

Effect of Acid Wash on Appearance and Physical Properties of Terry and Interlock Knitted Dyed Garment

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Abstract

The closing step in finishing of garment manufacturing process is involved washing in particular for fashionable garment. Acid washing is a method used in garment finishing to make valuable aesthetic of garment. This study examines how two knitted garments—a terry (100% cotton), and an interlock (100% cotton)—are affected aesthetically and physically by acid washing using potassium permanganate and granular thermocol balls as abradant. Physical characteristics of the garments were examined after acid washing, and it was found that the garment weight in grams per square meter and spirality increased while their bursting strength reduced. Furthermore, colorfastness to wash, dry and wet rubbing and pilling were unchanged. This work indicates that acid washing with thermocol ball is effective for making faded-look of terry and interlock garments for their value addition to customers.

Key words: Acid wash; thermocol balls, Knitted garment; Fastness properties; washing machine.

1. Introduction

The use of garment is fundamentally social aspects of human being but also to provide human being from different environmental protection [1]. Social aspects have gradually become fashion of garment especially for young generation of all over the world [2]. Textile and Garment manufacturer have developed fashionable Denim or jeans garment using various dry ad wet treatments [3]. Stone wash is the oldest method to create fade effect on denim or jeans garment. Pumice stones are used for demim washing to create a fade, worn-out look to the garment. Pumic stones are placed with the denim garments in a large washing machine. Pumic stones abrades the surface of the denim garment and makes wear and tear to create fading effects on garment [4]. Sand Blasting is also a conventional process to create faded area and localized worn effect on Denim or jeans garment [5]. Potassium Permanganate spray on jeans to create moderate bleaching effect on surface of garment [6]. Decolorization of Indigo color is achieved by Bleach washing [7]. Laser is the best alternative to Potassium Permanganate spray and can create a wide variety of surface effects on denim or jeans garment [8]. In order to create fashion-look on knit garments like T-shirt, Polo-shirt, various technological system have been developed. Slub yarns, Muticount and multitwisted yarns, neppy yarns, SIRO yarns, Mozaic yarns, cloudy yarns and Injects yarns are being commercially available during the production of yarns to create different aesthetic in the knit

garment. After the production of knit garment, they are also washed by enzymes, softeners, Silicone, pigment, caustic to get desirable fashion and comfort [9-12]. Apart from those techniques, Acid wash of knit garment is a popular method for color fading. In the past, denim clothing dyed with indigo dyes was typically acid washed. The acid wash technique produces a striking color contrast on the clothing [13]. As Potassium Permanganate (KMnO₄) was used in spray on jeans to create washing effect on garment. This Potassium Permanganate is also used in denim washing. A study demonstrated that the effect of change in concentration of KMnO₄ on physical and mechanical properties of denim jeans during acid washing [14-16]. Thermocol is a small granular or ball-like substance which is being used in garment washing in order to get similar or better effect produced by pumice stone. Essentially, thermocol balls are used in place of pumice stones while washing knitted clothing, combined with a range of chemical concentrations to create various fading effects. Additionally, any chemical cleaning of knit clothing causes the colors to fade, giving the garment a contrast effect [17-18]. Investigation on the Effect of Acid wash was conduction on the physical properties of Single Jersey 100% Cotton T-shirt, Single Jersey 95% Cotton 5% Spandex T-Shirt and Rib 100% Cotton T-Shirt. The study reported that fabric weight per unit area, Stitch density, spirality and shrinkage increased while bursting strength,

stitch length absorbency decreased after Acid washing treatment along with a little decrease of colorfastness to wash, wet and dry rubbing. There was no change in pilling [19].

The present study aims to apply Acid washing on Terry and Interlock knitted garment using potassium permanganate and thermocol balls in order to investigate the physical and mechanical properties of these garment in term of weight per unit length, spirality, bursting strength, wash fastness and dry to wet rubbing fastness.

2. Methodology

2.1 Raw Materials

Two knitted garments were used in this study namely 100% Cotton with Terry construction and 100% cotton with Interlock structure. Both garments were dyed with Reactive dye at their fabrication process. The grams per square meter of Terry and Interlock garments were 260 and 270 respectively.

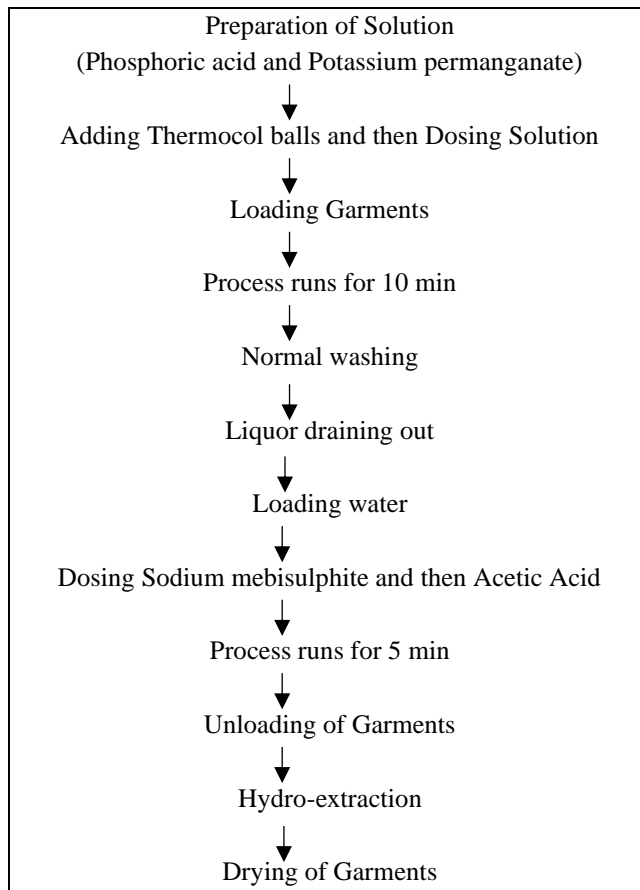
2.2 Acid Washing Process

Solution was prepared using washing agents of potassium permanganate and phosphoric acid. 5% phosphoric acid and 15 g/L potassium permanganate was used. Thermocol balls were loaded into the washing Machine on the basis of 0.1 % of garment weight. Washing solution was added into the machine. Washing was carryout out with garment for 10 minutes. Material and Liquor ration was kept 10:1. Washing liquor was drained for neutralization according to the process parameters at room temperature. Garment was brought out from the machine; dewatering was done by hydroextraction and garment was dried at the end. Process flow of the Acid washing is shown in the process flow diagram and the process parameters were mentioned in Table 1.

Table 1. Process Parameters of Acid Washing.

Process	Parameters	Amount
Acid Washing	Potassium permanganate	60 g/L
	Phosphoric acid	10 g/L
	Temperature	Room
	Time	10 min
Neutralization	Sodium metabisulphite	2 g/L
	Temperature	Room
	Time	10 min

Preparation of Solution



2.3 Assessment of Physical Properties

Fabric grams per square meter (GSM) was measured according to ASTM D 3776 method by GSM cutter. Dry and wet rubbing color fastness were tested according to AATCC 8 by Crockmeter. Colour Fastness to Wash was measured according to ISO 105 C06 Method. Spirality was measured according to AATCC Test Method 187-2013. Pilling test of the garments were tested by ICI Pilling box according to ISO 12945-1:2001 method. ISO 13938-2:2019 method was used to test the Bursting strength of garments.

3. Results and Discussion

3.1 Garments Appearance

After acid washing on reactive dyed knitted garments, there was a huge change in the appearance of the garments and the color were lighter than before wash. Fig. 1 portrays the fading and color change scenario of the garments. Acid washing acid and thermocol balls with solution breaks the chemical bond of the primary wall of the cellulosic fibres of the garments and after that, it attacks slightly the secondary wall. Therefore, weakly bonded dye particles are removed from the fabric surfaces and fabric color fading occurs as burnt-look.



Garment Type	Before Acid Wash	After Acid Wash
Terry (Back side)		
Terry (Front side)		
Interlock (Back side)		
Interlock (Front side)		

Fig. 1. Color change of garments before and after Acid wash.

3.2 Effect on Grams Per Square Meter (GSM)

The GSM of the sample (Terry and interlock) before and after acid washing has been changed as displayed in Fig. 2.

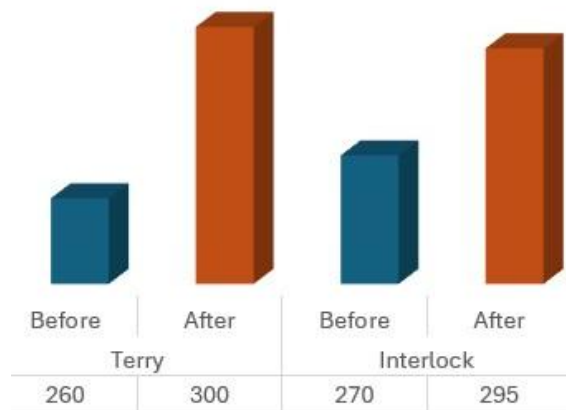


Fig. 2. GSM change of garment before and after acid Wash.

It can be observed that the weight of the fabric per unit area (GSM) increased after washing. When the knitted garments are faced with frictional action due to the thermocol balls and

rotating cylinder of the washing machine, a trace of solution of Potassium permanganate (KMnO_4) and Phosphoric acid (H_3PO_4) also penetrated the fiber structure causing the change in internal tension in the constituted fibres of the garments. The garments then tended to revert to their dimensions which resulted in the contraction of the yarns. This effect causes the reduction of the stitch length and there by the GSM of the fabrics is increased.

3.3 Effect on Bursting Strength

It is found that the acid washing treatment on knitted garments causes a decrease in bursting strength as portrayed in Fig. 3. At first thermocol balls with solution break the chemical bond of the primary wall of the cellulosic cotton fibres and after that, it attacked slightly on the secondary wall. The result of this reaction is that the primary wall of the cotton fiber is loosened and broken down quicker with the mechanical forces of the washing machine and the slightly rough surface of thermocol balls. As a result, the internal Hydrogen bonding force among the molecules of the cellulose gets reduced which causes lower strength. This causes a loss of bursting strength after acid washing.

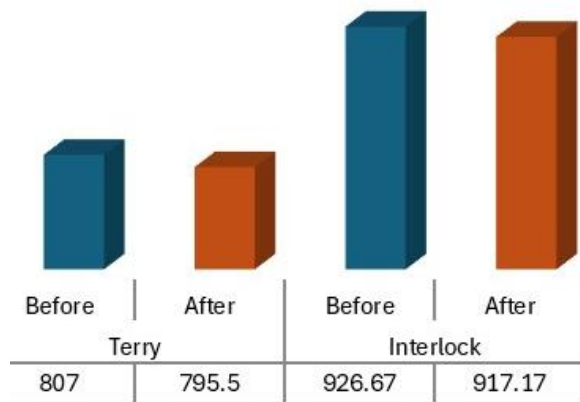


Fig. 3. Change in Bristing strength garments before and after Acid wash.

3.4 Effect on Color Fastness, Pilling and pH

It is evaluated that the value of color fastness and pilling was unchanged before and after acid wash for both garments tabulated in Table 2 for multifibre fabric staining. As acid damages the primary wall of the fibres of garment and also removed weakly bonded dye particles on fibres surfaces, and therefore it shows very good rubbing fastness. As weakly fixed dye particles are removed during acid washing so the garment shows good wet rubbing properties like before washing. From the result, Table 2 shows that the value of color fastness to wet rubbing is unchanged. Reactive dyeing is done in an alkaline medium where pH ranges from 9-10. After dyeing and normal washing, neutralization was done. Then acid washing was done in an acidic medium where the pH range is 4.5-5.5 then neutralization was done. Reactive dye creates a strong bond with hydroxyl groups of cellulosic cotton fibres. Also weakly fixed dyes are removed during acid wash and fabric fade and the garment shows good color fastness to wash and rubbing.

Table 2. Effect of Physical properties of garment before and after Acid wash.

Properties	Before Acid Wash (Terry and Interlock)	After Acid Wash (Terry and Interlock)
Color Fastness to Wash	4-5	4-5
Color Fastness to Dry Rubbing	4-5	4-5
Color Fastness to Wet Rubbing	2-3	2-3
Pilling	4-5	4-5
pH	6.81	6.83

pH remains almost unchanged after performing these tests. The slight variation that happens between before and after acid wash can be the results of the variation in neutralization. The reason for having no change in pH in the before and after acid wash garment is the neutralization (By sodium metabisulphite and acetic acid) process the garments were subjected to at the end of each process. If neutralization had not been done, the acid washed garment would have shown a lower pH, because acid wash was performed with a pH is approximately 4.5, whereas the pH of the garment after dyeing and neutralization process was 6.5. There were no changes found in pilling after acid wash even with abrasive nature of thermocol balls.

3.5 Effect on Spirality

From the Fig.4, it's observed that spirality after washing increased. During washing dimensional stability slightly decreases due to the reaction of acids to the primary wall of cellulosic fibres. The amount of spirality increases after acid wash. Interlock fabric, having a compact structure, shows the least spirality. On the other hand, terry fabric, being the loose structures and, it shows higher spirality.

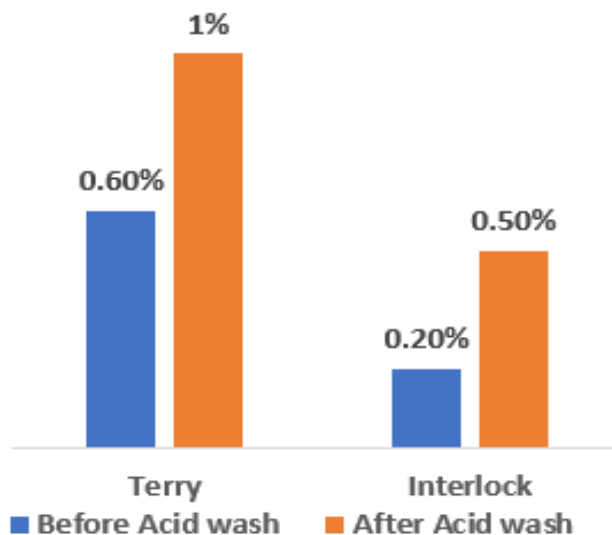


Fig. 4. Changes in Spirality of garment before and after Acid wash.

4. Conclusion

The experiment aimed to find out the effect acid wash on reactive dyed knit garments. Two types of coarse garment (Terry 100% cotton and interlock 100% cotton) were selected and acid wash with thermocol balls was conducted. It was noticed that acid washing faded the color of the garment and created a burnt-out shade for dyed garments. The GSM and spirality of the garment increased after acid wash for terry and interlock garments. On the other hand, bursting strength decreased after acid washing. Additionally, other properties like pilling, colorfastness to wash, dry, and wet rubbing remained unchanged after acid wash for both garments. This study suggests that Acid wash can add value to the knit garment for creating fashionable appearance.

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