

Research Article

Development of Washing Effects on Canvas Fabrics: A Value Added Process Towards Fast Fashion

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Received: April 09, 2018; Accepted: April 25, 2018;

Published: May 02, 2018

Abstract

The aim of this study was to investigate the washing effect on various canvas fabric having different construction. To do this, four different constructions $[(60 \times 60)/((10+10) \times (10+10))]$, $(70 \times 60)/((10+10) \times (10+10))$, $(80 \times 60)/((10+10) \times (10+10))$ & $(80 \times 60)/((20+20) \times (20+20))$ of canvas fabrics were weaved by CCI loom maintaining optimum process parameters. Then the prepared samples were dyed with dischargeable reactive dye and faded effect were created by various dry processes such as whisker, hand sanding, pp spray as well as wet process such as acid wash. Finally, the developed samples were characterized such as tearing strength, tensile strength, color fastness to rubbing and PH and stiffness. Moreover, visual observations of those samples were investigated. It was observed that all experimented samples showed fading effects as like denim. Among all, the tensile strength of $(80 \times 60)/((10+10) \times (10+10))$ fabric sample was observed 629.6, 511.5, 470 N for dyed, acid washed and pp sprayed respectively along warp direction. All acid washed & pp sprayed fabric revealed increased tearing strength then dyed sample. Tearing strength of acid washed sample $(60 \times 60)/((10+10) \times (10+10))$ found 45.018 N along warp direction and pp sprayed $(80 \times 60)/((20+20) \times (20+20))$ fabric showed 45.721 N. The color fastness to rubbing was good and pH results of all fabric were in range of 7.3-7.6. Bending length of $(80 \times 60)/((20+20) \times (20+20))$ pp sprayed fabric was 3.75 N and $(80 \times 60)/((10+10) \times (10+10))$ acid washed fabric was 4.56 N. Finally in this study, it was noticed that tearing strength, pH, stiffness, color fastness to rubbing, fading effects showed the desired results but tensile strength along warp direction was not satisfactory.

Keywords: Canvas; Color fastness; Dischargeable dye; Strength and washing effects

Introduction

Canvas is a heavy, closely woven fabric having weight range from 10 to 50 ounces per square yard is used for making sails, tents, covers, awnings and other functions where sturdiness is required. The word 'canvas' is derived from the Arabic word for cannabis, a Latin word meaning 'hemp'. In earlier times, hemp was popularly used to make canvas. Modern canvas is usually made of cotton, linen or synthetic materials. Modern canvas is usually made of cotton or linen, although historically it was made from hemp. It differs from other heavy cotton fabric, such as denim, in being plain weave rather than twill weave [1]. The use of correct synthetic materials can also provide excellent weather-resistant properties to canvas fabric. This has made it an ideal choice for architectural, industrial and marine applications.

Canvas is produced in many grades and qualities and may have a soft or firm hand. It is made by plain or basket weave and tightly woven having an uneven weave pattern. Because of tight weave, these fabrics are often use for outdoor purposes. Canvas is usually made with single or ply yarns and various types of canvas are produced by using plied yarn in warp and weft direction [2].

On the other hand denim is very strong, stiff and hard wearing woven fabric. Now- a- days denim is the term which conquers the world with spectacular fashion appeal (denim pant, shirt and others

wearable dresses). Denim is that fabric which goes through all forms, looks and washes to match with the ever-changing fashion trends of people. Conventional denim is a durable and heavy twill-weave fabric made from cotton [3]. By using washing technique faded or old look, color or tinted affect is created in the denim garments. In the current production practices, washing effect is generally developed in denim garments only to make it fashionable, wearable etc. Since denim is normally dyed with indigo, vat and sulphur dyes that's why it can be easily removed from the fabric by different discharge process and finally faded effect is created [4].

The introduction of dischargeable dye has made it easier to create fading effect on different garments especially hard wearing fabrics like- twill, canvas etc. This type of dye is applicable for dyeing as well as washing purpose. By utilizing this concept, this study was done to create different washed looks on canvas fabrics and characterized them in comparison with denim fabrics to meet consumer demand (Table 1).

Methodology

Research design

In order to develop the product, following steps have been followed sequentially as given in the (Figure 1). After developing, samples were conditioned and then taken for characterization. In the

Table 1: Specification of canvas fabrics.

Fabric type	Sample code	Construction	Weight (GSM)
Canvas	FCT ₁	60*60/(10+10)*(10+10) * 18"	328
Canvas	FCT ₂	70*60/(10+10)*(10+10) * 18"	342
Canvas	FCT ₃	80*60/(10+10)*(10+10) * 18"	363
Canvas	FCT ₄	80*60/(20+20)*(20+20) * 18"	191

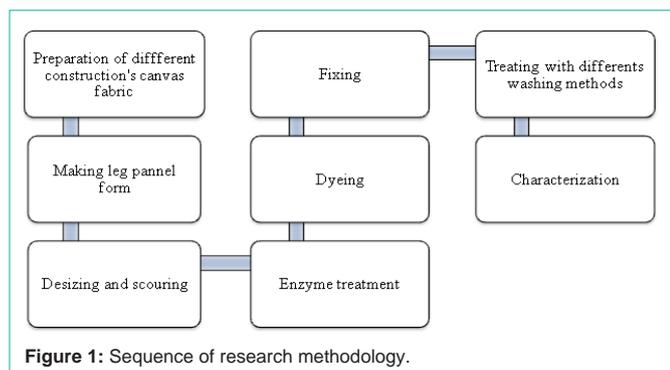


Figure 1: Sequence of research methodology.

Table 2: Recipe of sizing process.

Ingredients	Amount
Polytex	250 gm
Water	1 liter
Time	40 min
Temperature	80°C

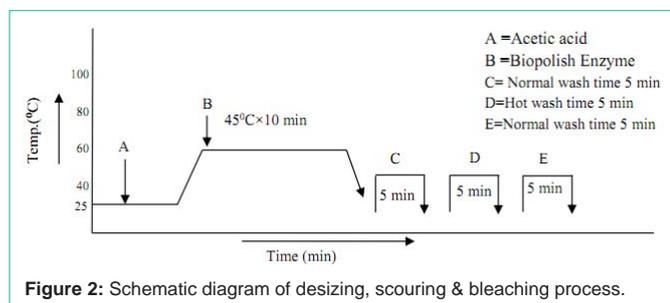


Figure 2: Schematic diagram of desizing, scouring & bleaching process.

characterization different parameters of the samples were tested and analysed in relation to research goal.

Raw materials

100% cotton leg panels of canvas fabric were used which were made from collected yarn. Counts of yarn were 10 Ne and 20Ne.

Chemicals

Reactive dye (AsudelNavy Blue DL, AsudelBlack MSD, Asudel Blue R, Asutex, Spain), Levelling agent (Albatex DBC, Relish, India), Detergent (Sandopal PCLF), Softener (Ultrafad XP-81, Relish, India), Wetting agent (Ludox LF 20, Relish, India), Catanizer (Modinate M, Asutex, Spain), Enzyme (Rexzyme USP and Kleerix NAC, Relish, India), Sodium carbonate (Soda ash light, Adorso, BD), Sodium hydroxide (Adorso, BD), Fixing agent (Optofix RSL) and Acetic acid (Adorso, Bangladesh).

Equipments

The garments dyeing, washing and testing procedure was

Table 3: Recipe of Pretreatment.

Ingredients	Amount
Sandopal PCLF 20	3 g/l
Soda ash	10 g/l
Caustic soda	10 g/l
H ₂ O ₂	10 g/l
Time	40 min
Temperature	80°C
M:L	1:25

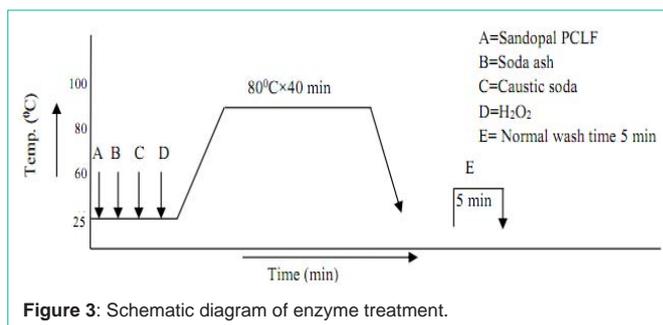


Figure 3: Schematic diagram of enzyme treatment.

Table 4: Recipe for enzyme treatment.

Ingredients	Amount
Acetic acid (A)	For pH 4.5
Biopolish Enzyme	120 g/l
Time	10 min
Temperature	45°C
M:L	1:25

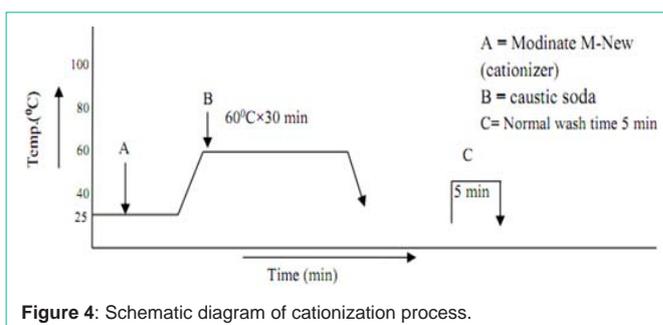


Figure 4: Schematic diagram of cationization process.

Table 5: Recipe of Cationization.

Ingredients	Amount
Modinate M-New(cationizer) (A)	2 g/l
Caustic soda (B)	5 g/l
pH	8.5
Time	30 min
Temperature	60°C
M:L	1:25

performed by using the following equipments: Electronic balance (Adventure Pro, Ohaus,UK), spectrophotometer (Model-650, Brand-Data Color, Origin-USA), Tumble dryer (Model-VT DOOP, Brand-Hot Point, Origin-UK), Drying oven (Model-HX30, Brand-James

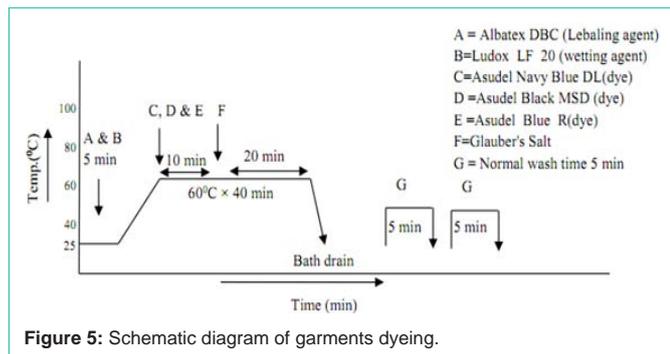


Figure 5: Schematic diagram of garments dyeing.

Table 6: Recipe of dischargeable dye.

Ingredients	Amount
Albatex DBC (Leveling agent) (A)	1 g/l
Ludox LF 20 (wetting agent) (B)	0.5 g/l
AsudelNavy Blue DL (dye) (C)	2.667%
AsudelBlack MSD(dye) (D)	0.267%
Asudel Blue R(dye) (E)	0.266%
Glauber's Salt (F)	20 g/l
Time	40 min
Temperature	80°C
M:L	1:25

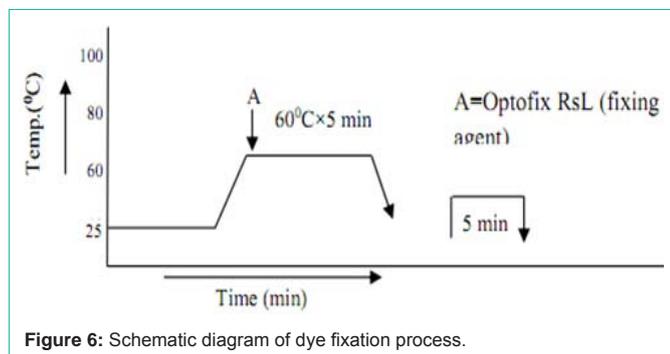


Figure 6: Schematic diagram of dye fixation process.

H. Heal, Origin-UK), PH meter (Brand-Eutech, Origin-Singapore), Fabric drape tester (Model-M213, Brand-SDLATLAS, origin-UK), Testrometric machine (Model:M250-3CT, Origin-India), Fabric stiffness tester (Model-M003B, Brand-Mesdan, Origin-UK), Rubbing fastness tester(Crock meter, Model- 670, Brand- James H Heals, Origin - UK).

Procedure of sizing

The primary purpose of warp sizing is to produce a warp which can resist the damage in weaving. Sizing process was done with CCI Sizing Machine (Table 2).

Working procedure: Polytex and water were heated at 800C temperature for 40 minutes with continuous stirring. Later, the sizing solution was added to sizing bath and then warp was immersed there to be sized at required level.

Procedure of pretreatment (Desizing, scouring & bleaching)

Canvas leg panels were desized, scoured and bleached by

Table 7: Recipe of fixation.

Ingredients	Amount
OptofixRsL (fixing Agent) (A)	1 g/l
Time	5 mint
Temperature	60°C
M:L	1:25

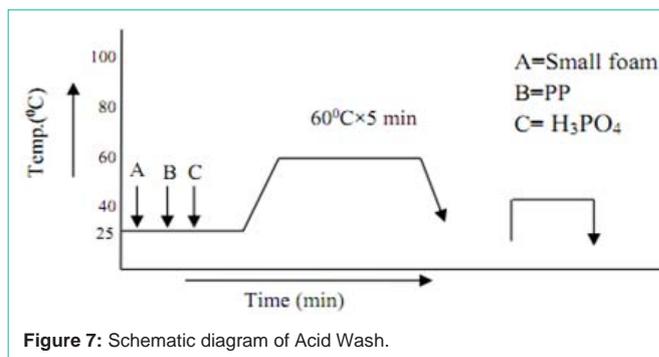


Figure 7: Schematic diagram of Acid Wash.

maintaining the following recipe and scheme as shown in the (Table 3) and (Figure 2).

Procedure of biopolishing

Samples were treated with enzyme by maintaining the following recipe and scheme as shown in the (Table 4) and (Figure 3).

Procedure of cationization

Samples were treated with catanizer by maintaining the following recipe and scheme as shown in the (Table 5) and (Figure 4).

Procedure of coloration

Dyeing of pretreated samples was done following the given parameters as shown in (Table 6) and (Figure 5).

Procedure of dye fixation

Fixing of dyed samples was done following the given parameters as shown in (Table 7) and (Figure 6).

Procedure of hand scrapping & whiskering

By using abrasive paper (grade no. 600) desired effect was developed at length wise direction. Whiskering effect was produced by using abrasive paper and pattern.

Procedure of pp spray

Samples were sprayed by potassium permanganate (pp) followed by sodium meta-bi-sulphite to create worn effect. The recipe of the prepared solution is given in the (Table 8).

Working procedure: After mixing Potassium Permanganate and Phosphoric Acid, solution was sprayed on the samples followed by neutralization at 25°C.

Procedure of acid wash

Dyed samples were treated through acid wash to create fading effect maintaining the following parameters as given in the (Table 9) and (Figure 7).

Testing and analysis

Tensile strength and tear strength along warp and weft

Table 8: Recipe of PP spray solution.

For pp spray		For neutralization	
Ingredients	Amount	Ingredients	Amount
PP	12 g/l	Na ₂ S ₂ O ₅	5 g/l
H ₃ PO ₄	2 ml/l	pH	6-7
PH	6-7	Time	10 min
Time	As required for expected fading	Temperature	35°C

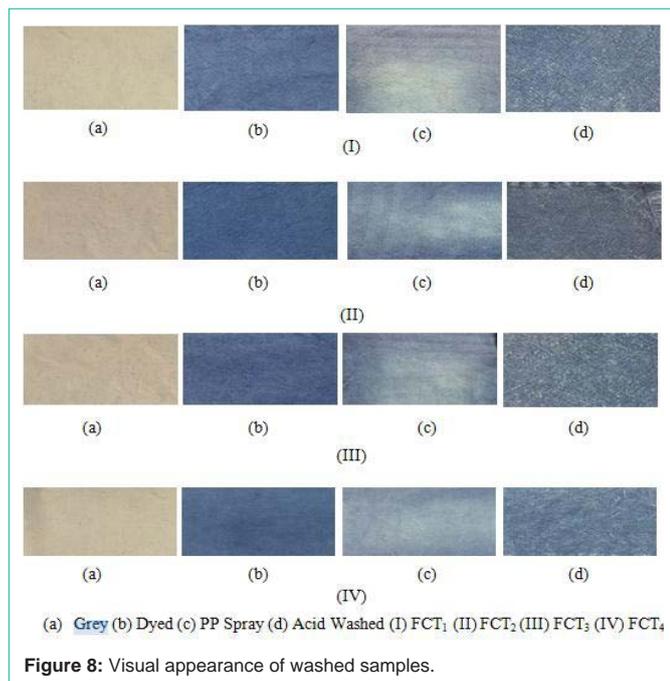


Figure 8: Visual appearance of washed samples.

direction determined by using fabric strength tester according to ASTM-D-5034 and EN ISO 13937-2 test method respectively. Fabric stiffness measured according to ASTM D1388 method using cantilever stiffness process. Color fastness to rubbing was measured using ISO 105 X 12: 1993 method. Besides visual observation of the sample was conducted by physical observation.

Determination of pH

Cutting the samples at 5 mm X 5mm dimension and then weighing it accurately. After that samples were dissolved into Potassium Chloride solution (KCl) and agitate the flask for a short period by hand to ensure that the textile material is properly wetted out. Finally, flask was shaken mechanically for 2 h ± 5 minutes.

Results & Discussion

Visual appearance of washed samples

Figure 8 represents the fading effects of the experimental samples developed by different wet and dry washing processes. All the fading effects show the same look when it is developed in the denim fabric which is a current trend. Since the fabric is dyed dischargeable reactive dyes, so it is easily possible destroy them to create desired fading effect.

Changes in tensile strength

Figure 9 reveals that dyed sample of C-1080 shows greater

Table 9: Recipe of acid wash.

For PP apply		For Neutralization	
Ingredients	Amount	Ingredients	Amount
Small foam	1 kg	Na ₂ S ₂ O ₅	2 g/l
PP	20 g/l	pH	6-7
H ₃ PO ₄	5 ml/l	Time	10 min
PH	6-7	Temperature	35°C
Time	As required for expected fading	M:L	1:10

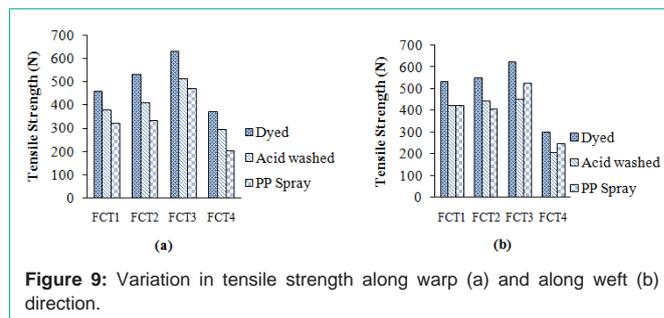


Figure 9: Variation in tensile strength along warp (a) and along weft (b) direction.

Table 10: Values of color fastness to rubbing.

Fabric type	Dyed		Acid washed		PP Spray	
	Dry	Wet	Dry	Wet	Dry	Wet
FCT ₁	4/5	2/3	4/5	3/2	4/5	2/3
FCT ₂	4/5	2	4/5	2/3	4/5	2
FCT ₃	4/5	2	4/5	2/3	4/5	2/3
FCT ₄	4/5	2/3	4/5	3	4/5	2

Table 11: Values of pH of experimented samples.

Fabric construction type	pH result		
	Dyed	Acid washed	PP spray
FCT ₁	7.6	7.5	7.4
FCT ₂	7.5	7.3	7.4
FCT ₃	7.5	7.4	7.5
FCT ₄	7.3	7.5	7.3

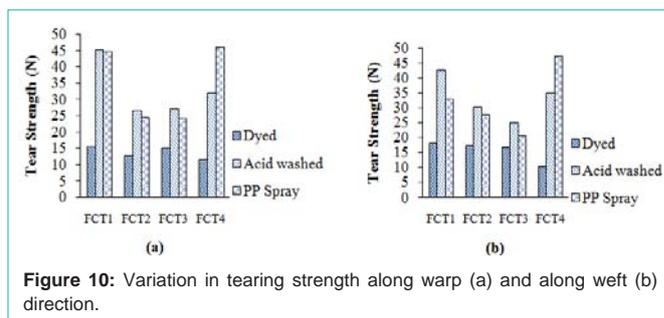


Figure 10: Variation in tearing strength along warp (a) and along weft (b) direction.

strength than C-1060 & C-1070. That because of higher warps density than others. C-2080 shows minimum strength because of the lower warp density and for higher yarn count. Acid washed samples shows greater strength than pp sprayed sample in all types of sample because of increased yarn density after subsequent washing. (Figure 10) shows dyed sample of C-1080 occupy greater strength than C-1060 & C-1070. C-2080 shows minimum strength. Acid washed samples

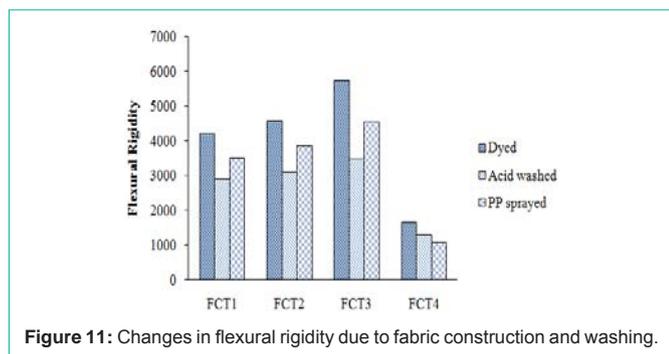


Figure 11: Changes in flexural rigidity due to fabric construction and washing.

shows greater strength than pp sprayed sample in all types of sample.

Changes in tearing strength

Figure shows that dyed, acid washed and pp spray sample of C-1060 shows greater strength than C-1070, C-1080 & C-2080. PP sprayed C-2080 sample shows maximum strength than others. That because it is less compact than any other fabric. Figure shows that dyed, acid washed of C-1060 shows greater strength than C-1070, C-1080 & C-2080. But pp spray sample of C-2080 shows higher strength than others.

Changes in rubbing fastness

Table 10 shows that dry rubbing of all sample shows very good fastness. Wet rubbing is also in a range from 2 to 2/3. But acid washed sample shows good rubbing fastness than dyed sample. That may because of lower amount of dye molecule is attached in acid washed sample.

Changes in Ph values

The value of the surface pH of the experimented samples has been shown in the above (Table 11). The general pH levels accepted for a finished garment to be wear lies between 4.5-7.5. All the experimented samples lie between these values and hence accepted in terms of pH measurement.

Effect of fabric construction and washing types on fabric stiffness

Figure shows that dyed, acid washed & pp-spray sample of C-1080 shows greater stiffness than C-1070, C-1080 & C-2080. C-2080 shows lower stiffness than others. This may happen because of higher yarn count and lower warp density in the fabric structure. Acid washed sample shows low stiffness than dyed and pp sprayed sample.

Table 12: Test requirements of international retailers'.

Retailers' name	C/F to rubbing		Tensile strength (N)				Tearing strength (N)				pH value
	Dry	Wet	Warp		Weft		Wart		Weft		
			GSM	Strength	GSM	Strength	GSM	Strength	GSM	Strength	
C & A	3-4	1-2	<200	200	<200	150	<200	12	<200	10	4.0-7.5
			201 to 270	300	201 to 270	200	201 to 270	18	201 to 270	15	
			271 to 390	550	271 to 390	300	271 to 390	24	271 to 390	20	
			>390	650	>390	400	>390	30	>390	24	
TOM TAILOR	4	2	<220	220	<220	200	<220	15	<220	8	4.0-7.5
UNIQLO	3	2	<150	196	<150	147	<150	9.8	<150	6.9	4.5-7.0

Fulfillment of international retailers' requirement

By analyzing the different test requirements as well as their particular values of the world renowned retailers', a comparison was made between the values of experimented samples with denim since right now washing effect is basically developed on denim garments. All the test requirement of C&A, Tom Tailors and Uniqlo has been tabulated as shown in the (Table 12) and it was collected from a renowned manufacturing washing plant that produce products for these retailers'. The values of the tensile strength tear strength, color fastness to rubbing and pH of the experimented samples fulfill the requirement of these particular tests in comparison with denim and hence it will meet up the customer requirements.

Conclusion

Washing effect on different canvas fabric was investigated in this work and then different characterization such as tensile strength, tear strength, color fastness to rubbing, stiffness and pH were done. Experimental sample C-1060 shows 511.5 N and 470 N tensile strength in case of acid wash and pp spray respectively along warp direction and 447.6 N and 521 N along weft direction. Tear strength of experimental (60x60)/((10+10)x(10+10)) fabric shows 45.018 N and 44.437 N at warp direction for acid washed and pp spray respectively and also 42.627 N and 32.819 N at weft direction for acid washed and pp spray respectively. Normally all buyers are given more attention to strength because durability. The test result ensures that washing effect of garments (leg panels) is varied due to construction variation. Dry rubbing fastness is very good and wet rubbing fastness is in the range 2-3. pH of all fabric is in the range of 7.3-7.5. In this research, all canvas fabric showed optimistic faded effect and (80x60)/((10+10)x(10+10)) fabric shows satisfactory result in tensile and tear strength at warp and weft direction, pH, color fastness to rubbing on both wet and dry condition. The tensile strength of (80x60)/((10+10)x(10+10)) is higher and only this construction meet buyer requirement. Also (80x60)/((20+20)x(20+20)) fulfills the buyer requirements according to GSM.

Acknowledgement

The authors are thankful to the management of Textile Lab, DUET for providing the laboratory facilities for this study.

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