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CHANGE OF WEIGHT IN PRETREATMENT OF DYEING: A STUDY ON 100% COTTON KNIT FABRIC

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***Abstract*: The study is to find out changes in weight of cotton knit fabrics in pretreatments of dyeing. Single jersey, single lacoste, 1x1 rib, 1x1 lycra rib, 2x2 rib & terry fabrics were used for this research and processed them in different pretreatments of dyeing. Standard recipes were followed with right chemicals were used in every stage. All the processes were conducted in a reputed industry and modern machines were used at every process. After values of weight changes at each stage were carefully measured maintaining same atmospheric condition. It was found that weight changing rate is different for the different knit structured fabric though same recipes and procedures were followed for all of the fabric samples in a particular stage. Finally, the reasons of variation in weight change were explained logically.**

Keywords: *Knit fabric, weight loss, scouring, bleaching, bio-polishing.*

1. INTRODUCTION

Pretreatment is very influential in terms of subsequent processing of fabric dyeing thus they are so called that good pretreatment means half dyeing. Because pretreatment clean the fabric by removing impurities and natural color so there are some changes in fabric after those processing. Besides after pretreatments knit fabrics are processed by bio-polishing to reduce protruding fibers from surface which is singing for woven fabric. Now those processes as scouring and bleaching of pretreatments and bio-polishing as finishing can change some properties of fabric where weight change is one of the fundamental issues. It has been studied that alkali pretreatment by tetra methyl ammonium hydroxide on lyocell fabric shows reduction of fibrillation as well as mass reduction which are more than other types of alkali treatments [1] though different enzyme treatments on interlock knitted fabric reduces the fabric weight and becomes thinner but extension properties becomes higher for different treatments of enzyme [2]. For different cotton based fabric of different composition including blends are bio-scoured, bleached and bio-polished where fabric weight is increased with respect of higher process temperature compared with 40º C, 50º C and 60º C though whiteness index and tensile strength is decreased [3]. Besides, selected alkaline stable and neutral-stable enzyme treatments on union fabric have different and radical effects on handle, softness, comfort, and mechanical properties [4]. The effect of resin and combination of different softeners on pigment-dyed PC blended fabric shows that fastness and mechanical properties are improved for combining of softener and fixer. Besides, softener reduces the stiffness and fixer increases the rubbing fastness and tear strength [5]. In case of khadi stripe fabrics after bio- finishing tensile strength and elongation were reduced but no changes observed for abrasion and pilling [6]. Similar kind of study on effects of different spinning system on physical and mechanical properties of yarn after mercerization showed that strength of yarn after bleaching, tension mercerization and reactive dyeing is generally higher in respect of yarn which undergoes bleaching, slack mercerization and non- mercerization process [7]. Again, UV curable pretreatment on inkjet printed polyester, pretreated taffeta, warp-knitted and weft-knitted polyester fabrics shows the increment of color depth and color gamut [8]. After dyeing of chemically modified jute fibers by different reactive dyes there is loss in tenacity after bleaching and changes in colorfastness to sunlight and colorfastness to wash as well [9]. On the other hand influence of pretreatment with low molecular weight chitosan (LWCS) on the dyeing of cotton fabrics shows that the molecular weight of LWCS decreased as the concentration of hydrogen peroxide increased and anti-bacterial properties of fabrics pretreated with LWCS were better than pretreated with chitosan [10] but continuous pretreatments by innovative optical brightening agent on linen fabrics exhibit excellent whiteness by retaining maximum strength with good wash fastness rating [11]. However, pretreatment of wool fabric with lipase enzymes earns more hydrophilic surface which improves the dye ability by reactive dyes at lower temperature with high rate [12], accordingly during grey to process of finishing changes of tearing strength of military khaki fabrics is wide in processes from grey to finished stage but changes of tensile strength is not so sensitive but tear strength falls at bleaching but more in dyeing [13].

Application of mercerization fabrics thickness, weight, bending and shearing rigidity, moisture absorption increased but extensibility, frictional coefficient, wicking of fabrics decreased [14] although shear stiffness values, roughness of rigid and resin fabrics is greater than bleached and softened denim fabrics, as well as bleaching and softening treatments had significant and positive impacts on thermal conductivity, thermal absorptivity and thermal diffusion [15]. Again, for the addition of softener to 100% cotton fabric decreases weight loss percentage due to abrasion resistance which improves for half and full plating samples [16]. Apart from this, whiteness and absorbency characteristics of wiping products containing grease cotton/polyester blend fabrics can be significantly improved by web formation [17] but heat and steam pretreatments during pretreatments is one of the influential causes of degradation of cotton fibers by enzymatic cellulose hydrolysis [18] though pretreatments using CIBAFIX ECO results good prints with better color strength and lower penetration than untreated fabric [19]. So prevailing studies reveals that there are significant changes in fibrillation, mass, extension property, whiteness index, tensile and tearing strength, color fastness, dyeing performance or dye ability for pretreatments, bio-polishing, mercerization, softening as well as heat and steam treatment done prior/during fabric dyeing. The precise changes of knit fabric weight due to scouring, bleaching and bio-polishing is omitted in existing studies which can subsidy to estimate the exact performance of pretreatments in wet processing industry. By considering the fact the study is to investigate the meticulous amount of weight change for different kinds of knit fabric and their comparison in subsequent process of pretreatments followed by bio-polishing.

2. METHODOLOGY

A. Fabric details: In this study, 100% cotton fabric of six different structures namely Single jersey, single lacoste, 1x1 rib, 1x1 lycra rib, 2x2 rib and terry were used. The use of various structured fabric has given a comprehensive idea about weight changes in different stages of wet processing.

B. About pretreatment of dyeing: All the fabrics were processed in same ways at a time. At first the samples were subjected to scouring-bleaching process to remove both impurities and natural color followed by bio-polishing. The samples were neutralized with acetic acid after scouring-bleaching process. Hydrogen peroxide killer was also used in this process to remove the existence of hydrogen peroxide.

Bio-polishing was carried out using cellulose enzyme to remove projecting fiber. The temperature and pH were carefully maintained during this treatment. After completing this process, the temperature raised to 80 ºC and continued it for ten minutes to deactivate enzyme.

After completing a particular process, the samples were subjected to a hot wash and then a cold wash. Then they were dried in a dryer and their weight were measured after conditioning the samples in same moisture and temperature.

The following recipes were used in the processes of wet processing:

TABLE I. RECIPIES OF PRETREATMENTS

Scouring-bleaching	Bio-polishing
Sequestering agent-1g/L Detergent-1g/L Caustic soda-2g/L H_2O_2-3g/L M:L-1:8 Temperature-98 ºC pH-11.5 Time-30 minutes	Acetic acid-1g/L Cellulose enzyme-1% M:L-1:8 Temperature-55 ºC pH-4.5 Time-50 minutes

C. Measurement of weight change: Same moisture and temperature were maintained during measuring the weight of the samples in every time. The weight change% was calculated using the following formula:

$$\text{Weight Change \%} = \frac{\text{Wb} - \text{Wa}}{\text{Wb}} x100$$

Where, Wb= Weight before the process and Wa= Weight after the process.

3. RESULT AND DISCUSSION

A. Change of weight in pretreatment: From the Table II, it has been revealed the weight was reduced in all the fabric samples at the scouring-bleaching stage. Cotton contains dirt, dust, oil, wax and other fatty acid as impurities and scouring process is used to remove all these impurities from the fiber. The natural color of cotton is usually grey and bleaching agent remove it from fiber. As the impurities and natural color has been removed by scouring-bleaching process, the weight loss was found.

Table II also indicates that the weight has also been lost in bio-polishing stage. During manufacturing of yarn some fibers do not get twisted and they projected from the axis of the yarn. Cellulosic enzyme is used in bio-polishing treatment to remove this projecting

fiber from the fabric. Whenever the projecting fibers are removed from the fabric, the weight of the fabric is reduced. As a result, weight loss has been observed in bio-polishing treatment.

TABLE II. WEIGHT CHANGE OF FABRICs DURING PRETREATMENTS

Fabric type	Yarn count	GSM of fabric	Brand of yarn	Process	Sample weight before treatment	Sample weight after treatment	Weight change	Weight change %
Single jersey	26	120	SHIRIN	Scouring & bleaching	10.575g	9.635g	0.94g	8.88
				Bio-polishing	8.285g	8.215g	0.07g	0.8
Single lacoste	32	140	A.MANN	Scouring & bleaching	9.310g	8.5g	0.81g	8.7
				Bio-polishing	7.105g	6.940g	0.16g	2.32
1x1 rib	24	150	BENGAL	Scouring & bleaching	7.200g	6.600g	0.44g	8.33
				Bio-polishing	5.780g	5.715g	0.06g	1.12
1x1 lycra (5%) Rib	30	150	MUL AZIM	Scouring & bleaching	10.405g	9.600g	0.80g	7.73
				Bio-polishing	7.870g	7.80g	0.09g	0.889
2x2 rib	28	210	SHIRIN	Scouring & bleaching	6.075g	5.750g	0.49g	5.35
				Bio-polishing	4.580g	4.495g	0.08g	1.85
Terry	24	230	A.MANN	Scouring & bleaching	10.020g	9.55g	0.72g	4.69
				Bio-polishing	7.440g	7.265g	0.17g	2.35

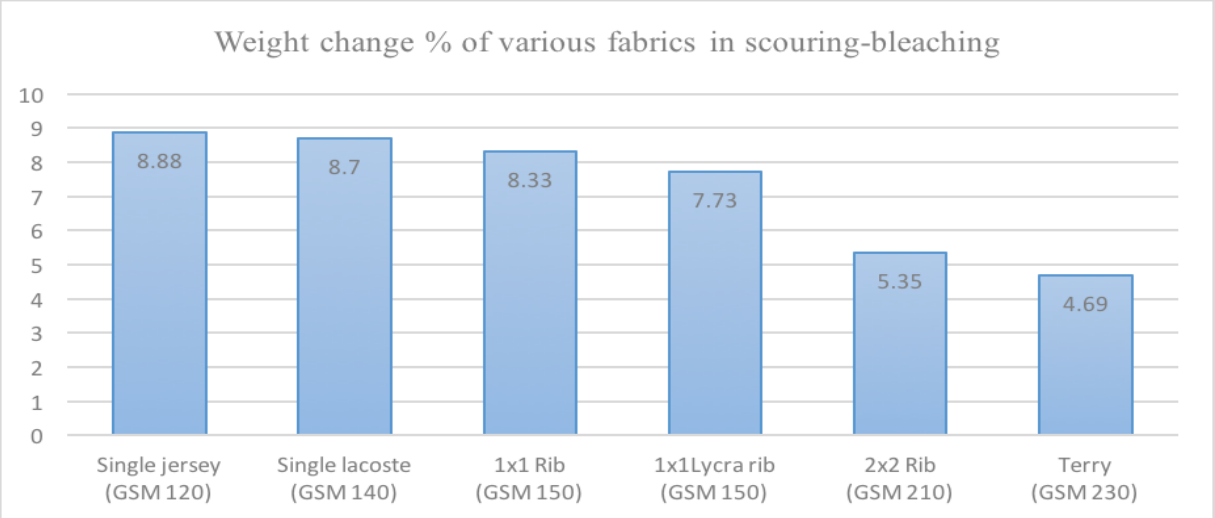

Fig. 1. Comparison of weight changes among the all knitted fabrics at scouring & bleaching stage

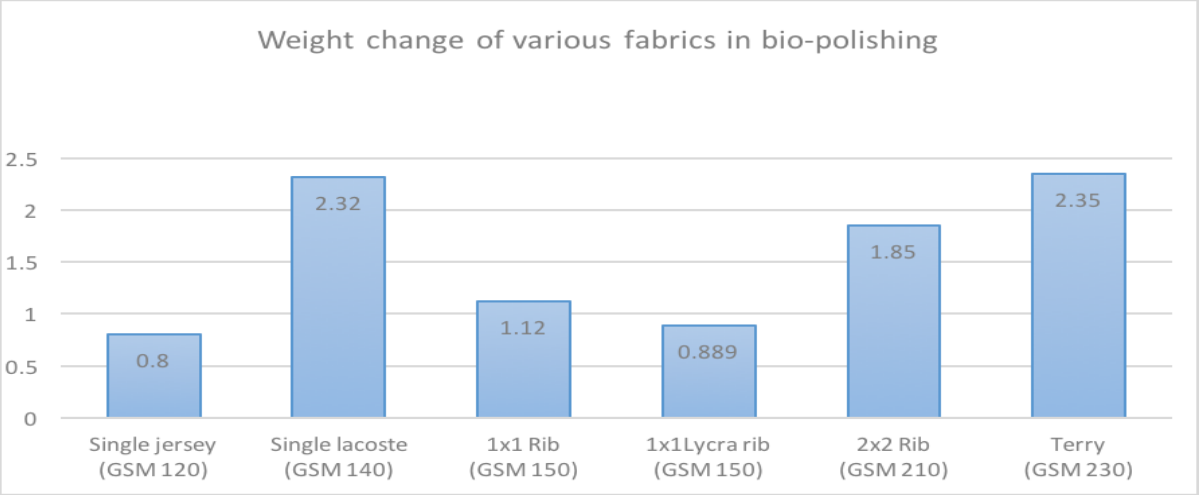

Fig. 2. Comparison of weight changes among the all knitted fabrics at bio-polishing stage

B. Comparison of Weight Loss among Fabrics: From the Fig. 1, it has been found that weight loss in scouring-bleaching of single jersey fabric is the highest (8.88%) but terry fabric has the lowest (4.69%) weight loss. Single lacoste has the second highest (8.7%) value of weight loss and 1x1 rib, 1x1 lycra rib, and 2x2 rib have third (8.33%), forth (7.73%) and fifth (5.35) highest value of weight loss respectively. The reason of pattern of weight loss can be explained in two ways. Firstly, the weight loss may depend on the structure of the fabric where it can be expressed as- single jersey> single lacoste> 1x1 rib> 1x1 lycra rib> 2x2 rib> terry. Secondly, it has been observed single jersey fabric has the lowest (120) GSM and terry has the highest (230) GSM. The single lacoste has the second lowest (140) GSM followed by 1x1 rib, 1x1 lycra rib and 2x2 rib. As a result it can be expressed that the weight loss has been decreased with increase in GSM of fabric. Whenever the GSM of the fabric increases, the compactness of the fabric also increases. The chemicals of scouring-bleaching may not work properly in compacted structure. As a result the weight loss of fabric having higher GSM exhibits lower weight loss.

Fig. 2 reveals that weight loss in bio-polishing is the highest (2.35) in terry fabric and single jersey has the lowest (0.8%) weight loss. It is completely different for scouring-bleaching process. Single lacoste has the second highest (2.32%) weight loss value like scouring-bleaching process. Unlike scouring-bleaching, 2x2 rib has third highest (1.85%) whereas 1x1 rib has the forth (1.12%) and 1x1 lycra rib has the fifth (0.88%) highest value of weight loss. The weight loss of bio-polishing depends on the amount of removing projecting fiber and the removing of projecting fiber does not depends on the compactness of fabric. As a result, the weight loss in bio polishing does not depends neither on the structure of fabric nor on the GSM of the fabric.

4. CONCLUSION

This study focused to find out the percentage of weight change at various stages of pretreatment of dyeing. It has been concluded that all the fabrics lost their weight in both scouring-bleaching and bio-polishing processes. But the values of weight loss varies not only from process to process but also from one fabric to another fabric in same process. . It has also been revealed that GSM and structure of fabric has impact on the weight loss of fabric in scouring-bleaching process and the weight loss decreases with increase of GSM. As a result comparative loose structure shows higher weight loss.

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