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Efficiency Losses Calculation and Identify Causes of Losses of Circular Knitting Machine during Knit Fabric Production

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Abstract This thesis deals with a major problem of production loss of a knitting industry. The knitting machine has to stop when defects occurred and then faults are corrected, which results in time loss and efficiency loss. Not only that the knitted fabric may be rejected if quality requirements are not met. An effective monitoring is required to avoid defects and to avoid productivity and quality losses. The study identifies two main categories of defects (average time required for correcting defects and machine down time) are responsible for reducing productivity. The thesis reflects that due to yarn breakage machine stopped for seen minutes per days, for maintaining machine stopped for two hours per month, for needle breakage six minutes per day and for technical problem machine stopped for several times.

Keywords Machine Diameter, Yarn Count, Machine Speed, Machine Gauge, Stitch Length

1. Introduction

Knitted fabric can be classified into two categories, namely weft knitted fabric and warp knitted fabric. In weft knitting a yarn presented horizontally is kinked into a row of loops. To achieve these needles can be moved simultaneously and the loops formed one after the other or at the same time or the needles are moved successively to form the loops [1]. Warp knitted fabric is composed of knitted loops in which warp threads forming the loops travel in warp-wise direction down the length of fabric. Weft knitted fabrics can be conventionally divided into flat knitted fabric which is made by a machine having straight needle bed, and circular knitted fabric which is made by a machine having the needle set in one or more circular beds. The introduction of stitching motion and related mechanisms driven by electronic system in these knitting machines has given much rise in their freedom to create versatile fabric structures, and in their productivity. For example, garment-length fabrics have become applicable to seamless women's innerwear, which can be produced by making an active use of the freedom in changing the stitch density and the number of stitch during operation [4].The demand for knit garment products all over the world are rapidly growing because of more interest in knitted fabrics due to its simple production technique, low cost, high levels of clothing comfort and wide product range. Knitting technology meets the rapidly-changing demands of fashion and usage. Knitted fabrics not only possess stretch and provide freedom of movement, but they also have good handle and easily transmit vapor from the body [1].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. Various types of knitted garments are produced in Bangladesh such as polo pique, single lacoste, double lacoste, rib and interlock fabrics. To produce knitted garments circular knitting machine-bed knitting machine are commonly used. A knitting machine contains different types of machine parts such as needles, cams, sinkers, Fabric take-down mechanism, creel, a yarn metering and storage device, yarn breakage indicator, feeders and lubricator.[2] 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.

Efficiency is used with the specific purpose of relaying the capability of a specific application of effort to produce a specific outcome effectively with a minimum amount or quantity of waste, expense, or unnecessary effort [5]. If outcome is greater than the input materials in this case machine is considered highly efficient. The efficiency of a machine depends on many factors such as machine speed, input materials quality, Routine maintenance, skilled machine's operator, auto spacing and oiling, power failure etc. A factory profit and loss depends on the efficiency of the

machine.

2. Materials and Methods

2.1. Materials

Single jersey and double jersey knitting machine were selected. The target sample was single jersey and 1*1 rib fabric. For calculate machine stoppage time a stop watch is used. For calculate the calculated production stitch length, machine rpm, number of feeders, number of needles, machine gauge (needles per inch) and yarn count were identified.

2.2. Methods

2.2.1. Stitch Length Measurement Process

In industry stitch length was measured manually. At first a stitch was identified and it was marked by red color. Considering its and it was marked by red color. Considering its base stitch, count hundred stitch and last stitch is marked by red color. Then the course was unroving from the fabric and its length was measured by a measuring scale. Finally the length was divided by hundred and this dividing result indicate the stitch length.

2.2.2. Number of Needles Calculation

For identifying number of needles at first identifying machine diameter by a measuring scales. Count the number of needles per inch. After multiplying Pi (π), no of needles and machine gauge, we found the number of needles.

2.2.3. Yarn Count Determination

Yarn count is determined by the Begley's balance. At first a one lea that means one twenty yards yarn was taken by Beasley's balance. Then by electric balance the weight of the sample was taken. Then by the following formula, yarn count is determined. Ne= L* w/l*L here, Ne= English count, w= Unit weight of the sample in pound, l= unit length of the sample in yard, L= Length of the sample in yard W=Weight of the sample in pound.

2.2.4. Time Determination Method

A stop watch was used for determine the time. When a problem was occurred on that time stop watch was on until the problem was recovered. This will determine stoppage time of machine and repairing time of the problem.

2.2.5. No. of Feeder Calculation

Actual Number of feeders was calculated by counting the number of feeders in the machine. In theoretically numbers of feeders are calculated by multiplying machine diameter by three.

3. Results and Discussion

3.1. Efficiency Loss Calculation

To do the study two types of knitting machine were selected. One was single jersey machine and another was double jersey machine. Single jersey machine specification is mentioned below:

Table 1. Machine Specification for Single Jersey Fabric

Machine Name	Fukahama
Machine Model	Taiwam
Machine dia and gauge	30× 24
Count	28
Stitch length	2.8mm
Efficiency	85%
No. of feeders	90
Machine rpm	30
Finished GSM	160

From the above data calculate the calculated production per single jersey m/c per day. For calculated production the following formula is used.

Production/hour=(No of Needle ×No of Feeder ×Stitch Length(mm) ×Efficiency ×RPM ×60)/(10×2.54×36×840 ×Count ×2.2046)

= (π×D×G×No of Feeder ×Stitch Length(mm) ×Efficiency ×RPM ×60)/(10×2.54 ×36×840 ×Count ×2.2046)

= (3.1416×30×24×90×2.80 ×.85 ×30 ×60)/(10×2.54×36 ×840 ×28 ×2.2046)

=18.37 kg⁄hour

=440.88 kg⁄day

The calculated production per day per Single jersey machine is 440.88 kg. But in factory actual production was found 300 kg⁄day during running the machine.

So efficiency in Circular Knitting Machine =300/440.88 × 100= 68.04 %. So, efficiency loss of Single jersey machine is = (100- 68.04) %=31.96 %

Table 2. Machine Specification for double Jersey Fabric

Machine Name	Terrot
Machine Model	Germany
Machine Dia × Gauge	30 × 18
Count	24
Stitch Length	2.6 mm
Number of Feeder	90
Efficiency	85%
RPM	25
Finish GSM	210

From the above data we can calculate the calculated production kg⁄day during running the machine. For calculated production the following formula is used.

Production=(No of Needle× No of Feeder ×Stitch Length(mm) ×Efficiency ×RPM ×60)/(2×10×2.54×36×840 ×Count ×2.204

=(π×D×G×No of Feeder ×Stitch Length(mm) ×Efficiency ×RPM×60)/(2×10×2.54×36×840×Count×2.2046)

=(3.1416×30×18×90×2.60 ×.85 ×25 ×60)/(2×10×2.54×36 ×840 ×28 ×2.2046)

=6.227 kg⁄hour

=149.45 kg⁄day

So efficiency in Circular Knitting Machine =110/149.45 × 100= 73.60%. So, efficiency loss of double jersey machine is = (100- 73.60) % =26.4 %. From the above calculation it is found that efficiency loss of single jersey m/c is 31.96 % and double jersey machine is 26.4 %.

3.2. Causes of Efficiency Loss and Machine Stoppage Time

Many causes are responsible for losses of machine efficiency. The following causes were the main reasons for reducing the productivity of the machine. Average time of machine stoppage and causes of machine stoppage are given following table.

3.3. Discussion

Today Textiles and Garments sectors are facing many problems such as workers unrest, Collapse garments building, prize increasing of raw materials, quality issues, suspend of GSP facilities etc. Workers also demand to increase their salary. Buyers are moving our neighboring countries. So our textiles and garments factories are now facing in order crisis. At this time if productivity is not increased than factories owner will be discoursed to continue their business. To increase the productivity machine efficiency has to increase and machine down time have to reduce. Regular maintenance is a necessary for quality production. It is also necessary to ensure machine lifetime and also to produce quality product with fewer breakdowns. To reduce machine breakdown motorized screw drivers can be used to remove the screws and nuts from the cam box and some tools can be used to hold the sinker and needle together. It may reduce the time required for maintenance and increase productivity.

4. Conclusions

From the above analysis and calculation it is found that 40 hours per month are wastage due to machine stoppage. If we calculate the production in kg, this is about 734.80 kg⁄month for single jersey fabric and 249.08 kg⁄month for double jersey fabric. In economic point of view this is a huge loss for an industry. By increasing m/c speed, production can be increased to overcome the loss but it has to make sure that excess tension is not imposed on yarn. Production is also related to the number of feeders and machine gauge .If the number of feeders and machine gauges are increased then production can be increased. Excess machine stoppage can be eliminate by applying yarn supply through plastic tube that eliminates the possibilities of damage, using yarn feed control device and using auto lints removal.

Table 3. Machine Specification for double Jersey Fabric

Serial No	Reasons for Stoppage	Mean Time of machine stoppage
1	Needle breakage	7 minutes/day
2	Program change	2 hours(two times in a month)
3	Star mark	7 minutes/day
4	Hole mark	5 minutes/day
5	Sinker mark	5 minute/day
6	Needle mark	6 minutes/day
7	Maintenance(three person)	1.5 hours per month
8	Hole mark	5 minutes/day
9	RPM,Oil & Belt check	6 minutes/day
10	Power failure	12 minutes/day
11	Yarn Breakage	7 minutes/day
12	Fabric Handling	15 minutes/day

REFERENCES

[1] Iyer, Mammel, Schach "Circular Knitting", second edition, 1995.

[2] D. J. Spencer, "Knitting Technology", third edition, Woodhead Publishing Ltd., April 2001.

[3] A. R. Horrocks, S.C. Anand, "Hand book of Technical textiles," Woodhead publishing Ltd, pp. 105, Oct 2000

[4] H. Hashi, J Text Machinery Soc, 52 (1999) 459

[5] http://en.wikipedia.org/wiki/Efficiency.

[6] R. E. Walpole, R. H. Myers, S. L. Myers, K. Ye, "Probability & Statistics for Engineers & Scientists-eighth edition," Pearson Education International