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A study on the Effect of Tuck Stitches on the properties of Pique and Lacoste Knit Structures

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Abstract - In this study, a detailed investigation has been done to know the effect of tuck stitches over the properties of pique and lacoste knit structures made out of cotton combed hosiery yarn. For this research work, three fabric structures namely single jersey; pique and lacoste were knitted with three uniform loop length variables by using circular multi cam track knitting machine. The developed fabric samples were subjected to different relaxation states namely dry, wet and full. After fully relaxation state, the fabric samples attained their dimensionally equilibrium state with minimum energy level. At this state, the final impact of tuck stitches on pique and lacoste has been recorded and the results have been compared with the results of bench mark jersey structure.

***Key words**: Tuck Stitches, Pique, Lacoste, Knit Structures,Single jersey*

I. INTRODUCTION

Single jersey fabric is one of the parental all knit structures with face knit stitches on its front side and back knit stitches on its reverse[(4)]. When this basic structure is introduced with tuck stitches at appropriate selected positions by replacing the knit stitches that will lead to the jersey derivative weft knit designs such as pique, double pique, cross tuck, lacoste etc., In this research work, we have developed pique and lacoste derivative structures to study the influence of tuck stitches on the fabric characteristics by comparing them with the results of single jersey. All the samples were made by using 30 tex cotton combed hosiery yarn each with three different loop length variables. The knitted samples have been tested for geometric, mechanical and dimensional properties after their fully relaxation state. Stitch length is the unit parameter of the knitted structure which is proportional to the inverse of the wales or courses per inch[(1-2)]. The results obtained for all the samples have been compared test wise for detailed discussion and finally the conclusions were drawn.

II. MATERIALS AND METHODS

Cotton combed hosiery yarn with yarn count 30 tex has been used to develop all the knitted samples for this work.

Single jersey, pique and lacoste samples have been developed with three loop length variables such as 0.30 cm, 0.33 cm and 0.36 cm with respective tightness factor values of 18.26, 16.60 and 15.21. The fabric samples were developed in multi cam track single knit Pailung circular knitting machine with 24" cylinder diameter, 24 gauge, 72 feeders and 1800 needles at a speed of 20 rpm. After knitting, the grey samples were laid flat under standard atmospheric condition (20±2^{0}C and RH 65%) for 24 hours to obtain their dry relaxed state. The dry relaxed samples were dyed in a 1 kg sample RBI soft flow dyeing machine and dried with the help of relax dryer. All the dried dyed fabric samples were kept flat under standard atmospheric condition (20±2^{0}C and RH 65%) for 72 hours to obtain their wet relaxed state. The wet relaxed samples were subjected to five repeated cycles of washing and drying with the help of IFB front loading fully automated washing machine and IFB tumble drier to attain their fully equilibrium state. After that, the samples were laid flat under standard atmospheric condition (20±2^{0}C and RH 65%) for 24 hours to obtain their fully relaxed state and minimum energy level.

Loop length of all the samples was estimated by adopting a common test procedure. 100 adjacent loops per course for 10 consecutive courses in each sample was carefully counted and marked at both left hand and right hand sides. After that, the courses from the marked samples were unraveled one by one. The crimp in the loops of the unraveled course has been removed with the help of a standard crimp tester and the length of the uncrimped course was measured. The measured length was divided by 100 to obtain the length of one loop. In the same manner, the remaining nine courses were uncrimped one by one to measure their length and the loop length of each course was calculated. Finally, the average of all the ten samples was calculated to obtain the mean loop length.

Each sample was kept flat on a smooth surface without any crease marks and the thread magnifier was placed on the top of the marked sample and the number of wales present in one inch width of it was carefully counted and noted down. The same method was repeated at ten random places

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and the mean value was calculated to determine the wale density in terms of wales per inch.

Samples were again kept flat on a smooth surface without any crease marks and a 1” X 1” square was marked and cut. After that, the courses were unraveled to estimate the course density by counting the number of courses present in one inch length of the sample. Stitch density of each was obtained by multiplying the mean values of wale density and course density.

Areal density of each sample was determined by cutting circular sample at ten random places with the help of standard circu cutter and weighed with the help of a highly précised digital balance. The obtained weight of each sample was multiplied by 100 to get the areal density in terms of grams per square metre. Finally, the mean was determined.

Tightness factor of each sample was obtained by using the standard formula.

Fabric thickness of all the samples was measured through the standardized test procedure ASTM D-1777. Bursting strength of the samples was estimated through the test procedure described in ASTM D-3786. Air permeability of the samples was determined by the method ASTM D 737-96. Abrasion resistance of the samples was estimated through the standard test ASTM D-4966. The degree of fabric pilling of the samples was evaluated through the test procedure ASTM D 3511 by comparing the tested specimens with visual standards.

III. RESULTS AND DISCUSSION

Effect of Tuck Stitch on Wale Density

It is observed from the results shown in Table 1 and Figure1 that the wale density values of jersey structure has been found higher than the remaining two structures. From this it has become clear that the presence of tuck stitches in alternate courses of pique fabric and in all the courses of lacoste fabric has led these two structures to expand widthwise and caused decrease in their wale density values. But, in all three samples there is no prominent difference in their wale density values because of their loop length variations. From this, it has become evident that wale density is the parameter not at all influenced by the change in loop length of the knitted fabrics.

Table 1 Effect of Tuck Stitch on Wale Density

Fabric Structure	Wales per Inch (WPI)		
	0.30	0.33	0.36
Single Jersey	37	38	37
Pique	27	26	26
Lacoste	27	26	26

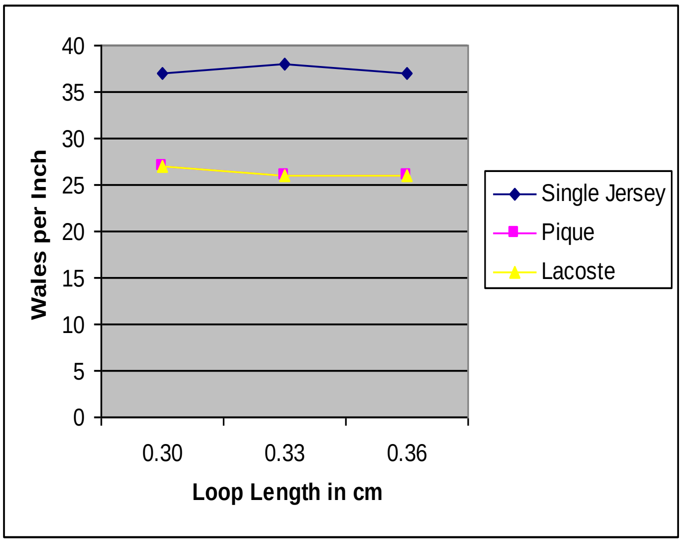

Figure 1 Effect of Tuck Stitch on Wale Density

Effect of Tuck Stitch on Course Density

From the results displayed in Table 2 and Figure 2 it has become clear that the course density of single jersey is found higher when compared to same loop lengths of the remaining two structures knitted with the combination of knit and tuck. Any how, the CPI is more for pique sample than the lacoste among the similar loop lengths. It may due to the existence of tuck stitches in every course of the latter and the resultant increase in the spacing between the courses. In all the samples, the course density values are seen inversely proportional to loop length. It means the smallest loop length has exhibited highest course density and vice-versa.

Table 2 Effect of Tuck Stitch on Course Density

Fabric Structure	Courses per Inch (CPI)		
	0.30	0.33	0.36
Single Jersey	58	49	42
Pique	55	47	40
Lacoste	44	40	37

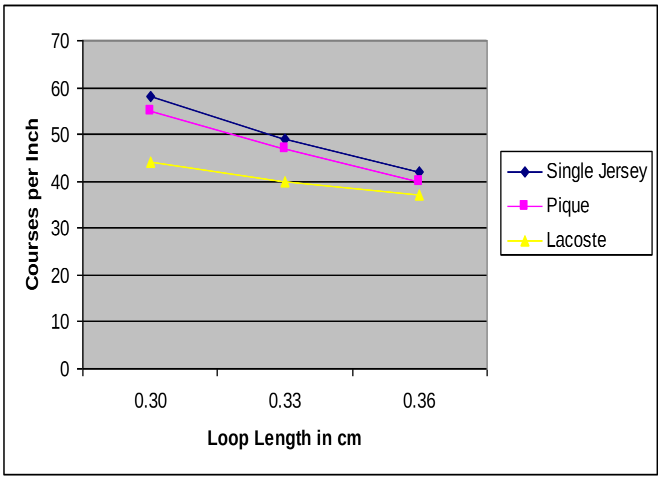

Figure 2 Effect of Tuck Stitch on Course Density

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Effect of Tuck Stitch on Stitch Density

It is evident from the results shown in Table 3 and Figure 3 that the stitch density values of are found maximum in the case of jersey samples and found minimum in the case of lacoste for all the three given loop lengths. Since, the inverted v - shaped tuck stitches present in both pique and lacoste have pushed the adjacent stitches and made these structures porous one with lesser stitch density values than jersey. Anyhow, in all the tested samples stitch density is inversely proportional to the loop length.

Table 3 Effect of Tuck Stitch on Stitch Density

Fabric Structure	Stitch Density		
	0.30	**0.33**	**0.36**
Single Jersey	2146	1862	1554
Pique	1485	1222	1040
Lacoste	1188	1040	962

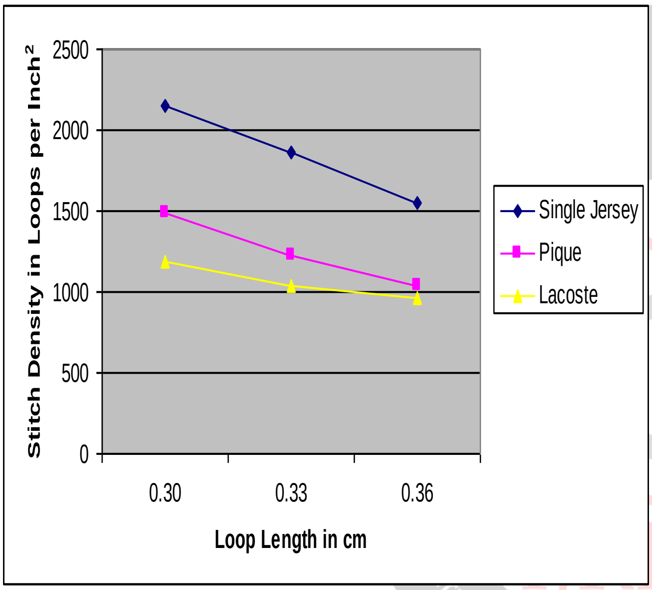

Figure 3 Effect of Tuck Stitch on Stitch Density

Effect of Tuck Stitch on Areal Density

From the results shown in Table 4 and Figure 4 it is obvious that the lacoste fabric exhibited maximum areal density when compared with pique and jersey. It is because of the accumulation of tuck stitches once in every two adjacent courses. At the same time, areal density of pique was found next because of the presence of tuck stitches in every alternate course. The jersey sample knitted with only knit loops has shown the lowest weight in grams per unit area. But, the areal density was uniformly found high for the smallest loop length in all the samples and vice-versa.

Table 4 Effect of Tuck Stitch on Areal Density

Fabric Structure	Areal Density		
	0.30	**0.33**	**0.36**
Single Jersey	231	217	198
Pique	241	222	207
Lacoste	271	247	237

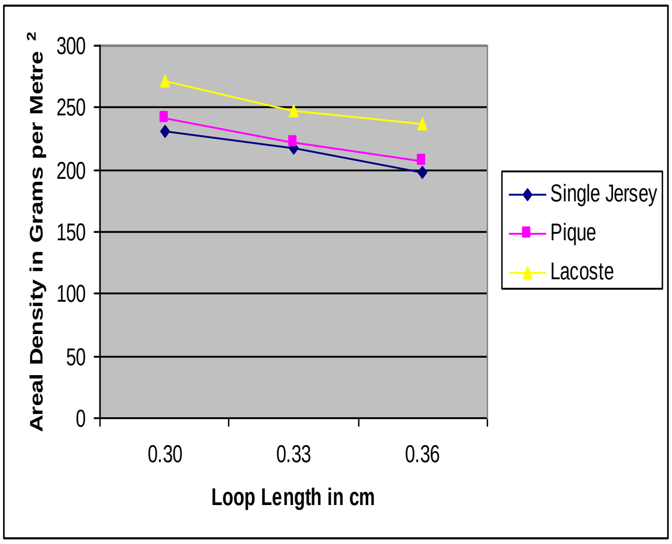

Figure 4 Effect of Tuck Stitch on Areal Density

Effect of Tuck Stitch on Fabric Thickness

From the results given in Table 5 and Figure 5 it is evident that the sample containing more number of tuck stitches was found bulkier than the others and hence, lacoste exhibited maximum thickness in all the loop lengths. Pique samples found thicker than jersey due to alternate course arrangement with tuck stitches.

Table 5 Effect of Tuck Stitch on Fabric Thickness

Fabric Structure	Loop Length in cm		
	0.30	**0.33**	**0.36**
	Fabric Thickness in mm		
Single Jersey	0.58	0.57	0.54
Pique	0.75	0.72	0.69
Lacoste	0.97	0.92	0.91

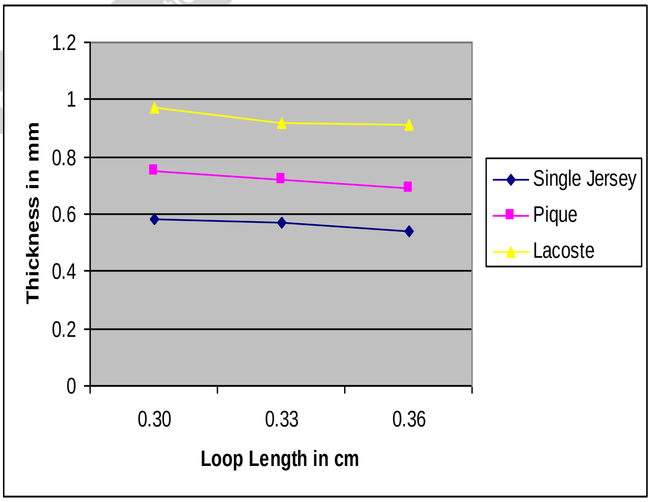

Figure 5 Effect of Tuck Stitch on Fabric Thickness

Effect of Tuck Stitch on Bursting Strength

From the results shown in Table 6 and Figure 6 it is apparent that single jersey samples constructed with three loop length variables exhibit the highest bursting strength.

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It may because of better closeness of loops in that samples occurred due to perfect intermeshing of all the yarn loops. Where as in pique and lacoste the possibility of perfect intermeshing has been obstructed by the formation of tuck loops at regular interval and that led to the construction of open and porous structure and hence, resulted in reduced bursting strength.

Table 6 Effect of Tuck Stitch on Bursting Strength

Fabric Structure	Loop Length in cm		
	0.30	0.33	0.36
	Bursting Strength in lb/inch²		
Single Jersey	174	172	168
Pique	130	127	112
Lacoste	140	128	120

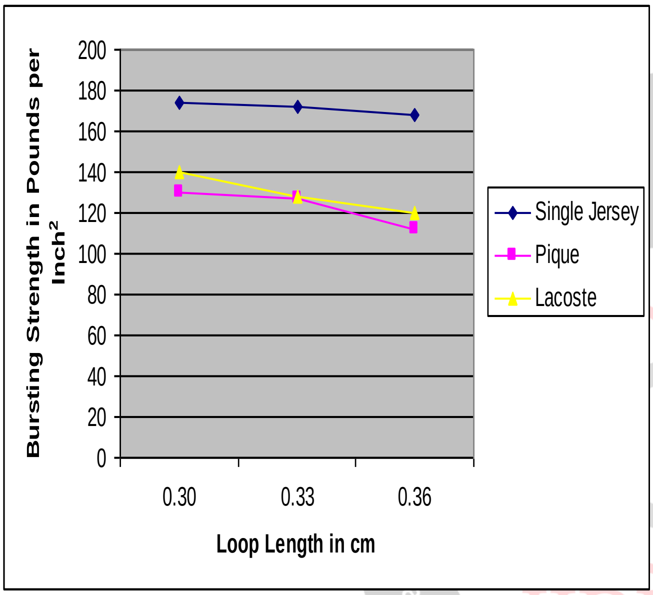

Figure 6 Effect of Tuck Stitch on Bursting Strength

Effect of Tuck Stitch on Air Permeability

From the results shown in Table 7 and Figure 7 it is clear that jersey samples knitted with three different variables of loop length have the lowest air permeability values. It is because of high degree of structural tightness occurred due to loops knitted with one another. But, pique and lacoste samples are highly air permeable due to the existence of tuck stitches and their impact over adjacent knit stitches which have made them more porous.

Table 7 Effect of Tuck Stitch on Air Permeability

Fabric Structure	Loop Length in cm		
	0.30	0.33	0.36
	Air Permeability in cm³/s/cm²		
Single Jersey	5.55	5.83	6.11
Pique	19.44	22.22	25
Lacoste	21.67	25	26.39

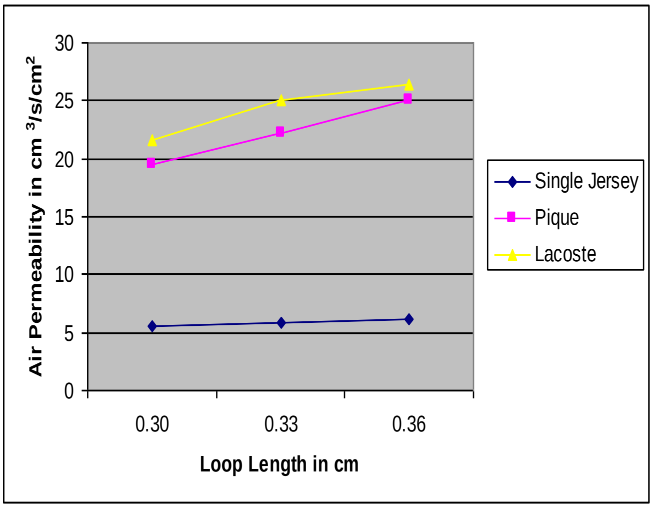

Figure 7 Effect of Tuck Stitch on Air Permeability

Effect of Tuck Stitch on Abrasion Resistance

From the results depicted in Table 8 and Figure 8 all the samples of jersey structure were found with less weight loss and exhibited more resistance against abrasion. It may due to the structural compactness and higher strength of those samples. At the same time pique samples had more weight loss and showed poor abrasion resistance when compared to lacoste. It may be the result of wear and tear of accumulated tuck stitches in these structures. Interestingly, abrasion resistance was found inversely proportional to the increase in loop length for single jersey and pique samples and vice-versa for lacoste.

Table 8 Effect of Tuck Stitch on Abrasion Resistance

Fabric Structure	Loop Length in cm		
	0.30	0.33	0.36
	Weight loss in %		
Single Jersey	0.7	0.8	0.84
Pique	1.27	1.36	1.49
Lacoste	1.06	0.91	0.83

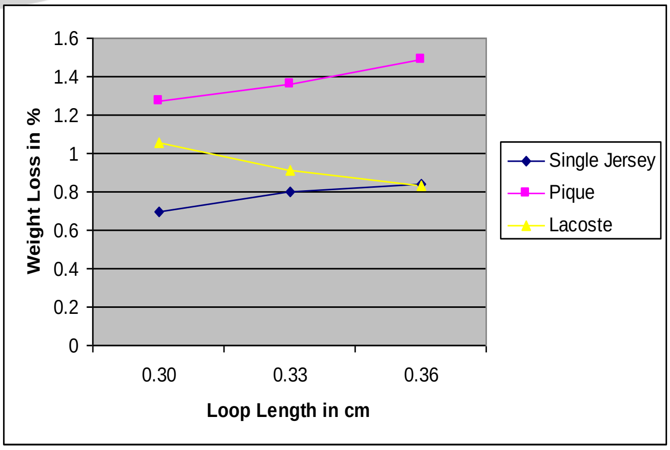

Figure 8 Effect of Tuck Stitch on Abrasion Resistance

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Effect of Tuck Stitch on Pilling

From the results shown in Table 9 and Figure 9, it is observed that pique and lacoste structures were prone to more pills. It may due to the presence of surface protruded tuck stitches changed into pills during rigorous physical agitation. At the same time, jersey samples were seen free from any pilling. But, the nature of pilling in pique and lacoste samples were seen in slightly ascending trend while the increasing of loop length. The reason may be the increase in the structural porosity and the samples knitted with larger sized tuck loops on the fabric surface.

Table 9 Effect of Tuck Stitch on Pilling

Fabric Structure	Loop Length in cm		
	0.30	0.33	0.36
	Grade		
Single Jersey	Nil	Nil	Nil
Pique	5	4	4
Lacoste	5	5	4

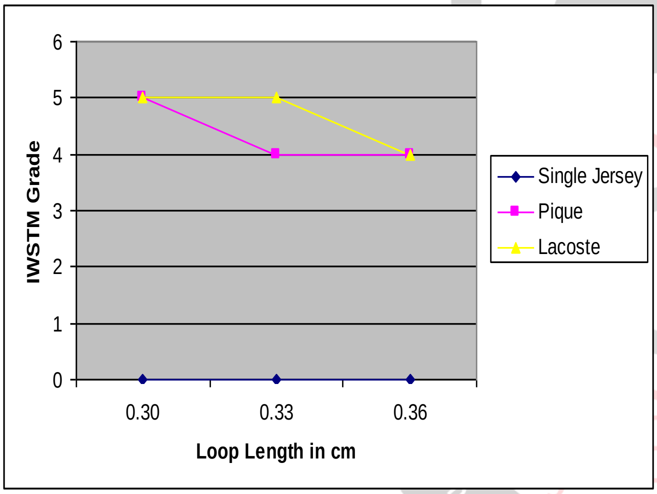

Figure 9 Effect of Tuck Stitch on Pilling

IV. CONCLUSION

The tuck stitches present in every alternate courses of pique fabric and in every course of lacoste fabric caused decrease in their wale density, course density and stitch density.

Lacoste fabric exhibited maximum areal density when compared with pique and jersey. It may due to the continuous accumulation of tuck stitches in every course of lacoste. At the same time, pique was noticed next to lacoste in weight per unit area due to the presence of tuck stitches in every alternate course. Tuck stitches made pique and lacoste fabrics with more thickness, less strong, more air permeable, less abrasion resist and with more pilling effect than single jersey. As a result of the research work, we have arrived to the conclusion that the existences of tuck stitches in the observed single jersey derivative structures caused solid and definite effect in their geometrical and mechanical properties.

REFERENCE

[1] Munden, D. L., The Geometry and Dimensional Properties of Plain Knit Fabrics, J. Textile Inst. (1959),50, T448- 471.

[2] Nutting, T.S., and Leaf, G. A. V., A generalised geometry of weft knitted fabrics. J. Textile Inst., (1968), 55, T45–53.

[3] Russell.M.H, Kullman, Clarence O, Graham, JR George F. Ruppenicker, Air Permeability of Fabrics Made from Unique and Conventional Yarns, Textile Research Journal (1981) ; 51; 781

[4] Peter Schwartz, Trevor Rhodes, Mansour H. Mohamed, Fabric Forming Systems, Noyes Publications, (1982)

[5] Bayazit, A., Dimensional and Physical Properties of various Single Pique fabrics, Knitting Technology, (1999), Vol.58,No.7, pp.423-425.

[6] Saville B.P., Physical Testing of Textiles, Woodhead Publishing Ltd., Cambridge, England, (2002)

[7] Punj, S.K., Mukhopadhyay, A. and Chatterjee, P., Plain Knitted Properties, Textile Asia, 2008, Vol.31, pp. 33-38.

[8] Nergiz Emirhanova, Yasemin Kavusturan, Effect of Knit Structure on the Dimensional and Physical Properties of Winter Outerwear Knitted Fabrics, (2008), Vol.16, No.2(67), pp.69-74

[9] Muhammet Akaydin, Characteristics of fabric knitted with basic knitting structure from combed ring and compact yarn, Indian Journal of Fibre and Textile Research, 2009, Vol.34, pp 26-30

[10] Fatkić E., Geršak J., Ujević D.; Influence of Knitting Parameters on the Mechanical Properties of Plain Jersey Weft Knitted Fabrics. Fibres and Textiles in Eastern Europe 2011, Vol. 19, No. 5 (88) pp. 87-91.

[11] G.Singh, K.Roy, R.Varshaney & A.Goyal, Dimensional Parameters of Single Jersey Cotton Knitted Fabrics, Indian Journal of Fibre and Textile Research, 2011, Vol.36, pp 111-116

 DOI : 10.18231/2454-9150.2018.1416