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Analysis of Production Loss and Way to Increase Productivity in a Particular Knitting Floor

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Abstract This research recommends a way to improve the productivity of a particular knitting floor. A knitting floor might be standstill due to various reasons that should resolve problems before and on the time of its arising immediately unless factory would get huge loss for that. In this research, production data of five days for 20 different types of the knit machine were recorded and compared with the target production. Most of the cases, the production efficiency were found around 10-30% lower than the targeted one since no mentioned steps have been implemented then. Surprisingly, when the mentioned steps have been implemented steps by steps, factory has started to receive around 80-90% efficiency on target production and a 10-30% extra production than the regular production. The best production rate has been observed when machine has faced less no. of program changed and better quality of yarn is supplied. Besides, knitting floor environment, relief from pressure and tension upon the machine operator also plays a very significant role here.

Keywords Knit fabric, Knit machine, Productivity, Efficiency, Necessary steps

1. Introduction

1.1. Introduction

The knit fabric is considered as one of the most popular, comfortable and largest readymade ware sector throughout the world. A continuous length of yarn is converted into vertically intermeshed loops by machine in knitted by using needle, sinker and thread [1]. Although knit fabrics are of two types basically; i) warp knit and ii) weft knit, the demand of weft knit fabric is increasing day by day because of its higher production rate, lower cost, higher quality of the fabric and easy machinery and design instalment [2]. A wide range of weft knitted fabric structure has been possible to produce with circular knitting machine after some changes such as the following four types; a) single jersey, b) rib, c) interlock and d) purl. Among the mentioned types of knit structure, purl structure has been declining day by day for its complexity and higher production cost. On the other hand, the popularity of other fabric types is increasing significantly for its structure varieties and lower production cost [3]. Due to air permeability and stretchable, knitted fabrics takes less time than woven items. Additionally, knitted fabrics have a wide range of garments versatility from hosiery, formalwear and casual wear, sleeping wear, leisurewear, underwear, sweaters, slacks, sportswear, and other home furnishings [4-5].

The production rate and efficiency of the weft knitting machine depend largely on the knitting parameters, yarn quality and the skills of the operators. The knitting parameters includes gauge, needle type, cam-type, yarn feeding system, number of feeders, takedown system, cloth rolling or spreading, monitoring, control systems, stitch length, tension of feeding yarn, no. of knit program and rpm of the machine, maintenance and servicing of the machines. Moreover, the types of yarn (card/comb) and the count of yarn influence per day production. Besides, the mental pressure and the performance rate of the machine operators play a vital role also [4,6]. Poor maintenance of machinery and fabric handling also causes serious reason for production loss. That's why actual production always recorded as lower than the calculated production [6]. During production of knit fabrics, a wide range of faults arises and kill the productive time, as a result, production hampered.

Due to that negative impact, several measures are present right now to minimize the loss; for example, checking needles, sinkers and cam; surveillance systems of faults detection implemented; uses of vision and optical devices for inspection has increased. Therefore, an established lean system has been introduced to resolve those problems and consequently productivity has been increased [7].

The objective of this research is to improve the productivity of a knitting floor by implementing all those factors responsible for production loss. Special training, categorizing knitting floor according to the capacity and

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types of production, strong monitoring along with the mentoring and ensuring the proper uses of the capacities can improve the production of a knitting floor.

1.2. Objectives

i) To analyze the regular production of the knitting floor of 5 days
ii) To analyze the productivity of the knitting floor of 5 days after implementation of necessary steps
iii) To compare the impact of changes on the efficiency of the knitting productivity

2. Materials and Methods

2.1. Materials

This research has been carried out at Fakir Knit Apparels Ltd, Narayongonj, Bangladesh. A specific knitting floor was brought into consideration. The survey and records of data have been conducted by analysing 20 different knitting machines for specific types of production of knit fabric. Each individual machine has been given a production target on the basis of the constant machine diameter and gauge; types and count of yarn count and RPM. For target calculation, the following formula has been considered and calculated.

Production/ day (22 hour) in kg at 100% efficiency (Target Production)

$$= \frac{\pi\ dg \times No.of\ feeder \times S.L. \times RPM \times 60 \times 22}{10 \times 2.54 \times 36 \times 840 \times Count \times 2.2046}$$

2.2. Machine Analysis

Table 1. Knitting machine parameters analysis

M/C no.	M/C diameter × gauge	Yarn Count	Fabric Types	Stitch Length Mm	RPM of M/C	Target Production, kg (22 hours)
1.	32 × 24	34 +20D Lycra	L/S/ Jersey	2.90	20	308
2.	30 × 24	34+20D Lycra	L/S/ Jersey	2.90	20	308
3.	38 × 24	30+40D Lycra	L/S/ Jersey	3 .10	20	534
4.	38 × 24	30+40D Lycra	L/S/ Jersey	3 .10	20	534
5.	38 × 18	34	1 × 1 Rib	2.55	18	344
6.	38 × 18	30+20D Lycra	1 × 1 Ly Rib	2.80	18	428
7.	32 × 18	24+70D Lycra	2 × 1 Ly Rib	2.90	19	276
8.	36 × 18	28+70D Lycra	2 × 1 Ly Rib	2.85	20	310
9.	38 × 24	40	Inter lock	1.50	18	217
10.	38 × 24	40	Inter lock	1.50	18	217
11.	34 × 24	34	Inter lock	1.65	20	264
12.	34 × 24	34	Inter lock	1.65	20	264
13.	36 × 20	34+16+75D	Fleece	4.7+1.8+3.25	20	349
14.	36 × 20	30+14+75D	Fleece	4.8+1.8+3.35	20	387
15.	34 × 20	34+16+75D	Fleece	4.7+1.8+3.25	20	366
16.	34 × 20	34+16+75D	Fleece	4.7+1.8+3.25	20	366
17.	32 × 24	30 +40D Lycra	L/Terry Fleece	3.10+1.30	20	265
18.	32 × 24	30 +40D Lycra	L/Terry Fleece	3.10+1.30	20	265
19.	32 × 24	30 +40D Lycra	L/Terry Fleece	3.10+1.30	20	265
20.	32 × 24	30 +40D Lycra	L/Terry Fleece	3.10+1.30	20	265

2.3. Methods of Data Calculation

For collection and calculation of data, there are three consecutive steps has been taken for each individual machine that has been considered as a test machine.

i) Target production calculated according to the formula
ii) Actual production has been recorded as data of five (5) days before implementing necessary steps
iii) Actual production has been recorded as data of five (5) days after implementing necessary steps

2.4. Steps have been Taken

After collecting the production data of 5 days, the following steps have been taken to higher productivity. After ensuring such steps, second phase data has been recorded.

i) Reduced no. of program

In a knitting floor, the knit program has been changed according to the quantity of the order or program has been given to a specific machine. That's why the machine gets standstill after completion of the program for sometimes. In this research, it has been ensured that unnecessary short program will not provide to run during the analysis.

ii) Ensured good quality knitting yarn

For data of 5 days before implementation, the factory was used to carded yarn for knit the program. However, combed yarn was supplied during the data collection of 5 days after that.

iii) Servicing of the knit machine

After collecting prior data of 5 days every knit machine were brought into under servicing before going to the second phase of analysis.

iv) Overhead removed from the employee

During the second phase of analysis, each operator of the machine was freed from any excessive pressure and load to them.

v) Motivation and Training

Operators were motivated and trained to develop the productivity of the machine.

vi) Supply of roll marking label

A label of roll marking has been given to the operator so that they do not have to stop machine during roll marking.

vii) Removal of loose yarn

Loose yarn causes tensioning problems. So, such types of yarn were avoided.

viii) Environment of the floor

It has been ensured to be free from any unnecessary yarns, sacks, fabric rolls etc. from the knitting floor. As a result, the floor environment was good enough to keep more concentration on production.

3. Results and Discussion

3.1. Determination of Production Efficiency of Jersey Machine

The below table 2 has shown the production of 4 Jersey machine before implementing any steps where Ly S/J fabric was produced. Besides, table 3 has shown the knitting machine data after mentioned steps have been implemented.

Table 2. Production data of Lycra Single Jersey fabric (Before implementation)

Parameters	M/c 01	M/c 02	M/c 03	M/c 04
No. of Program	4	3	4	3
Target per day, kg	308	308	534	534
Day-1, kg	242	290	486	377*
Day-2, kg	292	245	434	466
Day-3, kg	235*	224*	476	472
Day-4, kg	279	282	338*	448
Day-5	237*	236*	423	453
Average Production, kg (5 days)	257	255	431	443
Efficiency (%)	83.4%	82.8%	80.7%	83.0%
Remarks	L/S/J	L/S/J	L/S/J	L/S/J

* Program changed

Table 3. Production data of Lycra Single Jersey fabric (After implementation)

Parameters	M/c 01	M/c 02	M/c 03	M/c 04
No. of Program	2	2	1	1
Target per day, kg	308	308	534	534
Day-1, kg	264**	288	492	473
Day-2, kg	317	242*	434**	472
Day-3, kg	253*	234**	506	386**
Day-4, kg	283	295	512	476
Day-5	270	292	498	489
Average Production, kg (5 days)	278	270	488	459
Efficiency (%)	90.2%	87.7%	91.4%	86 %
Remarks	L/S/J	L/S/J	L/S/J	L/S/J

*Program changed, **Lycra Changed

From the above two data table 2 and 3, the following graph 1 can be plotted. The graph has shown higher production efficiency after implementing the necessary steps that have been taken into considerations than conventional. It is found around 13-20% lower production efficiency when knitting floor was running as usual. Experimentally, the mentioned steps have been increased production efficiency by a great number (4-10%), more specifically, 105 kg, 75 kg, 285 kg and 80 kg Lycra Single Jersey fabric production increased for machine 1, machine 2, machine 3 and machine 4 respectively after 5 days at that particular knitting floor. So, it can be decided that the production of Lycra Single Jersey fabric has upward inclination i.e. higher production efficiency after implementing the necessary steps.

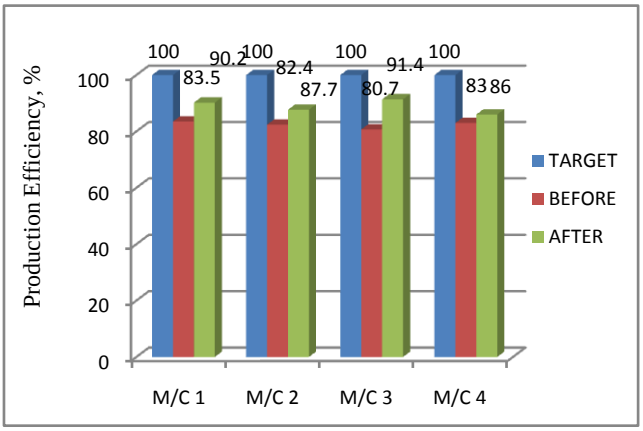

Figure 1. Efficiency analysis of the Lycra Single Jersey fabric

3.2. Determination of Production Efficiency of Double Jersey Machine (Rib)

The below table 4 has shown the productivity before implementing any steps of 4 Rib machine where different types of Rib fabric were produced. Besides, table 5 has shown the knitting machine data after mentioned steps have been implemented.

Table 4. Production data of Rib fabric (Before implementation)

Parameters	M/c 05	M/c 06	M/c 07	M/c 08
No. of Program	4	3	4	2
Target per day, kg	344	428	276	310
Day-1, kg	241	320	225	202*
Day-2, kg	253*	266*	196*	255
Day-3, kg	235*	325	185*	241
Day-4, kg	279	317	201*	248
Day-5, kg	237*	277*	218*	244
Average Production, kg (5 days)	249	301	205	238
Efficiency (%)	72.4%	70.3%	74.3%	76.8%
Remarks	1x1 Rib	1x1 L/Rib	2x1 HF L/Rib	2x1 HF L/Rib

*Program Changed

Table 5. Production data of Rib fabric (After Implementation)

Parameters	M/c 05	M/c 06	M/c 07	M/c 08
No. of Program	4	3	4	2
Target per day, kg	344	428	276	310
Day-1, kg	322	376	245	278
Day-2, kg	317	312*	238	292
Day-3, kg	254*	381	229	285
Day-4, kg	315	348	246	288
Day-5, kg	326	378	236	295
Average Production, kg (5 days)	307	359	239	288
Efficiency (%)	89.2%	83.9%	86.6%	92.9%
Remarks	1x1 Rib	1x1 L/Rib	2x1 HF L/Rib	2x1 HF L/Rib

*Program Changed

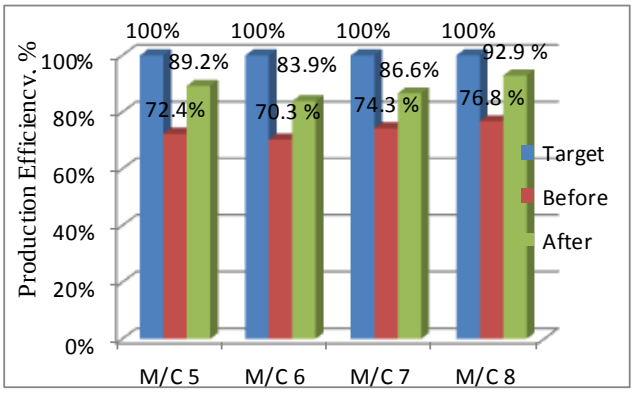

Figure 2. Efficiency analysis of the Rib fabric

From the above two data table 4 and 5, the following graph 2 can be plotted. Generally, the graph has shown higher production efficiency after implementing the necessary steps than conventional. About 24-30% low productions have been recorded than targeted production when rib machines were producing fabric as usual way. However, production jumped to 12-17% more than this when the mentioned steps were tried to implement. It is recorded that approximately 290 kg, 290 kg, 170 kg and 250 kg rib fabric production increased for machine 5, machine 6, machine 7 and machine 8 respectively after 5 days.

3.3. Determination of Production Efficiency of Double Jersey Machine (Interlock)

The below table 6 has shown the productivity before implementing any steps of 4 Interlock machine where only normal interlock fabric was produced. Besides, table 7 has shown the knitting machine data after mentioned steps have been implemented.

Table 6. Production data of Interlock fabric (Before implementation)

Parameters	M/c 09	M/c 10	M/c 11	M/c 12
No. of Program	3	2	3	2
Target per day, kg	217	217	264	264
Day-1, kg	172	196	176*	192
Day-2, kg	157*	170*	182*	184*
Day-3, kg	178	192	178*	213
Day-4, kg	176	192	178*	213
Day-5, kg	165*	184	188	204*
Average Production, kg (5 days)	170	185	183	200
Efficiency (%)	78.34%	85.3%	69.31%	75.75%
Remarks	Interlock	Interlock	Interlock	Interlock

*Program Changed

Table 7. Production data of Interlock fabric (After implementation)

Parameters	M/c 09	M/c 10	M/c 11	M/c 12
No. of Program	3	2	3	2
Target per day, kg	217	217	264	264
Day-1, kg	183	198	236	206
Day-2, kg	181	206	225	196
Day-3, kg	192	212	213	218
Day-4, kg	198	209	223	226
Day-5, kg	196	214	209	230
Average Production, kg (5 days)	190	208	221	215
Efficiency (%)	87.55%	95.85%	83.71%	81.43%
Remarks	Interlock	Interlock	Interlock	Interlock

From the above two data table 6 and 7, the following graph 3 can be plotted. Similarly, the graph has shown higher production efficiency after implementing the necessary steps than conventional. It is found about 15-31% low production efficiency for conventional method where 6-14% higher production efficiency found after implementing the mentioned steps. Moreover, approximately 100 kg, 115 kg, 190 kg and 75 kg interlock fabric produced more in 5 days after that. This clearly indicates the higher productivity of that particular types of machine in the knitting floor.

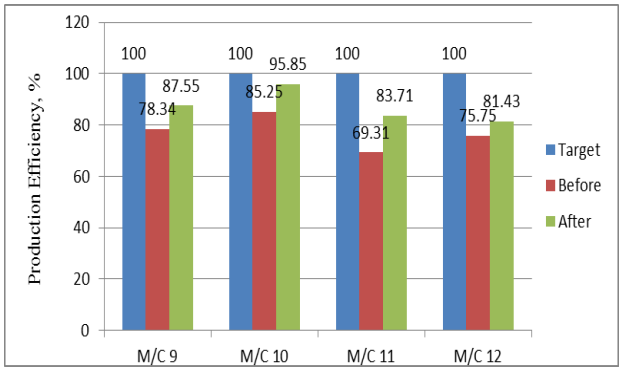

Figure 3. Efficiency analysis of the interlock fabric

3.4. Determination of Production Efficiency of 3 Thread Fleece Machine

The below table 8 has shown the productivity before implementing any steps mentioned of 4 Fleece machine where only normal fleece fabric was produced. Besides, table 9 has shown the knitting machine data after mentioned steps have been implemented.

Table 8. Production data of 3 threads fleece fabric (Before implementation)

Parameters	M/c 13	M/c 14	M/c 15	M/c 16
No. of Program	3	2	3	2
Target per day, kg	349	387	366	366
Day-1, kg	281	296	256	263
Day-2, kg	236*	308	225*	272
Day-3, kg	242*	318	218*	278
Day-4, kg	278	277*	265	281
Day-5, kg	272	277*	265	281
Average Production, kg (5 days)	262	302	245	267
Efficiency (%)	75%	78%	67%	73%
Remarks	Fleece	Fleece	Fleece	Fleece

*Program Changed

Table 9. Production data of 3 threads fleece fabric (After implementation)

Parameters	M/c 13	M/c 14	M/c 15	M/c 16
No. of Program	3	2	3	2
Target per day, kg	349	387	366	366
Day-1, kg	284	318	288	280
Day-2, kg	290	314	278	292
Day-3, kg	262*	325	271	302
Day-4, kg	296	318	276	296
Day-5, kg	284	324	296	295
Average Production, kg (5 days)	283	320	282	293
Efficiency (%)	81%	82.7%	77%	80%
Remarks	Fleece	Fleece	Fleece	Fleece

From the above two data table 8 and 9 the following graph 4 can be plotted. Similarly, the graph has shown higher production efficiency after implementing the necessary steps than conventional. After analyzing it is clearly visible that the 3 thread fleece fabric found upward productivity after taken necessary steps than the conventional methods. Around 4-10% extra production efficiency found compared to before implementing any steps. The floor has seen an increment of 105 kg, 90 kg, 185 kg and 130 kg of production in 5 days for machine 13, machine 14, machine 15 and machine 16 respectively.

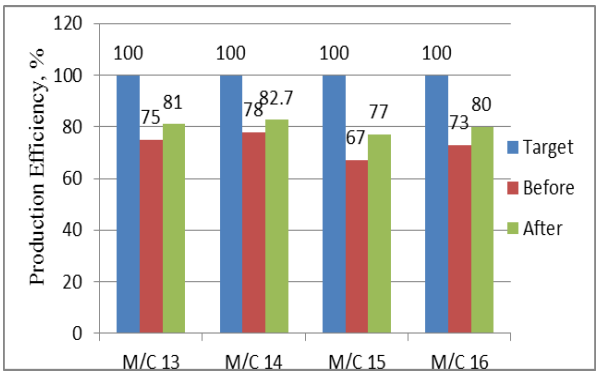

Figure 4. Efficiency analysis of the 3 threads fleece fabric

3.5. Determination of Production Efficiency of 2 Threads Terry Fleece Machine

Table 10. Production data of 2 threads terry fleece fabric (Before implementation)

Parameters	M/c 17	M/c 18	M/c 19	M/c 20
No. of Program	3	2	2	3
Target per day, kg	265	265	265	265
Day-1, kg	234	233	230	223
Day-2, kg	201*	215*	225	228
Day-3, kg	241	258	242	234
Day-4, kg	236	244	235	242
Day-5, kg	198*	240	232	227
Average Production, kg (5 days)	222	238	233	231
Efficiency (%)	83.8%	89.8%	87.9%	87.2%
Remarks	Terry	Terry	Terry	Terry

*Program Changed

Table 11. Production data of 2 threads terry fleece fabric (after implementation)

Parameters	M/c 17	M/c 18	M/c 19	M/c 20
No. of Program	3	2	2	3
Target per day, kg	265	265	265	265
Day-1, kg	256	245	248	234
Day-2, kg	249	253	242	252
Day-3, kg	244	242	238	248
Day-4, kg	252	239	244	243
Day-5, kg	258	255	232	247
Average Production, kg (5 days)	252	247	241	245
Efficiency (%)	95%	93.2%	90%	92.5%
Remarks	Terry	Terry	Terry	Terry

The above table 10 has shown the productivity before implementing any steps mentioned of 4 Terry fleece machine (S/J) where 2 threads fleece fabric was produced. Besides, table 11 has shown the knitting machine data after mentioned steps have been implemented.

From the above two data table 10 and 11, the following graph 5 can be plotted. Similarly, the graph has shown higher production efficiency after implementing the necessary steps than conventional. It is clearly visible that the 2 thread fleece fabric found upward productivity after taken necessary steps than the conventional methods. Approximately 10-16% low production found for the case when no steps have been taken properly. Around 5-10% more production efficiency found compared to before implementing any steps. The floor has seen an improve productivity of 150 kg, 45 kg, 40 kg and 70 kg of production in 5 days for machine 17, machine 18, machine 19 and machine 20 respectively.

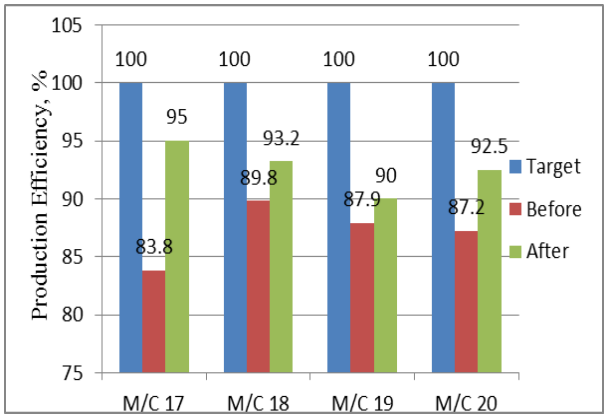

Figure 5. Efficiency analysis of the 2 threads terry fleece fabric

4. Conclusions and Recommendations

4.1. Findings

- ✓ Proper planning of implementation causes a higher production of a knitting floor
- ✓ Categorizes of the machinery can go for smooth productivity
- ✓ Less no. of program change ensures higher productivity and efficiency
- ✓ Supply of better quality knitting elements, yarn and other optical devices confirms the higher production rate
- ✓ Knitting floor environment and relief from pressure enhance the attention and growth the production much
- ✓ Supply of fabric role marking sticker saves time from loss of production

4.2. Conclusions

An effective knitting floor always is possible to have when a proper system of floor planning is implemented. In fact, a knitting production floor always should follow proper strategies. Not surprisingly, productivity and efficiency increased higher if the floor is run on a perfect planning basis only. In this research, nothing special parameters were changed or modified except ensuring to implement well-known planning steps accurately. As a consequence, factory has been observed a huge no. of improved production after implementation of the steps than the usual.

4.3. Recommendations

- ✓ Categorize each floor basis on the types of products they are recommended
- ✓ Well-developed planning and supply chain management can be a major implementation for high productivity
- ✓ Continuation must ensure in every moment
- ✓ Machining condition should have regular check

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