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DIFFERENT NEEDLE ARRANGEMENT EFFECTS ON BASIC RIB KNITTED FABRIC

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ABSTRACT

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Fabric width in relaxed state is not same to that in machine due to its tension relaxation in yarns of which it is composed. Changes in Loop shape and stitch length also cause the fabric to shrink. In this research, 11 different structures were manufactured by gradually making the gap between needles in the same fabric. The rib fabric became plain fabric at the last structure. This was done by v-bed flat knitting machine with two ply acrylic yarns. Important characteristics like GSM, fabric width and stitch length were investigated for different needle gap structures and compared using regression line. It showed decreasing tendency for all three properties with increasing number of needle gaps. Reason for these tendencies is being discussed in this report.

***Key words**: stitch length, GSM, fabric width, needle arrangement*

INTRODUCTION

The art of knitting has been rapidly progressing in the world. In our country knit sector already holds the highest position if compared with weaving or other small sectors related to textile. Knit RMG is the highest foreign currency earning sector of Bangladesh. The industry is also growing very fast due to strong backward linkage, less capital investment requirement and higher profitable.

A knit fabric is characterized by vertical lines within the cloth which is manufactured by dropping needles from the knitting bed or cylinder. Knitting creates multiple loops of yarn, called stitches, in a line or tube. Knitting has multiple active stitches on the needle at one time. Knitted fabric consists of a number of consecutive rows of intermeshing of loops. As each row progresses, a newly created loop is pulled through one or more loops from the prior row, placed on the gaining needle, and the loops from the prior row are then pulled off the other needle. These needle gap structures have attractive appearance and can be produced easily in Flat Knitting Machine. By dropping needles in any of the front or back needle bed, Gap needle structures are produced. (TECHknitting 2012) (Chowdhury and Haque, 2016) investigated the effect of stitch length, fabric width on basic rib fabric needle drop structures made of acrylic yarn. They observed that for the needle gaps or drops, fabrics behaviors and performance were changed (Chowdhury and Haque, 2016).

In this knitting procedure, for 1x1 Rib with Needle gaps production, raw material like Acrylic yarn was used. It was a two plied yarn in which a Red and a white color yarn were twisted to make the ply. Knitted fabrics produced from Acrylic yarns have wool like feel and basic acrylic rib fabrics with needle gap structures that are made in Flat knitting machines, have attractive appearances. Acrylic yarns have huge applications in knitted garments. This type of acrylic fabrics are used now a day's specially for producing high bulk and warm fabrics. Acrylic fabrics are lightweight, soft, and warm, with a wool-like feel and, therefore, can be made to mimic other fibers, such as cotton and wool or can be blended with them. Acrylic yarn is often perceived as "cheap" because it is usually priced lower than its natural-fiber counterparts and it is less soft, and warm (in wet condition) as wool and cotton. On the other hand, it is machine-washable, hypoallergenic, and extremely colorfast. This makes acrylic useful in certain items, like garments that require constant washing. It has good oil and chemical resistance and outstanding wick ability and drying time. However, it is much more flammable than natural fibers (Polymer Properties Database, 2015).

The GSM of fabric is one kind of specification of fabric which is very important for a textile engineer for understanding and production of fabric. "GSM" means "Gram per square meter" that is the weight of fabric in gram per one square meter. By this we can compare the fabrics in unit area which is heavier and which is lighter. (Kiron 2018) Stitch length is a length of yarn which includes the needle loop and half the sinker loop on either side of it. Generally, the larger the stitch length, the more extensible and lighter the fabric and the poorer the cover, opacity and bursting strength. (David 2001) GSM of a fabric directly depends on the stitch length.

This project work is basically on the analysis of parameter variations due to Needle Gap in basic Rib fabrics produced in V-bed Rib machine. GSM, Stitch length and fabric width which are important properties in case of knitted fabrics production, need to be checked to observe the variations. Needle gaps can make the fabrics to change its behavior and performance. The main objectives of this research are to find out the effects of Needle Gap on GSM, fabric width and stitch length and compare among them with the help of regression lines.

MATERIALS AND METHODS

In order to study fabric properties like GSM, fabric width and stitch length, "Acrylic" yarn of 2 plies was used. Resultant count was calculated by the following formula:

Count of Red Ply Yarn = 94.51 Tex = X_1
Count of White Ply Yarn = 113.47 Tex = X_2
Resultant Count in Direct System = $X_1 + X_2$ = 94.51 + 113.47 = 207.98 Tex
Type of Machine: Manual V-Bed flat knitting machine
Total Needle Bed Length: 40 inches
Total no of needle: In Front Needle Bed- 140 and in Back Needle Bed- 140
No of Feeder: 1, Gauge: 7 pcs. / 2 inches
Yarn Feeding System: Negative

Equipment used:
1. GSM Cutter
2. Measuring Tape
3. HATRA Course Length Tester
4. Electric balance

Methods are done as following:

a) Count measurement

At first the count of used yarn packages were measured. Some yarns were cut which are all of equal length. Weight of yarns and length were measured. Using these values formula was used to determine yarn count.

b) Knitting procedure

At first the yarn was fed from the package through yarn guides, spring tensioner and yarn feeder of V-bed flat knitting machine. Some yarns were placed in the needles for the first feed. It was checked that all cams were selected as knit cam. The carriage was moved from left to right and a course was produced in both front and back bed when all the needles were in action.

Then a single wire and a single comb were inserted on that course. For giving appropriate tension on the fabric in Flat knitting machine, this wire and comb hold the fabric downward as dead weight are hanged with it. The carriage was moved from right to left. By moving carriage from one side to another a plain fabric was produced because all the needles in the back bed were dropped.

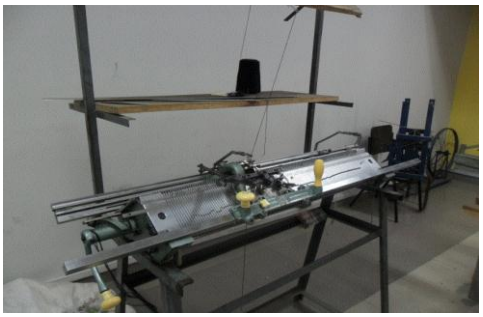

Fig. 1. V-bed Rib Machine

The first knock over of loops was done manually by placing yarns in the needles and tension was provided. After knitting about several strokes of carriage, the machine settings were changed. After every 9 needles in the back bed, 1 needle was raised and the front bed needles were same as previous. Then the carriage was moved and Rib fabric with 1 needle gap was produced. Similarly the number of needle uplifting in the back bed is increased gradually up to 10 needle gap, which became a plain fabric at the end.

c) GSM measurement

Several swatches from each of 11 structures were cut with GSM cutter to calculate average and weights were measured on an electric balance. Then the following formula is used to measure GSM:

GSM = Average weight of cut fabrics (each structure) x 100

d) Fabric width measurement

At first the fabric was relaxed for about 6 hours and after relaxation it was spread out over the inspection table. All 11 structures were separated by cutting with scissor. After that fabric width was measured for same no. of needles by measuring tape and recorded the data in the observation table for each needle gap and knitted structure, About 15 measurements were taken from different places for every structure of each needle gap. Average data had been noted down of finished width of fabric. Thus fabric width was measured.

e) Stitch length measurement

The "HATRA Course Length Tester" was used to measure the course length and stitch length. At first one course was unraveled from a knitted structure and marked by a pen to indicate the start and end of the course. Then it is placed over the pulleys in the HATRA course length tester in which starting end was wrapped with a spring screw and end of yarn was hanged by a dead weight of 10 gm. Then the measurement was taken of course length that is taken at the end of course. The scale was in cm. dividing this value by total no. of needles used in knitting we have got stitch length.

Stitch length= (Course length) / (No. of needles knitting in the machine)

By doing the above procedures for every needle gap structures the stitch lengths were measured and noted. About 15 measurements were taken from different places for every needle gap structures. Average data had been noted down of stitch length of fabrics.

f) Structure clarification

Fabric appearance on face side remained the same from the first structure with no needle gap to 10 needle gap structure. The needle set out and cam arrangement along with notation diagram remained the same for the produced fabrics. (Fig. 2)

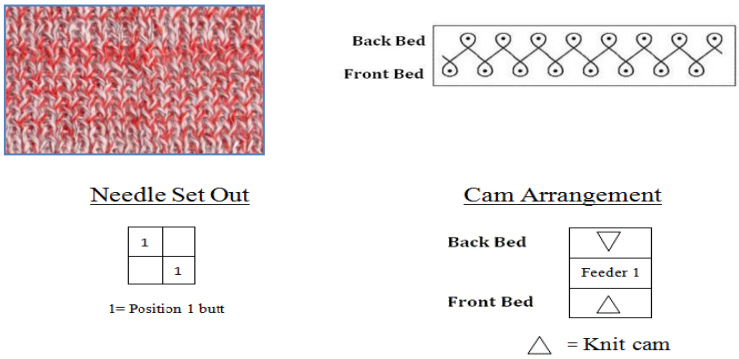

Fig. 2. Face side appearance, needle set out and cam arrangement and notation diagram

RESULTS AND DISCUSSION

a) GSM variation

Table 1. GSM variation with gap of needles

Needle Gap	GSM
0	363
1	358
2	355
3	351
4	348
5	344
6	342
7	338
8	333
9	329
10	321

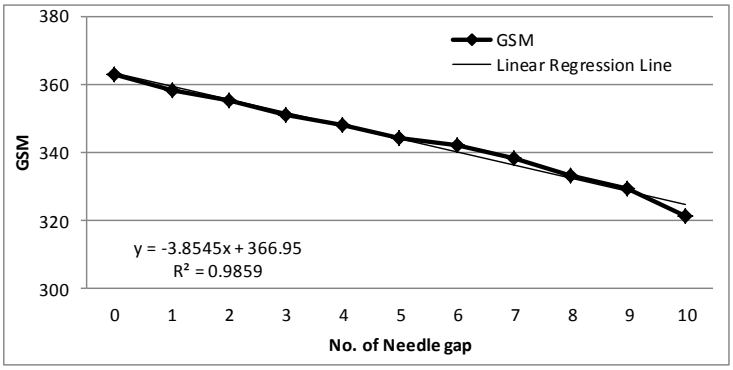

Fig. 3. GSM variation and linear regression for different needle gap structures

The structures had different GSM values because, in every structure, one loop is dropped from back bed of knitting machine. From Table 1 and Figure 3, the tendency with increasing number of needle gaps showed a declining manner. The GSM, with no needle gap structure, was 363. On the other hand, with the last plain fabric, with the highest number of needle gaps, it became 321. It clearly indicated that if the needle gap is increased, the GSM will go down.

Linear Regression line, $y = - 3.8545x + 366.95$
Co-efficient of determination, $R^2 = 0.9859$

Considering the regression line equation and co-efficient of determination, the deviations were not that much. Therefore, it is proved that higher no. of needle gap reduces the GSM.

b) Fabric width variation

The manufactured needle gap structures had different width values. When the fabric was relaxed for 6 hours, the tension was released by the yarns and due to the fabric shrinkage, the widths showed different phenomena for different structures. With increasing no. of Needle gaps, the fabric widths followed a decreasing manner. In case of knitted structures, with less no. of needles for fixed width fabrics production, fabric width decreases. As increasing no. of needle gaps allowed less no. of needles to do the production for the fixed width in machine, so fabrics widths were decreased gradually. Putting the values Figure 4 from Table 2, it is clearly indicated that the width values went down. For the basic rib fabric with no needle gap, the fabric had a width of 48.27 cm. It went down to 30.86 cm for the structure containing highest number of needle gaps.

Table 2. Fabric width variation with gap of needle

Needle Gap	Fabric Width (cm)
0	48.27
1	42.13
2	39.63
3	37.37
4	36.94
5	35.01
6	34.56
7	32.82
8	32.7
9	31.89
10	30.86

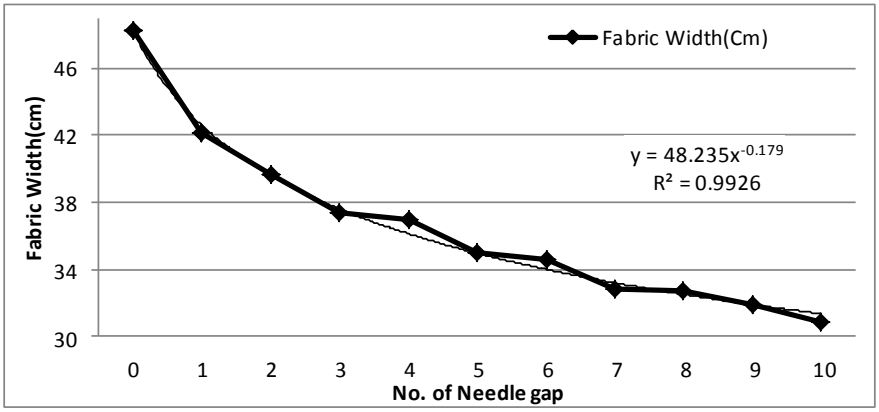

Fig. 4. Fabric width variation and linear regression for different needle gap structures

Power Regression equation, $y = 48.235x - 0.179$
Co-efficient of Determination, $R^2 = 0.9926$

The deviation from regression line indicated that fabric widths followed a slow decrease with higher no. of needle gaps. So, if the gap between needles is gradually increased, the width of the fabric will decrease.

c) Stitch length variation

All the needle drop structures had stitch length variations due to bed to bed loop position change. When loop changed its position from front bed to back bed and back bed to front bed in case of same course of yarn, stitch lengths did not remain the same. Stitch lengths were varied due to robbing back during bed changing. When a

loop was formed in front bed and then that loop was transferred to another needle bed the new loop robbed some yarn from previous loop. This is called robbing back. Due to this reason stitch lengths were not remain same in case of bed to bed loop position changing.

From Figure 5 and Table 3, the structure with no needle gap had stitch length value of 1.41 cm. On the other hand, sample with highest number of needle gaps had lower stitch value of 1.21 cm. It means with the increasing number of needle gap, stitch length goes down.

Table 3. Stitch length variation with gap of needles

Needle Gap	Stitch Length (cm)
0	1.41
1	1.39
2	1.38
3	1.36
4	1.34
5	1.33
6	1.31
7	1.28
8	1.26
9	1.24
10	1.21

Linear Regression Equation, $y = - 0.0195x + 1.4364$
Co-efficient of Determination, $R^2 = 0.989$

From the linear regression line, it is seen that the deviation was not that much. It concludes upon arguments that higher number of needle gaps causes lower stitch length values.

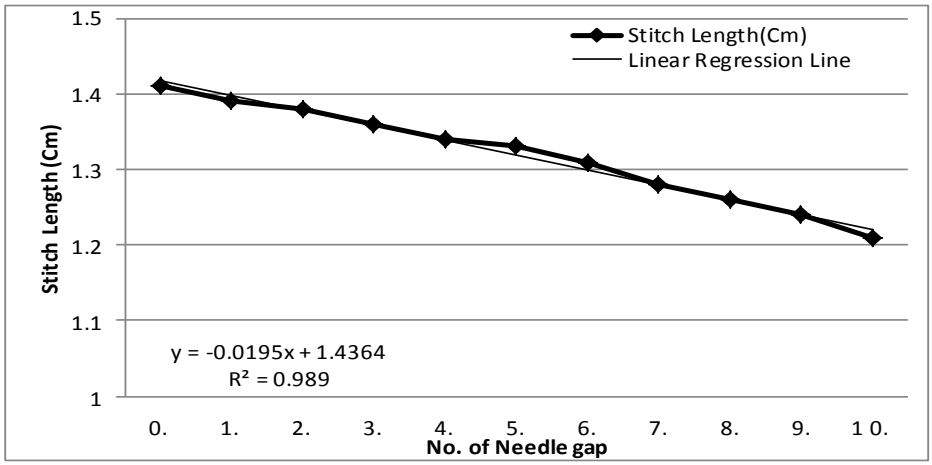

Fig. 5. Stitch length variation and linear regression for different needle gap structures

CONCLUSION

From this research work, it can be decided that, needle gap can prevail GSM, fabric width and stitch length. It has been shown, higher needle gap curtails GSM, fabric width and stitch length from basic Rib fabric. This type of fabric structures have attractive appearances and could be used to manufacture winter warm clothes like: sweater, jumper, hoodies etc. As the fabric width reduces with needle gap, it could be used to manufacture warm tights and ladies tops. So it has various possibilities depending on the consumer demand. Accuracy of the results of this project work is not over question due to having some limitations though it was tried best to overcome all constraints. So a further research work with needle gap structures is recommended.

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