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EFFECT OF PILLING ON DIFFERENT SINGLE JERSEY WEFT KNITTED STRUCTURE

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ABSTRACT

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The samples were knitted on a modern single jersey circular knitting machine. The samples were dyed and finished. The test was carried out according to EN ISO 12945-2:2000 with Martindale abrasion and pilling tester. The experiment was carried out at the Beximco Textile Limited, Beximco Industrial Park, Chokroborty, Gagipur, Bangladesh to screen the different effect of pilling on single jersey plain, polo pique, single lacoste and double lacoste weft knitted structure during the period of January-April 2014. The results shows that stitch length and knit structures have the great influences on propensity to pilling. It is apparent that fabric with tight stitches shows the greater resistance to pilling than that of loose structures. Double lacoste fabrics have a lower propensity to pilling and Plain fabrics have the least resistance to pilling.

***Key words**: knit structures, stitch length, pilling, raw materials and machine*

INTRODUCTION

Knitted fabrics provide outstanding comfort qualities, and they have been preferred as fabrics in many kinds of clothing long time. Clothing comfort is an extremely complex phenomenon resulting from the interaction of various physical and non-physical stimuli on a person wearing clothing under given environmental conditions (Chen and Collier, 1997). In clothing design and manufacturing, fabric characteristics are usually dictated by a specified end-use (Emirhanova and Kavusturan, 2008). A fabric may loose its aesthetic appeal due to wear, which is a combined effect of several factors like abrasion, repeated laundering, the application of forces in dry and wet states, etc. arising from everyday use and service. Some standard terms and definitions such as pills, pilling are applying according to EN ISO 12945-2:2000 (Chen and Collier, 1997). Pills mean entangling of fibers into balls (pills) that stand proud of the fabric surface and the light will not penetrate and will cast a shadow. Pilling means generation of pills over the surface of the fabric. Pills are forming during washing, dry cleaning and wearing of knitted goods. Pilling is a fabric fault. Fabric pilling is a serious problem for an apparel industry. The development of pills on a fabric surface, in addition to resulting in an unsightly appearance, initiates the attrition of the garment and can cause premature wear. Pilling studies have shown that there are three distinct stages in the life span of a pill (Gintis and Mead, 1959).

a) Fibers are drowning to the fabric surface because of some mechanical action, and these form fuzz;
b) The fuzz entangles into pills;
c) The pills wear of under continued mechanical action, such as rubbing, laundering, drying, etc., during wear and cleaning. In a given fabric construction, the rate or extent of which these stages occur is determined by the physical characteristics of the fibers that compose the fabric. Pill formation is a dynamic process, since pills are constantly forming and wearing off. If the formation rate is greater than the break-off rate, pills will build up on the fabric. The formation rate is influenced by fiber type, the number of fiber ends, linear density, length, cross-sectional shape, yarn twist, hairiness, and fabric construction (Can 2008). Any combinations that allow fibers to migrate to the yarn surface will increase the formation rate. In a fabric made from a blend of fibers there are more pills than in a similar fabric made from only one of the blend components, because of incompatibility between the fibers. An analysis of the conditions giving rise to pilling on knitted fabrics showed that its development was almost always promoted by a number of factors, the most important of which were the physical characteristics of the fibers, the yarn twist, the yarn linear density, and type of pattern of the fabric (Jasińska 2009). Apart from the above factors, dyeing and finishing also can exert influence over the rate of pill formation (Truncytė *et al*. 2008). A great deal of factors affected the pilling behavior of textile fabrics are described as physical-mechanical properties of fibers and yarns, the construction and surface characteristics of knits. Many of these structural variables have been carefully controlled to reduce pilling, but it continues to be a problem. Sometimes it is difficult to choose needed yarn properties that have effect on pilling of knitted fabrics. An importance of this problem demonstrates the fact the level of pilling of knitted goods is controlled by not only producers but also commercials firms. The main goal of this work was to investigate the influence of stitch length and knit structures on the pilling behavior of weft knit single jersey fabrics.

MATERIALS AND METHODS

Raw material and equipments used

For this work, four different types of weft knitted single knit structures–single jersey plain, single lacoste, double lacoste and polo pique were knitted on a 24-gauge single jersey circular knitting machine. Detailed information about the machine and yarn used to produce these fabric samples are presented in Table 1 and Table 2, respectively.

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Table 1. Details on knitting machine

M/C Type	Manufacturer	Country of origin	Model	No. of Feeder	Gauge& Diameter
S/J	Pai Lung	Taiwan	Pl-XS3B/CE	54	24G & 18 inch

Table 2. Details on Yarn used to produce the fabrics

Yarn Type	Manufacturer	Country of origin	Yarn Count	Tenacity	Gauge& Diameter
Ring Combed	Beximco	Bangladesh	30 Ne	54	24G & 18 inch

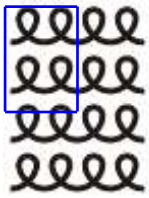
Other Equipments

Martindale M-235 Abrasion and Pilling tester.
Specimen Cutter of Martindale Abrasion and Pilling Tester.
Accessories of Martindale Abrasion and Pilling Tester.
Photographic Pilling Standards.

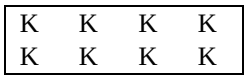
Details on Collected sample

Cam Arrangement & Needle Set Out:
Single Jersey (Plain)

Swatch



Cam Arrangement



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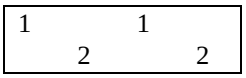
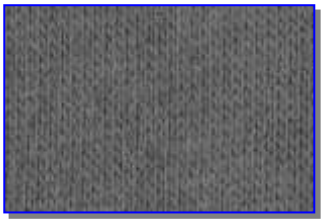
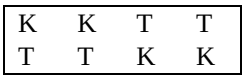




Polo Pique:

Cam Arrangement



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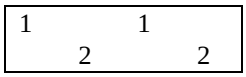
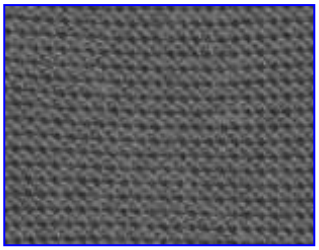
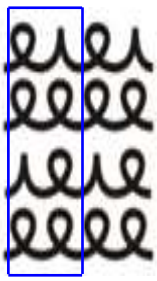




Single Lacoste:



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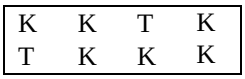

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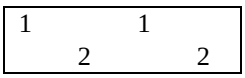
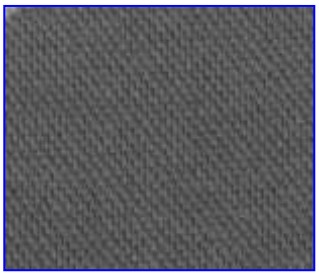
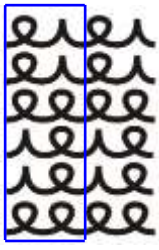




Double Lacoste:



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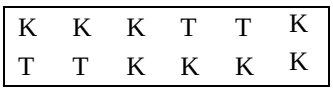
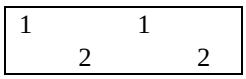
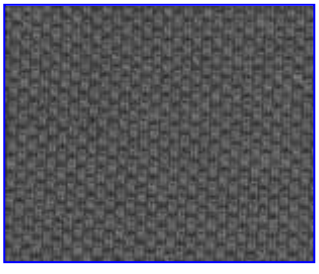


Needle Set-out:





Machine Setting for Piling

Total stroke of the outer peg	24.0+/-0.5mm
Total stroke of the inner peg	24+/-0.5mm
Abrasion area of the specimen holder	64 sq cm
Mass of specimen holder and spindle (For knitted fabrics)	163g+/-7g

Testing Standard

The testing standard followed during pilling test with Martindale abrasion and pilling tester was EN ISO 12945-2:2000 modified Martindale method.

Evaluation Standard

The abraded sample obtained from the machine was observed and compared to evaluate the amount of pilling. The degree of pilling was assessed using the following 5 point scale from the photographic plate (Booth 1968).
5 - No pilling or only very slight pilling.
4 - Slight but tolerable pilling.
3 - Moderate pilling of borderline acceptability.
2 - Unacceptable pilling.
1 - Extremely high pilling.

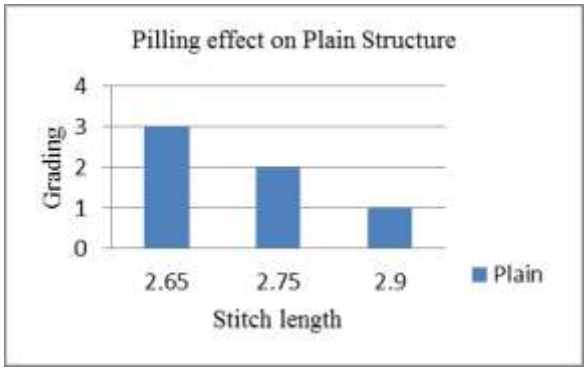
Working Methods

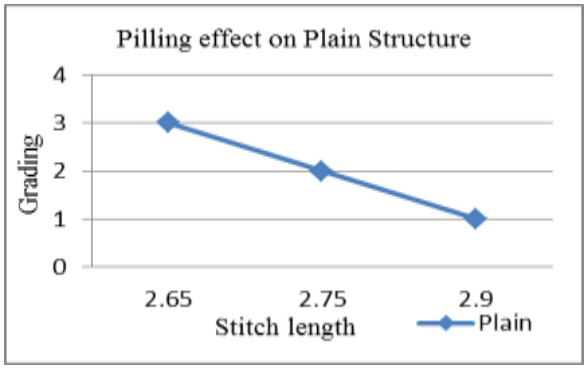
Single Jersey, Single Lacoste, Double Lacoste and Polo Pique which were produced in a small diameter machine having a diameter of 18 inch with 1358 needles and 24 gauge. During producing the fabric the machine setting was changed to produce different stitch lengths of the fabric were 2.90mm, 2.75mm, 2.65mm. At first Single Jersey fabric and cut the required number of samples from the test specimen. Diameters of samples were 140 mm. Next a rubber specimen holder ring was placed around the outside of the device. After that a 140mm disc of specimen was placed on top of the loading device, allowing the excess material to drape over the edge. Later 90mm disc was placed in the recessed top of the loading device. Next the specimen holder was inverted and placed on the top of the felt. Then the rubber ring was rolled up the loading block until it locates in the groove. During caring out the test we stopped the machine after every 500 cycle and lightly brush away any loose fibers which may have gathered on the test surface. Finally the specimen holder was removed after 2000 cycle. Repeated this process for all specimen holders and abrading tables. Finally the specimen holder was removed after 2000 cycle (Booth 1968). Repeated this process for all specimen holders and abrading tables.

RESULTS AND DISCUSSION

Observation -A (Single Jersey Plain)

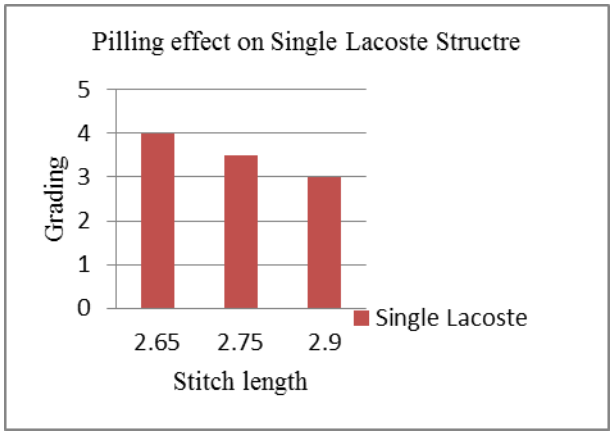
Srl. No	Stitch Length	Pilling Grade	Srl. No	Stitch Length	Pilling Grade	Srl. No	Stitch Length	Pilling Grade
01	2.90	1	01	2.75	1.5	01	2.65	2.5
02	2.90	1	02	2.75	2	02	2.65	2.5
03	2.90	1	03	2.75	2	03	2.65	3
04	2.90	1.5	04	2.75	2	04	2.65	3
05	2.90	1.5	05	2.75	2	05	2.65	3
Average		1.2			1.9			2.8
		≈1			≈2			≈3

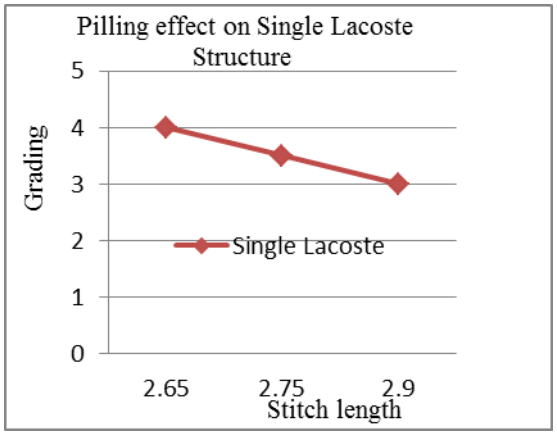




Observation –B (Single lacoste)

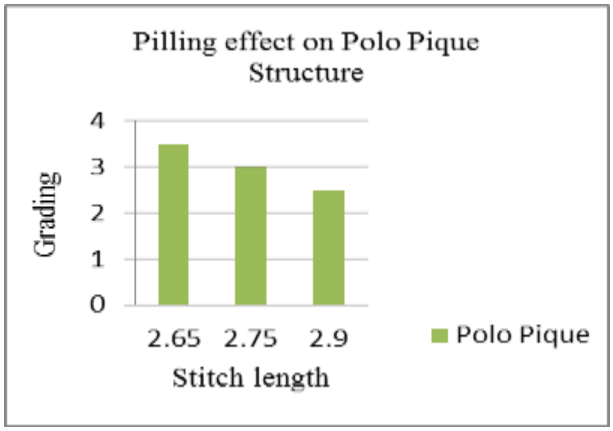
Srl. No	Stitch Length	Pilling Grade	Srl. No	Stitch Length	Pilling Grade	Srl. No	Stitch Length	Pilling Grade
1	2.75	3.5	1	2.65	4	1	2.9	3
2	2.75	3.5	2	2.65	4	2	2.9	3
3	2.75	3.5	3	2.65	4	3	2.9	3
s	2.75	3.5	4	2.65	4	4	2.9	3
5	2.75	3.5	5	2.65	4	5	2.9	3
Average		3.5			4			3

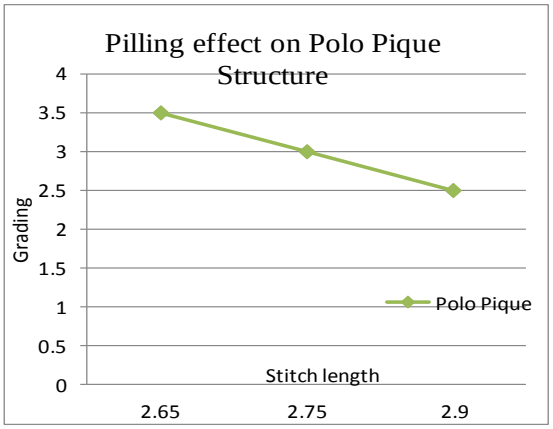




Observation –C (Polo Pique)

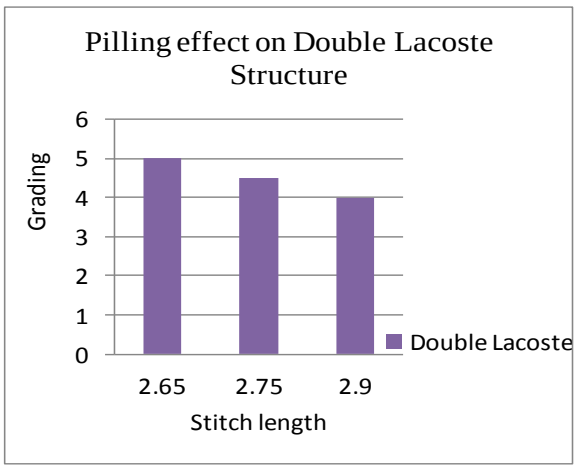
Srl. No	Stitch Length	Pilling Grade	Srl. No	Stitch Length	Pilling Grade	Srl. No	Stitch Length	Pilling Grade
1	2.9	2.5	1	2.75	3	1	2.65	3.5
2	2.9	2.5	2	2.75	3	2	2.65	3.5
3	2.9	2.5	3	2.75	3	3	2.65	3.5
4	2.9	2.5	4	2.75	3	4	2.65	3.5
5	2.9	2.5	5	2.75	3	5	2.65	3.5
Average		2.5			3			3.5

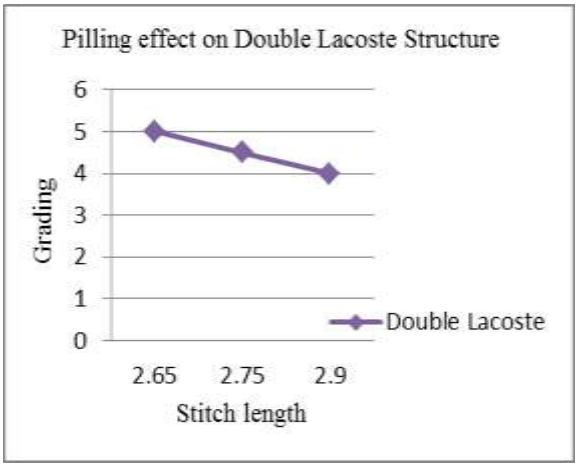




Observation –D (Double lacoste)

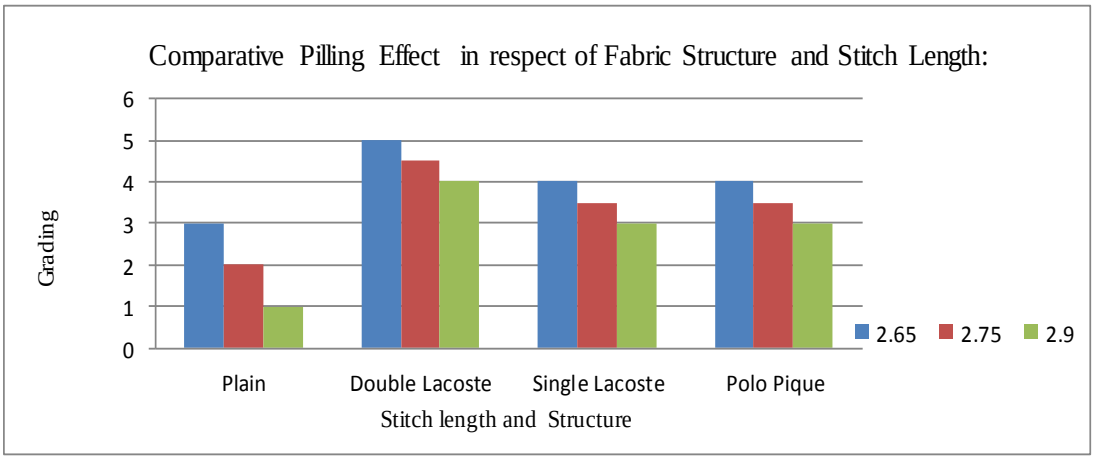
Srl. No	Stitch Length	Pilling Grade	Srl. No	Stitch Length	Pilling Grade	Srl. No	Stitch Length	Pilling Grade
1	2.9	4	1	2.75	4.5	1	2.65	5
2	2.9	4	2	2.75	4.5	2	2.65	5
3	2.9	4	3	2.75	4.5	3	2.65	5
4	2.9	4	4	2.75	4.5	4	2.65	5
5	2.9	4	5	2.75	4.5	5	2.65	5
Average		4			4.5			5

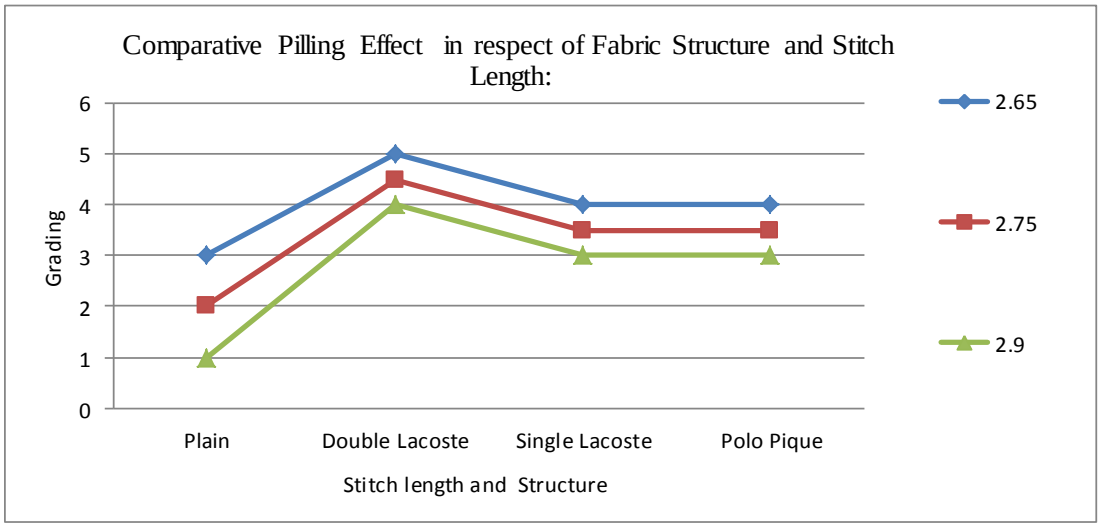




Comparative Pilling Effect in respect of Fabric Structure and Stitch Length:

Fabric Type/Grading	Stitch Length		
	2.65	2.75	2.90
Plain	3	2	1
Double Lacoste	5	4.5	4
Single Lacoste	4	3.5	3
Popo Pique	3.5	3	2.5





The influence of knitting structure on propensity to pilling is evident from the data presented above where the other structural factors are kept control. The fabric knitted in double lacoste design has the best grade of the visual assessment. The plain-jersey knitted fabric has the worst one. Polo pique structure has in half grade better visual assessment than the plain knitted fabric but worse than single lacoste structure. The influence of stitch length on propensity to pilling is apparent from the data presented. In all cases propensity to pilling of weft knitted fabric decrease by decreasing of stitch length. Fabric of lower stitch length is knitted more tightly. A tight compact knitted construction will have the best pill resistance. Plain-jersey fabric with stitch length 2.65 mm has half grade better visual assessment than plain jersey with 2.75mm. The same trends are got from comparison of visual assessment of other structures knitted with different stitch lengths.

CONCLUSION

Propensity to pilling of examined weft knitted fabrics depends on stitch length, knitting structure, raw material, yarn linear density, and fabric density. The double lacoste knitted fabric gives substantially fewer pills than the single lacoste, polo pique and single jersey plain fabric because of less operated surface area. Also resistance to pilling of weft knitted fabric increases by decreasing of stitch length. Fabric of lower stitch length is knitted more tightly. A tight compact knitted construction will have the best pill resistance.

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