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Effects of Different Drying Methods on the Properties of Viscose Single Jersey Fabrics

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***Abstract*—**The study discussed in this paper was conducted in an attempt to investigate effects of different drying methods (line dry and tumble dry) on viscose single jersey fabrics knitted with ring yarn.

***Keywords*—**Color change, dimensional properties, drying method, fabric tightness, physical properties.

I. Introduction

REPETITIVE laundering process in the washing machines causes negative effects on fibres and fabrics like swelling of fibres, changes in yarn diameter, damages in fibres, dimensional change, felting, spirality, puckering of fabrics, abrasion, pilling, changes in mechanical properties and changes in surface characteristic properties [1]. Dimensional change of fabrics consists of various types. One of them is the relaxation shrinkage which occurs as a result of release of the tensional forces on the fabric applied during knitting process. According to the AATCC (American Association Textile Chemists and Colourist), relaxation shrinkage takes place when the fabrics are dipped into the water and is mostly observed when fibres with high moisture absorption are used [2]. Progressive shrinkage which is the second type of the dimensional change occurs after repetitive laundering processes. Extension, which is the opposite of shrinkage, is generally observed in the width of the fabric and especially in knitted fabrics. To minimize the extension problem of the fabrics line drying is most widely preferred especially for fibres with low wetting resistance. The last type of the dimensional change is the contraction which is the decrease in the length that takes place in synthetic yarns/ fabrics when they are exposed to high temperatures [3]. Spirality takes place in knitted fabrics at different levels according to fibre type, yarn structure, fabric construction and finishing process type. Bursting is also a fabric defect that occurs in knitted fabrics. Bursting strength is the force, uniformly distributed over a given area, needed to break a fabric when applied at right angles to the fabric. According to some researches, bursting strength of knitted fabrics decrease after laundering and drying processes [3]. Pilling of the fabrics occurs with friction effects resulting from mechanical motion in the washing machine during laundering [4]. Abrasion is also related with the friction effects during laundering [3]. In comparison with woven fabrics knitted fabrics have lower abrasion resistance. Based on the literature survey, abrasion resistance increases with the increase in fabric density [5]. Forces applied and chemicals used during laundering also cause colour change in fabrics [6].

Number of the textile product types that can be laundered in domestic washing machines has been increasing for some time washing properties of these textile products might vary depending on the developments in fibre types, yarn structures, coloring agent types and fabric construction. Knitted fabrics are more negatively influenced by laundering and dying processes compared to woven fabrics. Therefore, analyzing dimensional and physical effects of these processes on knitted fabrics is more critical than analyzing their effects on woven ones.

The literature survey showed that there is limited number of reports on effects of laundering process and different dying methods on textiles from viscose fibres, despite the fact that the use of viscose textile products increases day by day. Viscose garments are more frequently laundered nowadays as a result of their increased use especially in the skin touchable garments and higher washing and drying performance is expected from them.

Consequently, the study discussed in this paper analyzed effects of different drying methods on viscose single jersey fabrics knitted with ring yarn.

II. Experimental Study

A. Materials

For the study, the single jersey fabric samples were produced, at three different tightness factors (slack, medium, tight), on circular knitting machines with 90 feeders. The fabric tightness factor is set with the change of loop length and showed with course length (cl). 100% viscose ring yarn with yarn count of Ne 30 was used. The properties of the yarn are given in Table I. All fabric samples were bleached by using peroxide and dyed with reactive colouring agent in the same boiler. Two set of fabrics were prepared for each tightness factor so that one set was tumble dried, whereas the other was line dried. The sample types are given based on the tightness values in Table II.

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TABLE I
YARN PROPERTIES

Yarn Property	Yarn Type
Yarn count	28.8
Twist (turns/m)	396.8
Twist CV	17.78
Twist factor (α_e)	1.9
Evenness CV%	12.3
thin places, thick places, neps (400m)	0,4,5
Hairiness (100mm) N1, N2, N3	18443, 4347, 1486
S3 (100mm)	2561
Strength (g/f)	441.5
Strength CV (%)	8
Rkm	22.4
Extension (%)	16.3

TABLE II
SAMPLE TYPES

Sample Code	Fabric Tightness
S-1	Slack: cl 780
S-2	Medium: cl 700
S-3	Tight: cl 650

The properties of the fabric samples are given in Table III.

TABLE III
PROPERTIES OF FABRICS

	Unwashed			After 5 Washing		
	Loop Density (/cm^2)	Loop yarn length (mm)	Fabric Weight (kg/m^2)	Loop Density (/cm^2)	Loop yarn length (mm)	Fabric Weight (kg/m^2)
S-1	216	2.86	119.8	247	2.88	140.9
S-2	247	2.66	138.7	308	2.56	157.2
S-3	308	2.34	165.2	360	2.38	195.9

B. Method

The fabric samples were laundered five times in the washing machine (temperature: 40±3°C, centrifuge time: 6min). One set of the fabrics was line dried while the other one was tumble dried. These fabrics were tested for some dimensional and physical properties, which were "Dimensional Change (ISO 3759 – 1994)", "Spirality (AATCC 179 – 2004)", "Bursting Strength (TS 393 EN ISO 13938-1 – 2002)", "Pilling (TS EN ISO 12945-1 – 2002)", "Abrasion Resistance (TS EN ISO 12947-2 – 2001)", "Bow and Skewness (ASTM D – 3882)" and "Color Change (Grey Scale)". The statistical evaluation of the data obtained was done by using SPSS 13 software package and ANOVA analysis. The relationships between different groups are determined at 95% confidence interval in SPSS.

III. RESULT AND DISCUSSION

The results obtained are discussed below with the help of the relevant Figs. 1, 2 and Table IV.

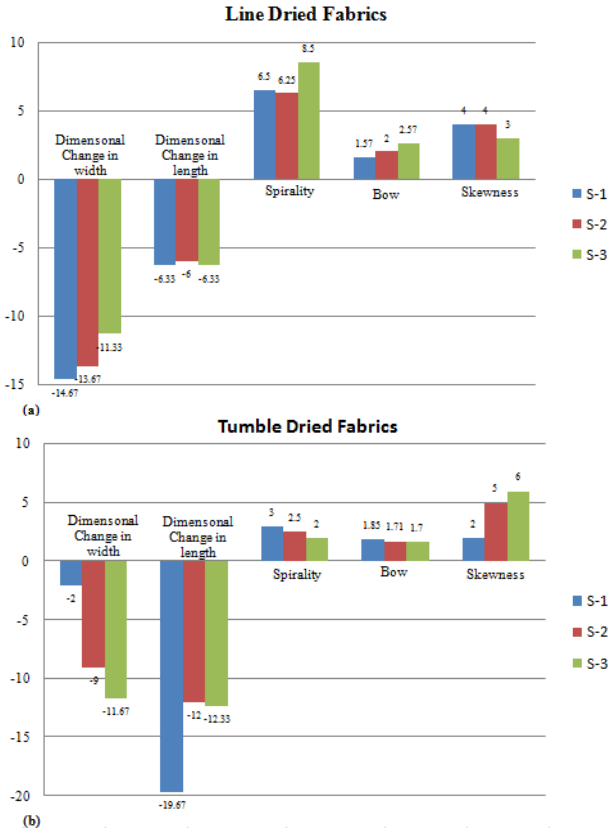
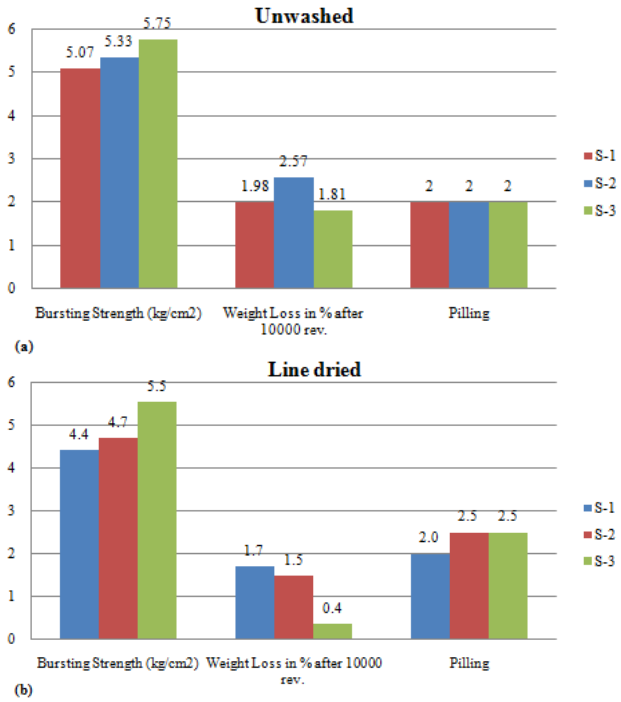


Fig. 1 Effect of studied parameters on dimensional properties of fabrics after 5 washing a) Line dried b) Tumble dried



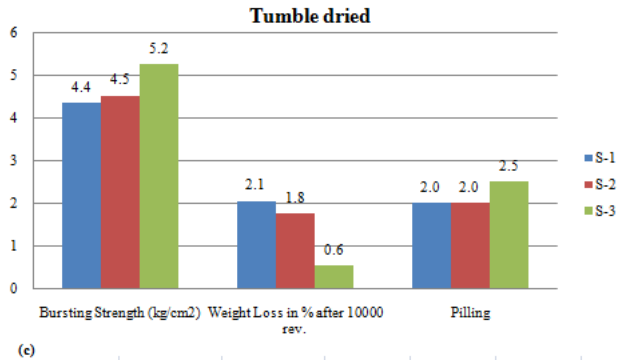


Fig. 2 Effect of studied parameters on some physical properties of fabrics after 5 washing (a)Unwashed (b)Line dried (c)Tumble dried

TABLE IV
EFFECTS OF STUDIED PARAMETERS ON COLOR PROPERTIES OF FABRICS AFTER 5 WASHING

Sample code	Color Change	
	Line dried	Tumble dried
S-1	3/4	4
S-2	4	4
S-3	3/4	3/4

A. Dimensional Properties

Our experimental and statistical results showed that the drying method had a significant influence on the dimensional properties of the fabrics and irrespective of the tightness factor, tumble dried fabrics displayed higher changes in length direction whereas, those were the flat dried fabrics that had higher changes in width direction.

B. Spirality

Spirality of the tumble dried fabrics was lower than the flat dried ones. Tightness factor did not have a significant influence on spirality, however in flat dried fabrics; tight fabrics had higher spirality than medium and slack fabrics. High loop density in tight fabrics might have caused the loops to push each other resulting in higher spirality.

C. Bow

Our experimental and statistical results showed that the drying method did not have a significant effect on bow but tumble dried fabrics had slightly higher bow due to extra mechanical forces acting during the drying process. Although it was expected that slack fabrics had more bow compared with medium and tight fabrics due to more freely movement of loops in slack fabrics, the expected effect of the tightness factor on bow was not observed.

D. Skewness

Skewness of tumble dried fabrics was higher than the flat dried ones as expected.

E. Bursting Strength

Our experimental and statistical results showed that higher loss in percent of bursting strength occurred in tumble dried fabrics. This might be due to the additional mechanical forces acting on the fabrics during the drying process. Besides, the tight fabric showed the highest bursting strength and lowest change in percent. The reason of this can be explained with high loop density in tight fabric.

F. Abrasion Resistance

According to our experimental and statistical results, the higher weight loss after the abrasion action was occurred in the tumble dried fabrics as expected due to additional mechanical forces which cause a decrease in abrasion resistance. Besides, we observed the expected effect of tightness factor on the abrasion resistance. Highest weight loss of the slack fabrics after the abrasion test was an expected result since abrasion resistance increased with increase in fabric density, because tight fabrics have high fabric weight [7].

G. Pilling

According to the results of the study the tumble dried fabrics had lower pilling resistance than the line dried ones. Higher shrinkage of the tumble dried fabrics might have resulted in a tighter structure. As a result, it might have been difficult for the fibers to leave the fabric structure. Furthermore, the fabric density did not have a significant effect on the pilling performance although better pilling values were s expected in tight structures since the fibres can be more securely kept in the fabric and were not allowed to go away from the surface.

H. Color Change

As both literature surveys and the study showed, laundering process had negative effect on fabric color. Chemicals in detergents and chlorine amount in water used in laundering process cause fading although color protective detergents are mostly used [6]. Moreover, the function of finishing decreases with the increase in the number of laundering process. As a result of this, performance properties and appearance of fabric get worse [8]. Drying methods did not have a significant effect on color change. The flat and tumble dried fabrics showed the same grades irrespective of the tightness factor.

IV. CONCLUSION

The study attempted to discuss the change in dimensional and physical properties of viscose single jersey fabrics knitted with ring yarn after repetitive laundering and drying processes. Our experimental variables were fabric tightness and drying methods. These two variables were found to have significant impact on the dimensional and physical properties of fabrics investigated. The results showed that tight fabrics gave the best results except for the fabric shrinkage in the width of the fabrics. The fabrics were negatively affected by additional mechanical forces acting during the tumble drying process. Thus, line dried fabrics showed better properties compared to the tumble dried ones. Finally, it can be concluded that if single jersey fabrics knitted by tighter setting are used, and line drying is preferred as the drying process after laundering, best results can be achieved in terms of some dimensional and physical properties.

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