhering impurities. After that a wash is given to the sample with 1 liter (2ml/liter) acetic acid for 5 minutes. At last 0.5 kg (0.5%) softener was used to soft the sample for 10 minutes and hydroextracted the sample and finally drying was done in a drying machine for 15 minutes (Mehta and Bhardwaj, 1998).

Enzyme wash

250 gm (0.2-0.5g/l) (Sandozin MRN) wetting agent and 50 gm (0.2-0.5g/l) (Bactosol MIN Liquid) desizing agent were used to desize the sample at 60⁰C for 15 minutes. Keeping pH 6-8 (by Sirrix 2UD liquid). Then bio-abrasion is applied to the desized sample with 1 kg (0.2%-2%) dispersing agent, 80 kg (20%-150%) pumice stone and 1 kg (0.6%-2%) enzyme at 50⁰C for 45 minutes keeping pH 6.5-7.0 (by Sirrix 2UD liquid). After that an additional bleaching is performed with 1.2 kg (0.5-5g/l) Calcium hypochlorite (20%) at 60⁰C for 20 minutes keeping pH 9-10. Sodium meta-bi-sulphite is used to remove the residual chlorine from the bleached sample. Finally the sample is softened with softener and hydro extracted and then dry (Harrison 1988).



Fig. 3. Enzyme Wash fabric

Stone wash

Pretreatment is applied to the sample with 1.5kg (1.5%) detergent at 60⁰C for 20 minutes. Then the pretreated sample is washed at 50⁰C and continued for 5 minutes. The washed sample is treated with 4 kg (4%) bleaching powder, 8kg (8%) soda ash and pumice stone (½ volumes of the garments) at 45⁰C for 40 minutes. After that the stone washed sample is washed with detergent for cleaning, neutral washed and made soft by applying softener. Finally the sample is hydro-extracted and then dried (International Organization for Standardization (ISO) 1993).



Fig. 4. Pumice Stone



Fig. 5. Stone washed fabric

Super white wash

At first the sample is bleached with 10 kg (10%) caustic soda, 2kg (2%) detergent, 12L (12%) hydrogen peroxide and 5L (5%) stabilizer at 95°C for 75minutes. An additional bleaching applied to the sample by adding 4 kg (4%) caustic soda, 2kg (2%) detergent, 10L (10%) hydrogen peroxide and 4 L (4%) stabilizer at 95°C for 75minutes. Then the bleached sample is washed at high temperature and neutralized with acetic acid. Finally the sample is whitened with 1kg (1%) FBA and 1kg (0.5%) softener and hydro-extracted and dried.

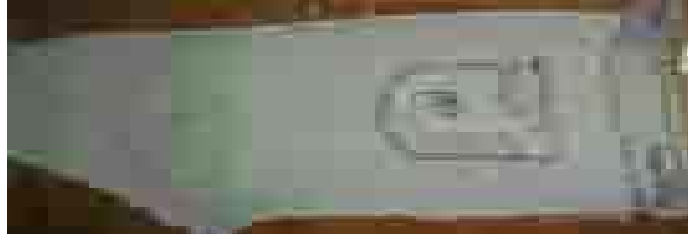


Fig. 6. Super white wash fabric

Experimental

Denim fabric (black jean) used, 100% cotton with 2/1 weave construction and weft and warp No of 15 Nm with Z twist, weft density of 20/cm, warp density of 26/cm and fabric wt 270 gm/m² in figure 1,2,3,4,5 and 6.

The following tests that have been done during this work-

1. Strength test by Titan Machine: ASTM-D5034 was followed to determine fabric strength (ASTM Method, D5034).
2. Color fastness (washing) Test method: ISO 105 C03 was followed for color fastness to wash (ISO 105 C06: 1994).
3. Color fastness to rubbing (crocking test): ISO 105-x12 was followed for color fastness to rubbing (ISO 105-x12).
4. Weight loss of fabric after different garment wash.
5. Color fastness to light: ISO 105 BO2 was followed for color fastness to light (ISO 105 BO2).

Table 1. Experimental Data for Fabric Strength

Sample no	Sample Type (warp wise)	Fabric Strength (N)
1	Before Wash(Unwashed sample)	845.21
2	Bleach wash	831.44
3	Caustic wash	823.46
4	Super White wash	600.11
5	Stone Wash	756.86
6	Enzyme wash	487.39

Table 2. Experimental data for color fastness to wash (color change)

No.	Name	Grading for color fastness
1.	Before wash	3-4
2.	Bleach wash	3-4
3.	Caustic wash	4
4.	Super white wash	1-2
5.	Stone wash	4-5
6.	Enzyme wash	4

Average grade/range of testing: 1-5 grades

Interpretation of grade: (5) Excellent, (4) Good, (3) Fair, (2) Poor, (1) Very poor

Table 3. Experimental data for staining result (color fastness to washing)

Grading for staining							
No.	Name	Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
1.	Before wash(Unwashed)	4	3	1-2	4-5	4-5	4
2.	Bleach wash	4	3	4	4	4-5	4
3.	Caustic wash	2-3	2	1-2	2-3	4-5	4
4.	Super white wash	2	4-5	3	4-5	4-5	4
5.	Stone wash	4	3-4	2	4	4-5	4
6.	Enzyme wash	2	2-3	1-2	3	4	3-4

Average grade/ range of testing: 1-5 grades

Interpretation of grade: (5) Excellent, (4) Good, (3) Fair, (2) Poor, (1) Very poor

Table 4. Rubbing test result for denim fabric (Color fastness to rubbing)

		Dry		Wet
Before wash	Warp	CC	4-5	4
		S	3	1-2
	Weft	CC	4-5	4-5
		S	4	1
Bleach wash	Warp	CC	5	5
		S	4-5	3
	Weft	CC	5	5
		S	5	3-4
Caustic wash	Warp	CC	5	4-5
		S	4-5	2
	Weft	CC	5	4-5
		S	4-5	2
Super white wash	Warp	CC	4-5	4
		S	4-5	3-4
	Weft	CC	4-5	4
		S	5	3-4
Stone wash	Warp	CC	5	4-5
		S	4-5	2-3
	Weft	CC	5	4-5
		S	4-5	1-2
Enzyme wash	Warp	CC	4-5	4-5
		S	4	2-3
	Weft	CC	5	4-5
		S	4-5	4-5

*** CC = Color Change

Table 5. Experimental data for washing fastness to light: (Test Method ISO 105 -B02)

No.	Name	Grading for Light fastness
1.	Before wash	5
2.	Bleach wash	4
3.	Caustic wash	5
4.	Super white wash	3
5.	Stone wash	6
6.	Enzyme wash	6

In current study, it was observed that super white wash fabric losses a great amount of strength in both warp & weft direction and it's color fastness to washing & light is poor and also losses much weight after wash from table 1 to 5.

RESULTS AND DISCUSSION

Effect of different garments washing on Denim fabric strength:
Graphical presentation of strength loss (Warp direction):

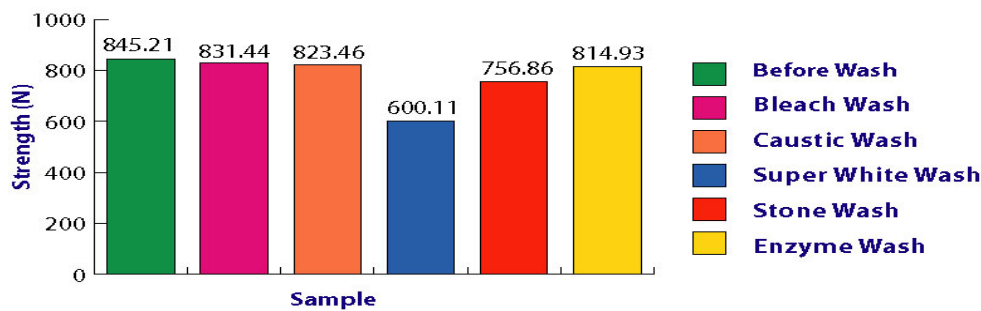


Fig. 7. Denim fabric strength warp wise

From the above bar diagram (Fig. 7) it is clearly shows that bleach and caustic wash fabrics losses a very small amount of strength after wash. But in the case of super white wash fabric losses a large amount of strength after wash. During super white wash fabric are washed two times under highly concentrated Hydrogen Peroxide. For this reason super white washed fabric losses this amount of strength. Stone wash fabric is the second highest strength loss fabric where fabric losses strength due to friction between denim fabric and pumice stone. In enzyme washing, strength loss is occurred due to removal of size materials from fabric (American Society for Testing and Materials 1995).

**Effect of different garments washing on Color Fastness to wash:
Color fastness to washing:**

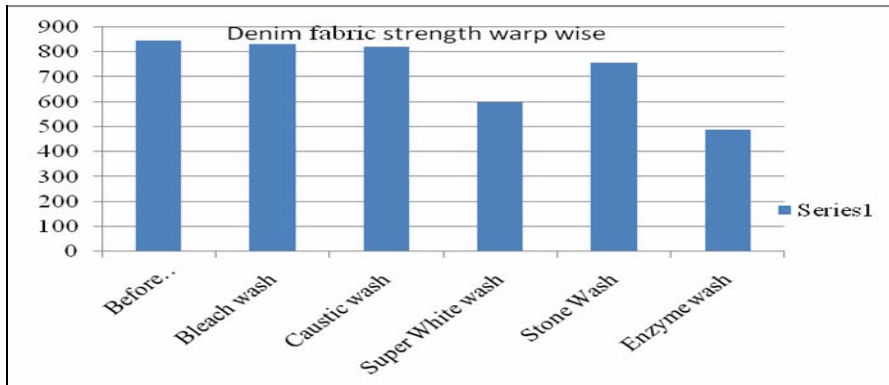


Fig. 8. Color fastness to washing on denim fabrics

The above bar diagram (Fig. 8) represents color fastness to different types washing on denim fabric. The arrows represents that the actual value lies within that region. From the bar diagram it shows that stone washed fabric has excellent color fastness to washing. Then caustic & enzyme washed fabric has good color fastness to washing. In before wash fabric color fastness to washing is same to bleach wash. But super white washed fabric has poor fastness property. In the practically points of view that a great amount of color is wash way during super white wash and some dyes are present in the fabric which are unfix dyes.

**Fabric weight loss on different garments washing:
Graphical presentation of weight loss:**

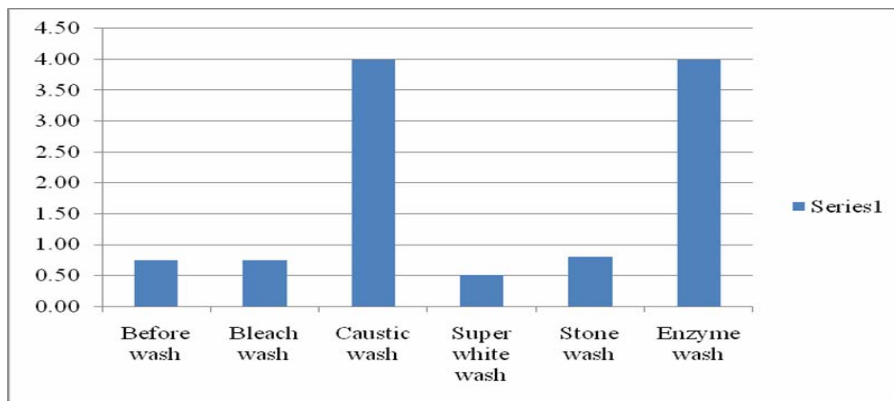


Fig. 9. Weight loss on denim fabrics after different wash

From the above bar diagram (Fig. 9) it is clearly shows that weight loss % of the fabric after caustic wash is lowest. In stone wash & bleach wash weight loss is also very small. But in Enzyme wash fabric weight loss % is highest amount. In super white wash fabric weight loss % is little bit less than enzyme wash. Super wash fabric losses significant amount of strength both in warp & weft direction and it's color fastness to washing property also poor. Enzyme wash fabric losses a significant strength in weft direction.

Effect of different garments washing on color fastness to rubbing:

Color fastness to rubbing is good in all washing fabrics than the unwashed fabric. Comparative to the washed fabric, super white washed fabric shows best fastness.

Fastness to rubbing in dry state, always remain better than the wet state.

Effect of color fastness light on different garments washing:

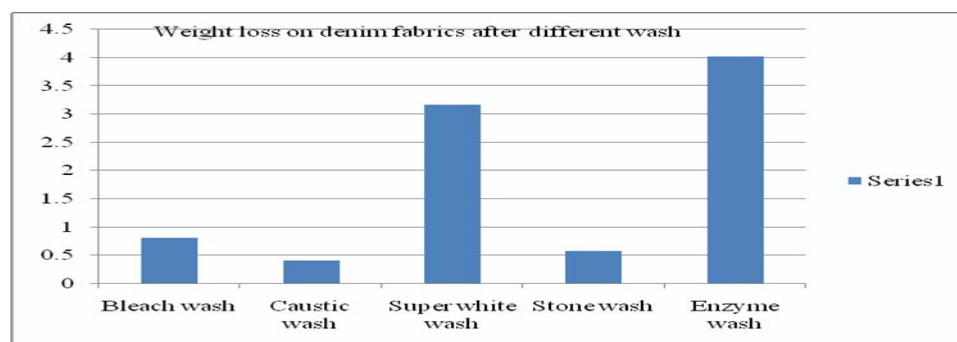


Fig. 10. Color fastness to light on denim fabrics after different wash

From the above bar diagram (Fig. 10) it is obviously state that stone wash & enzyme wash fabric has same grade which is very good and their there degree of fade is very slight. But in case of super white wash light fastness to washing is fair which means its fading is significant. In the case of super white wash fabric color fastness to washing is also poor. In unwashed & caustic wash fabric has good light fastness property where bleach wash fabric has moderate fastness property (Montazer and Maryan, 2009).

CONCLUSION

Denim washing is known as one of the finishing treatment that vast usage because of creating special appearance and updating clothes. In current study, it was observed that super white wash fabric losses a great amount of strength in both warp & weft direction and it's color fastness to washing & light is poor and also losses much weight after wash. Weight loss percentage of the fabric after caustic wash is lowest & bleach wash is little bit higher than caustic wash. Strength loss of those wash is considerable amount and during color fastness to wash test shows good result. In the case of light fastness test those washed fabric give moderate and appreciable fading which means their degree of fading good & moderate. Enzyme wash fabric losses a small amount of strength in warp direction. On the other hand stone wash fabric losses remarkable amount of strength in warp direction. Color fastness to wash test they give good result which is 4-5 for stone wash & 4 for enzyme wash. Color fastness to rubbing is good in all washing fabrics than the unwashed fabric. For color fastness to light they give same result which is their light fastness is very good and their degree of fading is slight. But in the case of weight loss percentage enzyme wash fabric losses remarkable amount of strength on the other hand stone wash fabric losses little amount of weight.

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