International Journal of Industrial Engineering, 2018;2(4):95-99.
ISSN: 2456-8449.
http://ijie.gjpublications.com

Research Article

Improving Productivity of Double Bed Automatic Flat Knitting Machine by Caston Modification

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Abstract

Different factors can affect productivity and quality of knitted fabric produced on automatic flat knitting machines. For example, yarn input tension, cam setting and take down load can be mentioned. The interaction between these factors and their effect on loop length and the percentage of contribution of variables on final fabric quality and production efficiency is determined. It was observed from the results that the contribution of cast on modification has vital role in fabric quality and productivity improvement. The main aim of this thesis is to illustrate the contribution of caston modification on productivity and quality. From the result obtained from calculation only from cast on modification, the efficiency of the machine increased from 68.75 to 74%. There is 5.25% efficiency increment. Therefore, 3579 courses per day or 1,288,440 courses per year which is about 1044.227 kg more fabric is produced compared to the casting the factories are following now. The research is conducted on cast on modification by replacing waste fabric feeding by direct knitting from the yarn and pulling down the loops formed during first knitting cycle toward the take down roller. It is achieved by using stiff steel wire of about 5 mm in diameter and nylon threads. The metal rod should be removed after certain knitting cycle because it cannot pass between take down rollers without stopping the machine.

Keywords: Canton; Needle bed; Takedown; Waste Fabric Re-feeding.

Introduction

The concept of knitting for converting yarn in to fabric/garment was visualized long back may be about 3000 years ago and the same was implemented by some curious and innovative minds using two sticks or needles. Such technique is of course known as hand knitting but there is no record of the name of the inventor of knitting. Hand knitting is a slow process and still in practice. Knitting is the second widely used method of fabric manufacturing next to weaving. It is a technique for producing a two-dimensional fabric made from a one-dimensional yarn or thread. Knitting is the method of creating fabric by transforming continuous strands of yarn into series of interloping loops, each row of such loops hanging from the one immediately preceding it. The basic element of a knit fabric structure is the loop intermeshed with the loops adjacent to it on both sides and above and below it. Knitted fabrics are divided into two main groups, weft and warp knitted fabrics. Weft knitted fabrics can be produced in circular or flat knitting machine. The primary knitting elements are needle, cam and sinker. With the variation of the elements different characteristics of fabrics can be produced. The rising demands on knitted garments all over the world motivate the researchers to research about the various knitted fabrics, their production processes, developing new structures. Knitting machine comprise a needle holder that supports a plurality of needles, which are arranged side by side and can be actuated with an alternating motion along their axis with respect to the needle holder in order to form knitting. Flat knitting machine is first developed and were used for glove knitting and after 1962 it started knitting flat and tubular fabric. The latest version automatic double bed flat knitting machines can knit fully fashioned seamless garments [1].

The introduction of stitching motion and related mechanisms driven by electronic system in the knitting machines has given much rise in

Received: 11.04.2018; Received after Revision: 24.04.2018; Accepted: 25.04.2018; Published: 29.04.2018

their freedom to create versatile fabric structures, and in their productivity. Knitted fabrics not only possess stretch and provide freedom of movement, but they also have good handle and easily transmit vapor from the body. Knitted fabrics are also noted for their freedom of body movement in form fitting garments (due to inherent stretch), ease of care, resilience, soft draping qualities, good air porosity and relatively low cost of simple fabrics. All those machine parts are responsible to increase or decrease the productivity of knit fabric production. Due to the problem of machine parts, machine has to shut down for certain period. For this it reduced productivity overall loss of efficiency of the machine. In addition, the knitting machine has to stop when defects occurred and then faults are corrected, which results in time loss and efficiency loss. An effective monitoring is required to avoid defects and to avoid productivity and quality losses [2-5]. Factors for knitting machine stoppages: There are basically three factors which are responsible for optimum fabric production. They are (a) Yarn characteristics includes tenacity and breaking extension, elasticity and friction of yarn. Tenacity is expressed as specific stress at rupture. It is usually expressed in cN/tex (for staple fiber yarn) and in cN/dtex (for filament yarns) (b) Machine quality requirements such as long lasting and trouble free quality functioning of the knitting machine could be possible by proper maintenance care and lubrication. Proper horizontal installation of the machine, tension free yarn feeding, flawless yarn guides and needles, exact centering of needle bed towards one another, proper fabric take-off and proper lubrication are the basic quality needs of a knitting machine (c) Knitting production conditions such as (i) Suitable yarn count: Selection of suitable yarn count should be based on machine gauge, machine types and knitting structures. The relation between yarn count and machine gauge, Yarn Tex= $(100/G)^2$, where G is the machine gauge. (ii) Machine setting: Optimum setting is based on yarn type and knitted structure. For this balanced yarn tension prior and after to feeder is maintained. Lower fabric take up tension is also observed in machine setting. Finally proper needle timings of dial and cylinder needles in order to obtain loose or tight structure. (iii) Yarn storage: For the yarns to have sufficient moisture for knitting, they should be stored at 20°C and 65%RH. Storage under extreme temperatures must be avoided. Higher temperature leads to paraffin migration and lower temperature leads to water condensation. (iii) Air conditioning: Air conditioning of knitting plant prevents yarn dry up, reduces yarn breaks and improves the surface structure of fabric. The recommended conditioning is 55%+10%RH and 25°C+ 3°C temperature [6-8].

Materials and methods

Material and equipments

To accomplish this project the machine manual and different literature written on flat knitting were used as references. The data required for this project were collected primarily from work station. Material listed in Fig. 1 and Fig. 2 are used to this accomplish this research.

i. Measuring tapes
ii. Thin metal rods (5 mm in diameter 1 m in length)
iii. Nylon chords
iv. Yarn packages (30 - 34Ne)
v. Knitting machine

Fig. 1. Materials and equipments used

Fig. 2. Shima Seiki SFF 152 Flat knitting machine

Method

The project is conducted on automatic double bed flat knitting machine in the case of Ethiopian textile Industry development Institute (ETIDI) of Model SFF 152 as shown in Fig. 2. The research was conducted on cast on modification by replacing waste fabric feeding by direct knitting from the yarn and pulling down the loops formed during first knitting cycle toward the take down roller as it is shown on Fig. 3 and Fig. 4. It is achieved by using stiff steel wire of about 5 mm in diameter and nylon threads as observed in Fig. 1. The metal rod should be removed after certain knitting cycle because it cannot pass between take down rollers without stopping the machine.

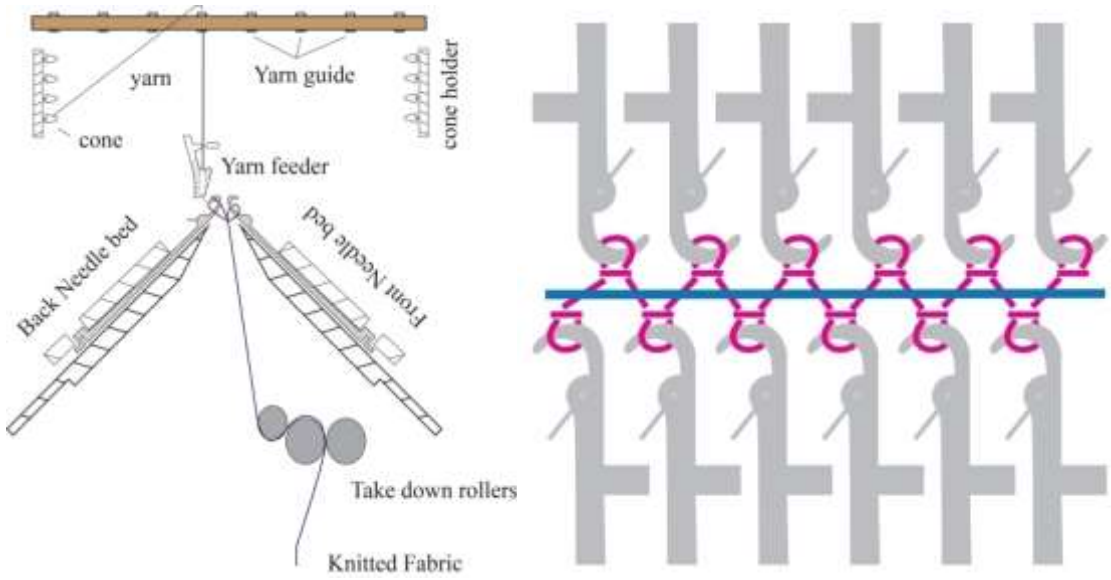

Fig. 3. Yarn feeding and takedown mechanism on automatic flat knitting machine

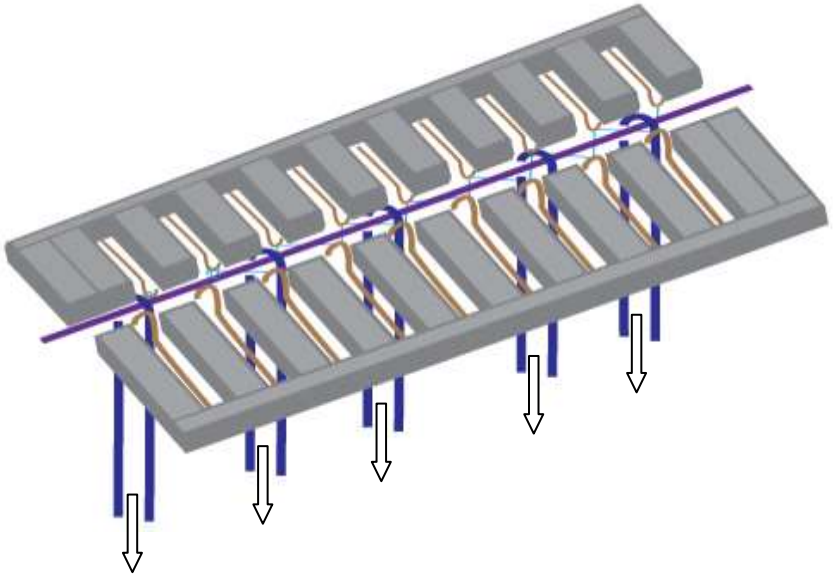

Fig. 3. Illustration of new loop pulling down mechanism

Results and discussion

Productivity and quality are the main issue in textile industry because the profit is directly related to them. Different factors can affect productivity and quality of knitted fabric produced on automatic knitting machines. The main are power failure, maintenance, new design preparation, lubrication, and caston. The main aim of this thesis is to illustrate the contribution of caston modification on productivity and quality. The results were obtained first by taking machine information from Shima Seiki machine and the required parameters were calculated.

Shima Seiki machine information

Machine revolution per minute (RPM) = 20
Machine speed = 1.2 m/s
Machine width = 152 cm (60 inch)

Gauge = 12
Total idle time per shift 2.5 hr
Machine stopped time due to caston = 30 min
Time for caston after modification = 5 min
Course per centimetre (cpc) = 17
Loop length = 4.7 mm
Wales per centimetre (wpc) = number of needles/fabric width = 1440/152 = $9.5 \approx 10$

$$efficiency\ \ before\ \mathrm{mod}ification = \frac{8-2.5}{8} * 100\% = 68.75\%$$

$$efficiency\ \ after\ caston\ Modification = \frac{8-2.08333}{8} * 100\% = 74\%$$

$$Number\ of\ needle = gauge * width$$

$$= 12 * 60 = 720\ needles(one\ bed\ needles)$$

$$for\ the\ two\ \ beds = 1440\ needles$$

$$From\ \ speed\ \ formula$$

$$speed(V) = \frac{machineWidth}{Time}$$

$$so, 1.2m/s = \frac{1.52m}{t}$$

$$\Rightarrow t = \frac{1.52m}{1.2m/s} = 1.267\,\mathrm{sec}onds.$$

$$therefore\ it\ takes\ 1.267s\ to\ complete\ one\ knitting\ \ traverse$$

$$From\ this, total\ \ number\ of\ \ courses\ \ per\ shift\ will\ be$$

$$No.courses = \frac{total\ time\ *\ efficiency}{time\ \ to\ complete\ \ one\ \ traverse}$$

$$= \frac{28800\ *\ 0.6875}{1.267}$$

$$= 15,627\ courses$$

$$After\ caston\ \ Modification\ = \frac{28800\ *0.74}{1.267}$$

$$= 16,820\ courses$$

The difference is 16,820 - 15, 627 = 1193. Therefore, by modification on caston we can produce 1193 * 3 = 3579 courses per day. In one full course since the total number of stitches are equal to the total number of needles, the productivity is improved by 3579 * 1440 = 5,153,760 stitches per day.

Length of yarns converted into fabrics per day = Total number of stitches produced per day * loop length.

= 5,153,760 * 0.0047 m
= 24,222.672 m

Since the fabric is produced from four plied yarns of 20Ne yarn count, the total length of yarns converted into fabric is 24,222.672 * 4 = 96,890.688 m (105,960.944 yards)

$$wight\ of\ \ fabric\ produced\ per\ day in\ pounds = \frac{length\ of\ \ yarns\ converted\ \ \mathrm{int}o\ fabric\ \ per\ day in\ yards}{840 * yarn\,count\ Ne}$$

$$= \frac{105,960.944\,yd}{840 * 20Ne}$$

$$= 6.307\ pounds(2.860Kg)$$

Therefore, the production in kilogram per year is equal to 1044.277 kg. From the result obtained from calculation only from caston modification the efficiency of the machine increased from 68.75% to 74%. There is 5.25% efficiency increment. Therefore, 3579 courses per day or 1,288,440 courses per year. Since total number of stitches produced in one full course is equal to the total number of needles in the two beds, the total stitches increment is 3579 * 1440 = 5,153,760 extra stitches are produced per day. The product of total number of stitches and loop length, yarn consumption, 24,222.672 meters per day. Since the collar is produced by four plied yarns of 20Ne count total yarn consumption is about 96,890.688 meters per day. Weight of yarns converted to fabric is 6.307 pounds (2.860 Kg) per day after caston modification which is about 1044.227 kg per year.

Conclusions

The effects of different parameters on loop formation and productivity of V- bed flat knitting machine have been studied and is initiated with experiments designed by considering three knitting process variables: Yarn input tension, Cam setting and Take down load. The interaction between these factors and their effect on loop length and the percentage of contribution of variables on final loop length is determined. But the effect of caston on productivity and quality is not taken into consideration by scholars. Caston modification has its own contribution for productivity and quality improvement for automatic flat knitting machine owners. The down time of machine due to caston is reduced by 25 min after caston modification. From the result obtained the efficiency of the machine increased from 68.75% to 74%. There is 5.25% efficiency increment, and major defects are minimized by total number of 55. The occurrence holes at the start of knitting commencement is totally avoided which contribute for quality. In addition to these the force applied on the needles is reduced so that the service life of needles is improved.

Acknowledgement

First of all thanks to God for giving me chance to step forward in my profession and I also wish to express my sincere appreciation for all those individuals and organizations. I have especial thanks to Mr. Degu Betaw and Mr. Gizaw Gutema of Ethiopian Textile Industry Development Institute (ETIDI) for your kind cooperation during my libratory work. Lastly, thanks to those who have directly or indirectly contributed towards the completion of this thesis.

Conflicts of interest

Authors declare no conflict of interest.

References

[1] Pranjali C, Madhuri VK, Chitra P. 2017, Minimization of defects in knitted fabric. International Journal on Textile Engineering and Processes. 2016;2(3):12-8.

[2] Catarino AP, Rocha AM, Monteiro JL, Soares F. A System for knitting process monitoring and fault detection on weft circular knitting machines. World Textile Conference – 4th AUTEX Conference. Roubaix; 22-24 June 2004.

[3] Solaiman M, Khalil E, Rahman M, Sarkar J. Efficiency Losses Calculation and Identify Causes of Losses of Circular Knitting Machine during Knit Fabric Production. Manufacturing Science and Technology. 2014;2(5):93-6.

[4] SES122FF/124FF. The reference standards in computerized flatbed knitting. Shima Seiki Mfg. Ltd. 85 Sakata Wakayama, Japan.

[5] Taher MA, Rahman MM, Jahangir MA, Mia MS, Ashaduzzaman. Study on Different Types of Knitting Faults, Causes and Remedies of Knit Fabrics. International Journal of Textile Science. 2016;5(6):119-31.

[6] Reza MH, Hossain MK. A study on causes of knitting machine stoppages and their impact on fabric production. European Scientific Journal, 2015;11:262-69.

[7] Hossain AKMM, Moin CJ, Mahabubuzzaman AKM. Determining the most frequent defects for circular weft knitting Fabric machines: A case study. J Innov Dev Strategy 2017;5(2):10-7.

[8] Catarino A, Rocha A, Monteiro JL, Soares F. Techniques for Unveiling Faults During Knitting Production. Proceedings of IEEE International Symposium on Industrial Electronics. 4-7 May 2004. Ajaccio, France: 2004;89-94.

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