Influence Of Enzyme And Silicone Wash On The Physico-Mechanical Properties Of Non-Denim Twill Garments

Elias Khalil, Joy Sarkar, Mostafizur Rahman, Md. Solaiman

Abstract— Garments washing is one of the most important finishing treatments applied on apparels which have vital use to create special outlooks and improving the fashion. Technologically washing is one of the most important fashion elements for clothing industry and production of washed garments depends on the machine quality. In order to achieve an optimum effect of washing process, on the woven fabric in different washing time, Enzyme Wash and then Silicone wash were carried out for cotton fabric. However, there are some of the comments that when the garments have longer washing time, use of the chemical on the washing procedure will affect the physical and mechanical performance. The aim of this study is to determine the effects of industrial enzyme silicone wash combined with silicone wash. For this study currently fashionable regular Non- denim (100% cotton with twill 3/1 weave construction) trouser was chosen. The selected Non-denim trouser has been processed by enzyme and then silicone wash. In order to evaluate the washing effects on Non-denim trouser, changes of fabric handle, fabric specification (ends/inch, picks/inch, surface density, warp & weft yarn linear density), fabric strength has been determined during and after washing.

Index Terms— Enzyme Wash, GSM, Non-Denim Garments, Silicone Wash, Tear Test, Rubbing Test.

1 INTRODUCTION

Industrial garments washing is one of the major processes followed in the Textile sector. By industrial garments washing, dust, dirt and infectious materials can be removed from garments. For improving special look on garments as per fashion requirement, a variety of wash techniques can be followed [1]. The technology which is used to modify the appearance, outlook comfort ability and fashion of the garments is very much available in our countries [2]. Some of these garment washing techniques were originally developed for denim garments, but are now being used for a wide variety of different garment types. The mills and fashion houses involved in garment processing are continuously searching for ways to achieve unique and new looks. The common wash techniques are the basic wash, stonewash, stonewash with chlorine, ice wash, and Enzyme wash techniques used for cotton garments [3].

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Any of these procedures can be modified to fit a particular situation, depending upon garment type (i.e., heavyweight denim versus lightweight chambray), available equipment, and process flow. Also, some of these procedures yield garments suitable for over dyeing, which may create a whole new look [4]. Enzymes are important in regulating the chemical reactions that occur within all living organisms. Without enzymes, many of these reactions would not be able to take place at a perceptible rate. Enzymes play an important role in the digestion of food, where large molecules are broken down into smaller molecules, and they are needed for the conservation and transformation of chemical energy [5]. Besides biological processes, enzymes are also useful in industrial and medical areas. For example, the fermenting of wine, curdling of cheese and brewing of beer are the result of the catalytic activity of enzymes. In medicine, enzymes are used in killing disease-causing microorganisms and promoting wound healing [6]. A method that has long been studied, and has been put into some practice, is the immobilization of enzymes on a solid support. Although enzymes have been immobilized on silica gels, the vast majority of these have been done on pre-formed gels. This method has been successfully used for enzyme immobilization; however the loadings have been limited. When the activated gel is introduced to the enzyme solution, enzyme immobilization first occurs at the pore openings. At higher loadings, the enzymes can effectively block the pores preventing enzyme diffusion into the interior. A more effective method must be developed for the immobilization of enzymes [7]. Silicones are polymers that include silicone together with carbon, hydrogen, oxygen, and sometimes other elements. Some common forms include silicone oil, silicones grease, silicone rubber, silicones resin, and silicone caulk [12] Silicon is the second most abundant element on earth, after oxygen, making up approximately 25 percent of the earth's crust by weight; largely found in the form of oxides such as sand and clay [7]. Sodium silicate, of formula Na_2SiO_3, is commercially produced by the reaction of soda ash and sand in a furnace. Also known as "water glass", sodium silicate is used as an adhesive [8], detergent [9] and fire-retardant [10]. In addition to sodium silicate, several organic silica precursors are available, such as tetraethoxysilane (TEOS), of formula Si $(OC_2H_5)_4$, and

tetramethoxysilane (TMOS), of formula $Si(OCH3)_4$

2 Materials and Methods

2.1 Materials

100% cotton non- denim twill leg panels were used. The fabric GSM (Grams per Square Meter) was 309, 3/1 warp faced S-twill, construction 112 x 58 / 14 x 10, fabric width 57 inch. The leg panels were desized using the standard recipe. Then the denim leg panels were washed using enzyme and softener and then with enzyme, silicone and softener in a combination. Enzyme (Biorazer-200), detergent (Hostapur WCTH, Germany), softener (Vel- 1500), Silicone (MeSoft G, Matex, Singapore) and cationic silicone softener (MeSoft-CCS Flakes, Matex, Singapore) were used for washing.

2.2 Methods

Twill leg panels were desized using detergent. This pretreatment was conducted in liquor containing detergent, Hostapur WCTH (1% owg). Material to liquor ratio was 1:10 in a small scale front loading industrial washing machine (Sutlick, Singapore). This treatment was carried out at temperature 70°C for 10 min. After desirable time the liquor was drained. The leg panels were then washed with normal water for 3 min. Desized denim leg panels were treated using enzyme. This process was carried out in liquor containing enzyme (1% owg); acetic acid (1.5 g/l) at pH 6- 6.5, and material to liquor ratio of 1:10 in the washing machine. Temperature was kept 50°C and treatment time 55 min. The denim garments were then washed with hot water at 70° C for 4 minutes for enzyme killing then washed twice with cold water for 3 minutes each. Then softening was done with softener (2% owg) in a bath containing material to liquor ratio 1:8, at pH 5.5 for 7 minutes. The temperature was 40° C. Silicone wash is carried out in the softening bath containing cationic silicone softener (1g/l), Silicone (0.5g/l) and Acetic Acid (0.6g/l) at 40°C for 20 minutes for imparting more slippery effect on the fabric. Enzyme and enzyme- silicone washed non- denim twill leg panels were squeezed in a laboratory scale hydro-extractor machine (Zanussi, Roaches International Limited, England) at 200 rpm for 3-4 min. Then dried at 65°C for 35 min in a steam drier (fabcare, India). Treated leg panels were then analyzed to determine their physical and mechanical properties using standard test methods.

2.3 Testing and Analysis

Treated all denim leg panels were conditioned in 65% RH and 20°C for 24 hour before testing according to BS EN 20139 and ASTM D1776. Tearing strength was determined according to ASTM D1424 - 09(2013). Weight change (%) in fabric / GSM was calculated from the difference in fabric weight before and after the treatment according to ASTM D 3776. Color fastness to crocking has been determined according to AATCC Test Method 8- 2013. [11]

3 Results and Discussion

3.1 Changes of fabric weight after washing

It is clear from fig.1 that the enzyme and enzyme- silicone washing imparts significant change in the fabric properties. The fabric weight (GSM) has been found increased up to 9.38%. The occurred shrinkage might be the reason for this change in the fabric weight. After treating with silicone the weight has been found less than that of the enzyme washed sample.

Fig. 1. Change in fabric weight (GSM) in before wash, after enzyme wash and after enzyme- silicone wash

3.2 Changes of tearing strength after washing

The warp way tear strength has been found increased. It has been found that, the tearing strength increases by 6.44% after enzyme wash and by 15.47% after enzyme- siliconee wash. The weft way tearing strength are almost same in the different washing conditions. As the woven fabric has a normal tendency to shrink more in warp way, that's why the strength in the warp way has been increased.

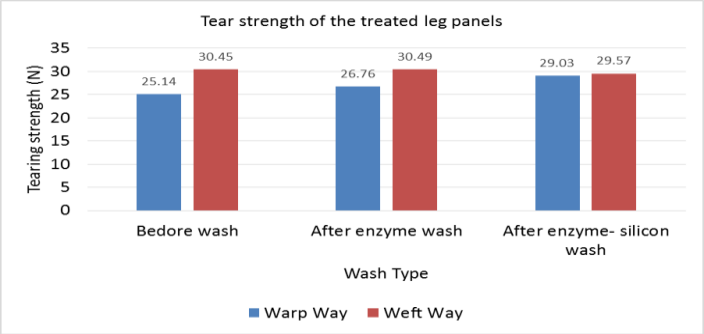

Fig. 2. Changes in fabric tearing strength in before wash, after enzyme wash and after enzyme- siliconee wash

3.3 Change in color fastness to crocking after washing

From fig.3 it is clear that, the color fastness is good in the dry state but in wet state the color fastness not so impressive. With comparing the before wash state, the color fastness was found poor in the washed fabric in wet state.

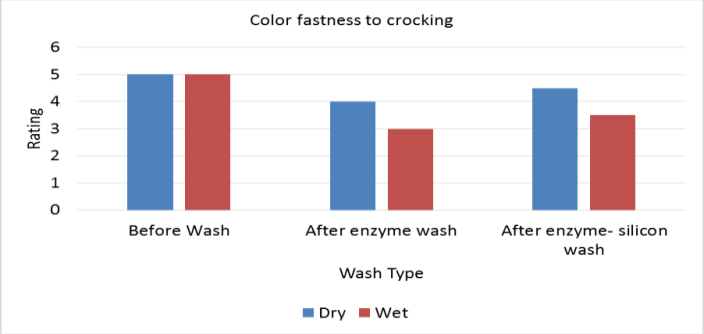

Fig. 3. Change in color fastness to crocking in before wash, after enzyme wash and after enzyme- silicone wash

3.4 Changes in EPI and PPI after washing

The Ends per Inch (EPI) and Picks per Inch (PPI) are almost same in different wash conditions. The change which occur is minimum and occurs due to the shrinkage of the sample after washing treatment.

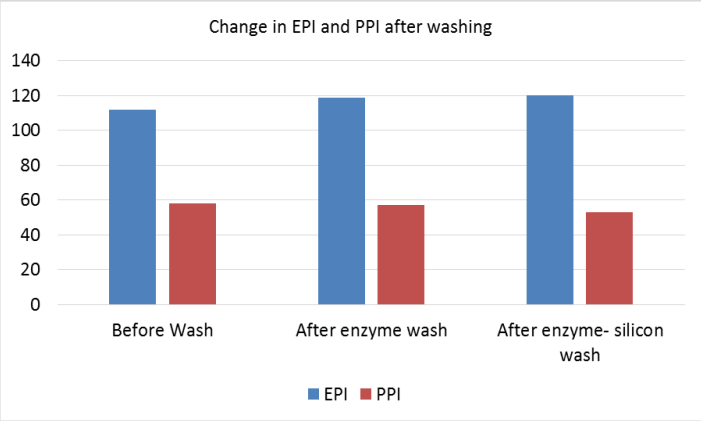

Fig. 4. Changes in EPI and PPI in before wash, after enzyme wash and after enzyme- silicone wash

4 Conclusion

The enzyme and the enzyme- silicone wash has a lot influence on the properties of non- denim twill. The GSM or fabric weight has been found increased after enzyme wash and a bit lower after enzyme- silicone wash. The tearing strength property of the twill garments has been increased after the washing treatment. The color fastness property is found poor in wet state but good in dry state. Other fabric specification like EPI and PPI is changed in a very thin margin which is not actually considerable. Enzyme wash actually hydrolyzes the hairiness from the fabric surface and assist in color fading of the treated garments and silicone imparts a slippery effect on the fabric surface. Besides imparting these properties, enzyme wash and enzyme- silicone wash affects the physical and mechanical properties of the twill garments.

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