Faculty of Engineering

Department of Textile Engineering

Project on
Analysis Technical Relationships within Count, Stitch Length and GSM of (1x1) Interlock and (1x1) grey Rib Fabric

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Advance in Fabric Manufacturing Technology

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Declaration

We hereby assure that, ***Md. Abu Sayed, Md. Robiul Hasan***, and ***Md. Hasem Ali*** have done this project under the supervisor of ***Asit Ghosh***, Assistant Professor, Department of Textile Engineering, Daffodil International University. We also ensure that, this project report is an original work and no part of this report has been copied from elsewhere.

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Special thanks goes to Textile engineers of Industries ***Robintex Group*** from whom we collect the sample.

We would like to acknowledge our deep debt to all teachers of our University and especially of 'Fabric Manufacturing Technology' department for their help and kind inspiration, which remain us the backdrop of our efforts.

At last, we like to like to accept that we remain responsible for the insufficiencies, inadequacies and errors, which doubtlessly remain.

Abstract

This project mainly concentrated on Rib and Interlock fabric where we find out relationships within count, stich length and GSM. Most of the industries are faced some ordinary problem concerning the proper selection of count, GSM and stitch length to manufacture a good quality knit fabric. In this project, both the empirical and analytical data were compared with each other to find through an equation where if the stich length and count increase then the GSM will be decreased. This occurred due to the relation within GSM, count and stitch length; where count and stitch length is inversely proportional to the GSM. This project mainly concentrated on grey knit fabric GSM where yarn count respectively 26Ne, 28Ne, 34Ne for (1x1) rib, and 26Ne, 30Ne, 32Ne used for (1x1) interlock. In this project, we have been compared both the theoretical as well as the practical implications from the factory and we have to try our best mark on the adjustable points of fabric GSM, count and stitch length directly and indirectly. This report set up an acceptable result, which would be preferable for workable use and would simplify for carrying out further activities related to this type of research.

Keywords:

Rib and Interlock Fabrics, Count, Stitch length, GSM, Weft Knitting

TABLE OF CONTENT

LIST OF TH FIGURE

LIST OF THE TABLE

CHAPTER 1

INTRODUCTION

1.1. Introduction

A fabric is produced by assembly of fibers and yarn that has substantial surface area in relation to its thickness and sufficient cohesion to give the necessary mechanical strength. Commonly 2 types of fabric are used that are woven and knitted. Our experimental project is based on Analysis technical relationships within GSM, Count and Stitch length of different knitted fabric.

In this time, knit fabric are very popular in the whole world. Knit sector are represented the largest share of our export oriented RMG sector. Therefore, the development of knit products is really a challenging matter. Recently there are many system has been developed that allow a manufacturer or user to fully understand the knit fabric and control the knitting machine as well as stitch length , GSM processing , selection of yarn count etc.

There are so many problems in our industries to produce knitted fabric with required GSM as well as other specification like fabric width, fabric dimension etc. The main reason of this problem due to improper selection of yarn count, GSM and stitch length.
.

So our main intention of this project is to get well better idea about technical relationship among count, GSM, stich length.

1.2. Objective of the Study

In Bangladesh there are many types of knitted and woven fabric are available. Comparatively knit fabric production more than woven fabric. There are different kinds of knitting machine used in the Industry. In this project, we know about relation among GSM, Count, and Stitch length. The overall objective of this report are given below-

1. To learn difference between Rib & Interlock fabric structure.
2. To learn relation between Stitch count & GSM
3. To learn about Rib fabric.
4. To learn about Interlock fabric
5. To learn about stitch length of the knitted fabric when stitch length will be increase or decrease.
6. To learn GSM of knitted fabric.
7. To learn about Count.
8. To learn how to GSM measurement calculation.

CHAPTER 2

LITERATURE REVIEW

2.1.1 Knitting:

Knitting is the process of producing fabric by transferring continuous yarns into interlocking loops, where each row of loop hanging from the one immediately preceding it.

Knitting can be divided into 2 classes. These are-

1. Circular Knitting
2. Flat Knitting

Circular knitting are also classified into 2 ways.

The main Forms of Knitting are

1. Weft Knitting
2. Warp Knitting

2.1.2 Weft Knitting:

Weft knitting is the process which is one set on yarn using. Weft knitted fabric structure thread runs in horizontal direction and loop produced by one thread. It has highly elastic and highly drape characteristics structure. It has suitable for under and outer garments. It can be both flat and tube form.

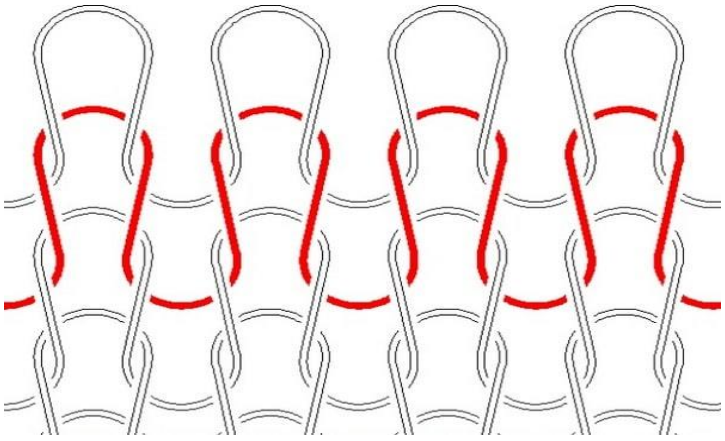


Fig 1: Weft Knitting

Weft knitted fabric can be classified into two classes. These are

1. Single Jersey or Plain Jersey Fabric
2. Double Jersey

There are some important and most popular derivative of single jersey fabrics are given below:

- 100% single jersey.
- Single Pique
- Single Lacoste
- Polo Pique/Double Pique
- Terry Fleece
- Fleece etc.

Double jersey fabric can be divided into two classes. These are

a. Rib Fabric

b. Interlock Fabric

2.1.3 Warp Knitting:

In case of warp knitted structure, the work is progressed by length wise, through the intermeshing of loops in the direction of wale. Each loop in the horizontal direction made from different thread in warp knitted structure. The advantage of this fabric structure that it is not easily unroll. So, it has less elasticity characteristics from weft knitting.

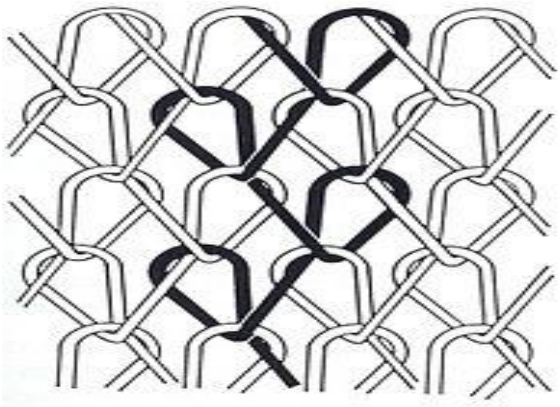


Fig 2: Warp Knitting

2.2. Terminology & Definition

2.2.1. Course and Wales

Knit fabric are made by 2 way. These are called course and Wales. Wales is produce by vertical yarn and Course is produced by horizontal yarn.

The wales line are fixed by the machine gauge. This are fixed and the coarse lines can be changed by adjusting in the machine. It's called Texture.

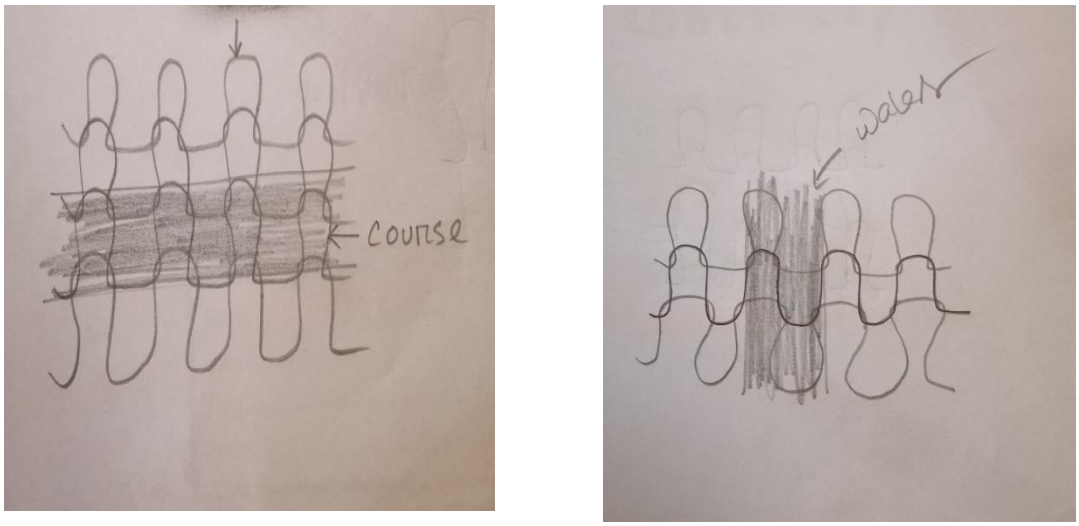


Fig 3: Course and Wales lines of Knitted Structure

2.2.2 Course per inch

It is measured by placing an inch glass (counting glass) on the fabric and counting the number of courses are contained within the area. These values may be vary if the fabric is distorted.

2.2.3. Wales per inch

Wales per inch are measured by placing an inch glass (counting glass) on the fabric and counting the number of Wales, which are contained within the area. These values may be vary if the fabric is distorted.

2.2.4. Needle Gauge

Needle Gauge is denoted by the Number of needle contained in per one inch of the needle bed in knitting machine.
Total number of needles can determine by the help of needle gauze. The formula is given below-

Number of Needle = ∏ x machine diameter x machine gauze

2.2.5. Machine Gauge

Machine gauge are expressed by the number of needles in a unit length of the needle bed. The needle bed may flat or circular. In case of circular double knitting machine it used for cylinder as well as dial. It is denoted by alphabet “E”. The formula is given below-

Machine Gauge= No of needle/inch

2.3. Study of Knitting Machine

2.3.1. Circular knitting machine

Circular knitting machines, which make the fabric for inner and over wear purposes. These type machines are widely used for knitted fabric manufacturers to meet the needs of apparel and textile industry. Circular knitting machine is the first choice throughout the knitting industry for its productivity and user friendliness. Circular knitting machine has yarn creel, which is used to place the yarn cone, where the yarn is supplied to the machine, through pipe. Then the yarn the passes through moving needles by yarn guide which are controlled by cylinder & cams. Cam are manufactured in compliance with prescribed quality standards using high-grade material. It has been manufactured and design.

There are various types of circular knitting machines used in textile industry. Such as,

1.Single jersey circular knitting machines.

2**.** Double jersey :
* Rib Machine
*Interlock Machine

3.Flat bed-knitting machine **:**
* Sinker wheel-knitting machine.
* Loop wheel-knitting machine.

2.3.2. Single jersey circular Knitting Machine:

Fig 4: Single jersey circular knitting machine

2.3.3. Double jersey circular knitting machine (Rib)

Fig 5: Double jersey Circular Knitting Machine (Rib)

2.3.4 Double jersey circular knitting machine (Interlock)

Fig 6: Interlock Machine

2.3.5. Parts of knitting machine and their function:

Table 1: Parts of knitting machine and their function:

Serial No	Parts Name	Function
1	Needle	To stretch the thread and making new loop also pass the new lop through the old loop.
2	Sinker	The main function is to hold the old loop and help to formation of new loop.
3	Creel	It is use to hold the yarn package.
4	Yarn guide	The main function of this is to guide the yarn in proper direction.
5	Knot catcher	To hold the dust and other extra impurities also knot. Only allow yarn pass through this.
6	Positive wheel	To feed the specific amount of yarn keeping proper tension and ensure even yarn feed.
7	Sensor	To stop the yarn after breaking a single yarn as result machine will stop.
8	Indicator light	The function of this device is to identify the feeder or wheel place where yarn break.
9	Ceramic yarn guide	To guide the yarn properly to the feeder.
10	Yarn feeder	To feed the yarn to the needle for loop formation.
11	Sinker Bed	This is use to hold/place the sinker.
12	Sinker Cam	To make sinker path also give to and fro motion properly.
13	Cylinder	To hold and place the needle in right position.
14	Base plate	To hold and place the cylinder properly.
15	Needle Cam	To make a path for needle for accelerating through in the cylinder according to the fabric construction..

16	Nozzle	To pass the oil into the cylinder for better movement also reduce friction.
17	Blower Fan	Removing dust from the cylinder and feeder wheel by air blowing.
18	VDQ pulley	To control the GSM also change the stitch length.
19	Take up roller	To winding the fabric after producing in even direction.
20	Tensioner Roller	Maintain the tube fabric tension during winding.
21	Lycra feeder	To feed Lycra to the machine with proper direction.
22	Toothed Belt	To transfer the motion from the VDQ pulley to the positive feeder.
23	Cylinder Brush	To clean dust from the surface of the cylinder.
24	Fabric detector/sensor	To check any type of split in the fabric if it is found in the machine then machine will stop.
25	Wastage oil pot	To store additional and wastage oil.
26		To set the motion of take up properly.
27	Fabric spreader	To make tension in width wise direction of fabric during take up action.
28	Off switch	To stop the machine.
29	Start switch	To start the machine
30	Jog switch	To rotate the machine slowly
31	Handle	To make motion in the cylinder after shade up to solve it.
32	Tension pulley	To maintain the tension of toothed belt.
33	Air gun	To clean the machine also use foe feed the yarn after breakage.

CHAPTER 3

MATERIALS AND METHOD

3.1. Materials:

Cotton (100%) and Grey Melange (5%) yarn was used for producing Rib (1x1) and Interlock (1x1). These fabric were collected from Robintex Group of industries and collected fabrics count was 26,28, and 34 used for Rib and Interlock fabric were used 26,30, and 32**.**

Source of yarn:

* AA Yarns Mills.
* Metro Spinning Mills.
* Usterised Contamination Cleared.

Fig 7: Different types of yarn Package

3.2. Instruments:

1. Machine *** PAOLO ORIZIO**

   *** ZENTEX**

2. GSM Cutter
3. Electrical balance
4. Scale

Fig 8: PAOLO ORIZIO

Fig 9: ZENTEX

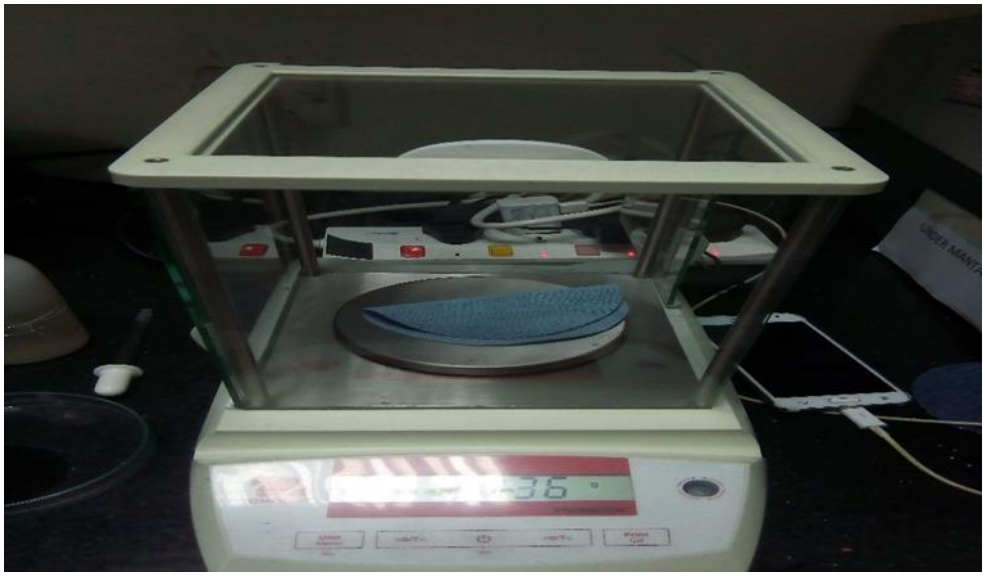
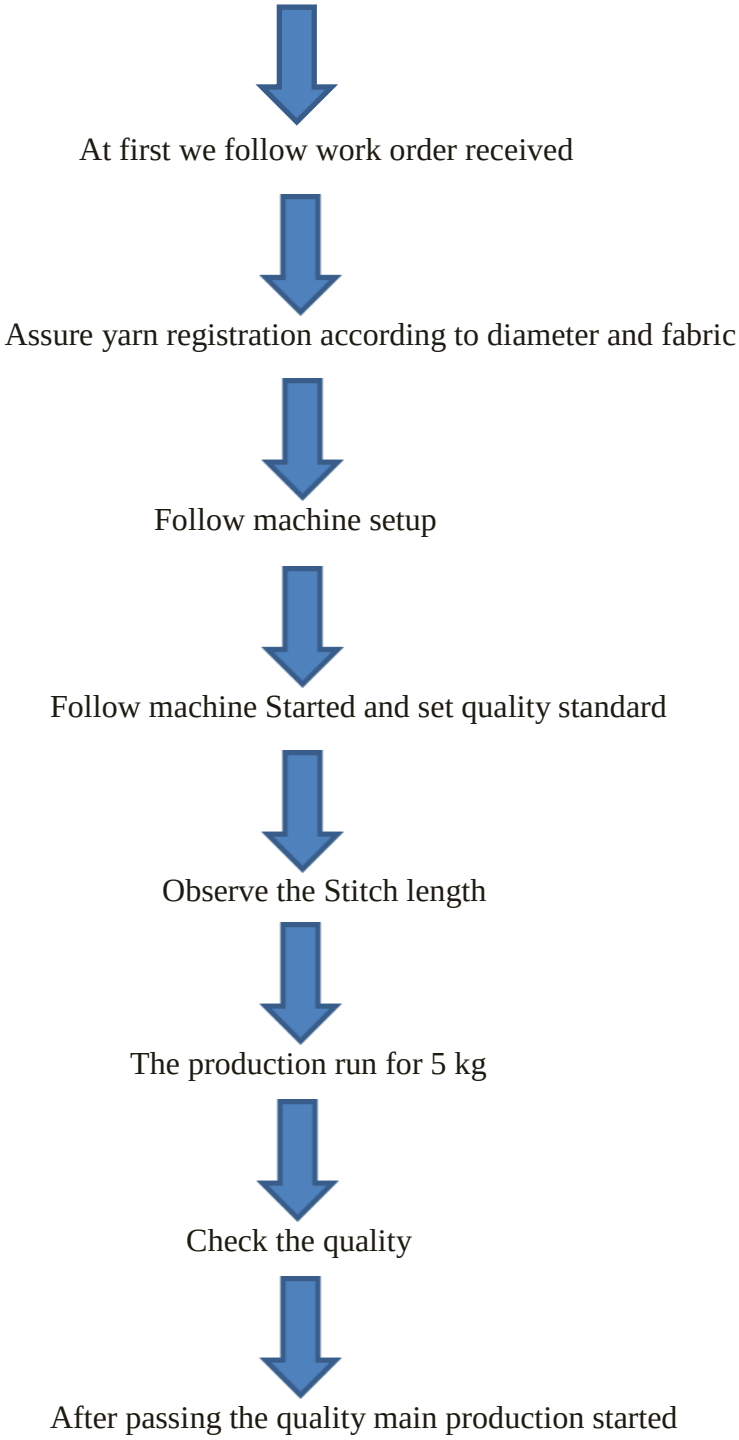


Fig 10: Electrical Balance

Fig 11: GSM Cutter

3.3 Method:

At first Collected different data and experiment those data for this project and relation within Stitch Length, Count & GSM. Work flow chart is given below:



Production roll unload

Before delivery collected the desire Sample

Then Analysis the collected data with empirical data

Then check the stitch length

Check the GSM following Fabric

Then analysis the data relation within Count, stitch length GSM

CHAPTER 4

EXPERIMENTAL WORK

4.1. Rib Fabric:

Rib fabric one kind of fabric in which face loop and back loops are same appearance and vertical rows of stitch interloop possibly on the back and face side of the fabric.

Properties:

* The appearance of face and back can be identical.
* Lengthwise and widthwise extensibility of fabric is nearly of single jersey.
* Fabric edge does not curl.
* Thickness of fabric is nearly than single jersey.
* Two series of knit loops are arranged into parallel in a couse.

4.2. Different types of Rib Structure:

Rib (1x1)

Rib (2x2)

1x1 Lycra rib

Double Pique

4x2 rib

5x2 rib

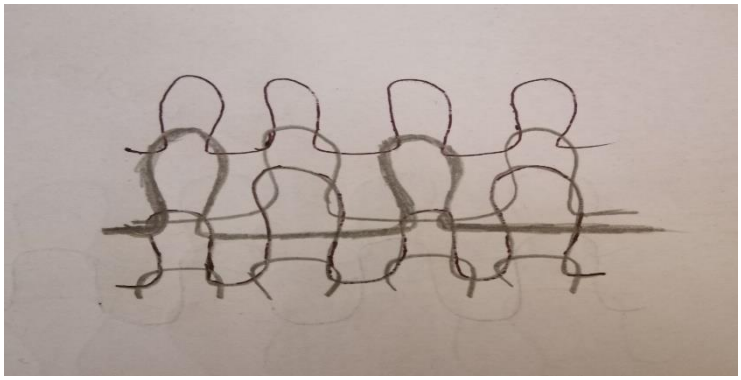


Fig 12: Structure of Rib fabric

4.3. Rib Machine Specification

Brand Name : ZENTEX
M/C Model : ZN2-1XDU
M/C Diameter : 36
Gauge : 18
Feeder : 78
No of Needle : 1860
M/C Serial No : 2844
Year Manufacture : Feb 04
Origin : Singapore

Fig 13: Rib Machine

4.4. Interlock Fabric:

Each side of loops are locked and fabric are produced closely interlocking stitches allowing it two stretch.

Properties.

***** The appearance of the both side of fabric are same.

* The wales line are opposite to each other and loops are locked together.
* Elongation of fabric lengthwise and widthwise are same as single jersey.
* Edge of the fabric does not curl
* Possibility unraveled fabric from the knitted last. .
* Thickness of fabric are double than single jersey.

4.5. Different types of Interlock Structure

* Interlock (1x1)
* Lycra Interlock (1x1)

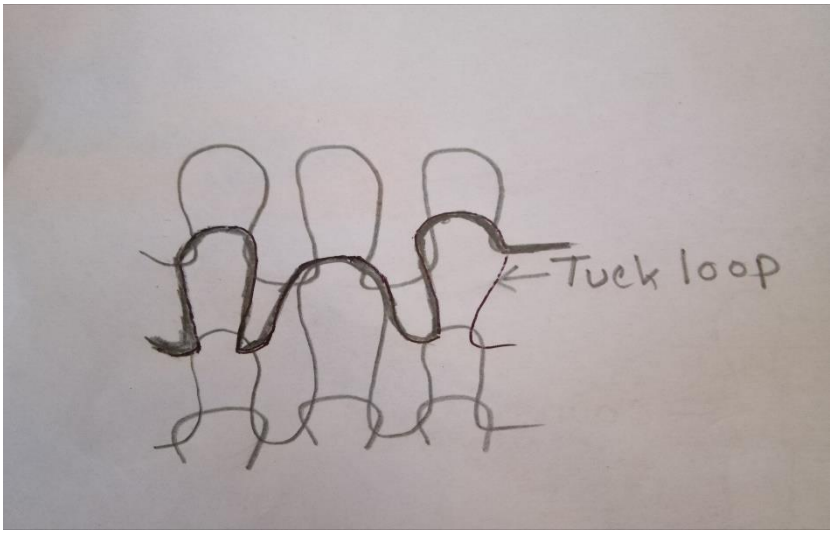


Fig 14: Interlock Knitted structure

4.6. Interlock Machine Specification

Brand Name	: PAOLO ORIZIO
M/C Model	: CMOAL
M/C Serial No	: 1027880
M/C Diameter	: 30
Gauge	: 20
No of needle	: 1860
No of feeder	: 80
Origin	: Italy

Fig 15: Interlock Machine

5.7. Stitch length

Stitch length that means loop length. It is indicate to the length of a complete knitted loop of yarn. It can be influence the fabric dimension and fabric weight. It is denoted by mm.

5.8. Fabric GSM

The GSM is one kind of fabric specification that is very important factor 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 1 square meter. By this specification, which helps to compare the fabrics in unit area which is heavier and which is lighter. For measuring GSM, at first fabric GSM cutter cuts sample then the cut sample weight is taken by electric balance. By this way, we found the weight in gram per one square meter fabric. The GSM of the fabrics by the GSM cutter is obtained by the multiplying the sample weight with 100.

Fig 11 (2): GSM Cutter

5.9. Count

Count is numerical expression, which is define the coarseness or fineness of yarn. It indicate the weight/unit length or length/unit weight. There are two system to indicate the fineness and coarseness of yarn.

Count is 2 types:

1. Direct Count.
2. Indirect Count.

Direct Count:

Direct count of yarn can be express by when the length unit is fixed but weight unit is variable. If the count is higher than the yarn is coarser.

$$\text{Count} = \frac{W \times l}{w \times L}$$

Here,

W = Wt. of sample

L = the length of sample

w = the unit wt. in system

l = the unit wt. in system

Table 2: Direct count method

Method	Unit mass	Unit Length	Uses
Denier	Gram	9000 m	Polyester
Pounds/Spindle	Pounds	14400 Yds	Jute
Woollen	Grain	20 Yds	Wool

Indirect Count:

Indirect count can be expressed by when the weight unit fixed but length unit is variable. If the count is higher than the yarn is finer.

$$\text{Count} = \frac{w \times L}{W \times l}$$

Here,

W= Wt. of sample

L= Length of sample

w= Unit wt. in System

l = Unit wt. in System

Table 3: Indirect Count method

Method	Unit Mass	Unit Length	Uses
English (Ne)	840 yds	1lbs	Cotton yarn
Metric (Nm)	1 Km	1 Kg	Cotton yarn
Worsted (Ws)	560 yds	1 lb	Worsted yarn
Woollen (Nw)	256 yds	1 lb	Woollen yarn

The English count (Ne) is widely used in industry and it is also known as English cotton count. The above conversion table, which are more beneficial to calculate the count.

Table 4: Table of Count Conversion

	Ne	**Nm**	**Tex**	**Grex**	**Denier**
Ne	1 x Ne	0.5905 x Nm	590.5/Tex	5905/Grex	5315/Den
Nm	1.693xNe	1 x Nm	1000/Tex	10000/Grex	9000/Den
Tex	590.5/Ne	1000/Nm	1 x Tex	0.1 x Grex	0.111 x Den
Grex	5905/Ne	10000/Nm	10 x Tex	1 x Grex	1.111 x Den
Denier	5315/Ne	9000/Nm	9 x Tex	0.9 x Grex	1 x Den

CHAPTER 5

RESULT AND DISCUSSION

Result and Discussion:

For this experiment, collected 3 sample 3 types of different Count & 3 types of different Stitch Length and GSM for both Rib (1x1) and Interlock (1x1) fabric.

5.1. Experimental Calculation for GSM measurement:

At first, collected the fabric and then cut the collected fabric by a GSM cutter. after then weighted from a Electric balance. Finally the measuring wt. multiple with 100/m2..

For 26 Count 1x1 Rib fabric, from electric balance, weight found 2.12-gram grey fabric.

Therefore, grey GSM = 2.12gm x 100/m2
=212 gm/m2

Like above, (28 and 34 Count) 2.02 gm and 1.85 gm grey fabric wt. found 202 and 185.

Same as, 26 Count 1x1 Interlock fabric, wt. found 2.50 gm grey fabric,

Therefore, grey GSM = 2.50 gm×100/m2
=250 gm/m2

Like above, (30 and 32 Count) 2.35 gmb2.25 gm grey fabric GSM found 235 and 225

5.2. Analytical calculation for Stitch length measurement:

At first, took a fabric and marked by a pencil (50 wales) for all fabric sample. After that opened the one course from the marking line, measured length in (cm) by a scale, divided those data by 10 mm, and measured stitch length in (mm).

For (1x1) rib fabrics, measurement 50 wales length in same course 25 cm.

Therefore, Stich length = 25/10 mm
= 2.50 mm.

Like above, where 50 wales length 26.2 cm and29.5 cm then the stich length found 2.62 mm and2.95 mm.

Similar, 1x1 Interlock fabric measured 50 wales length in same course 19 cm.

Therefore, Stich length = 19/10 mm
= 1.9 mm.

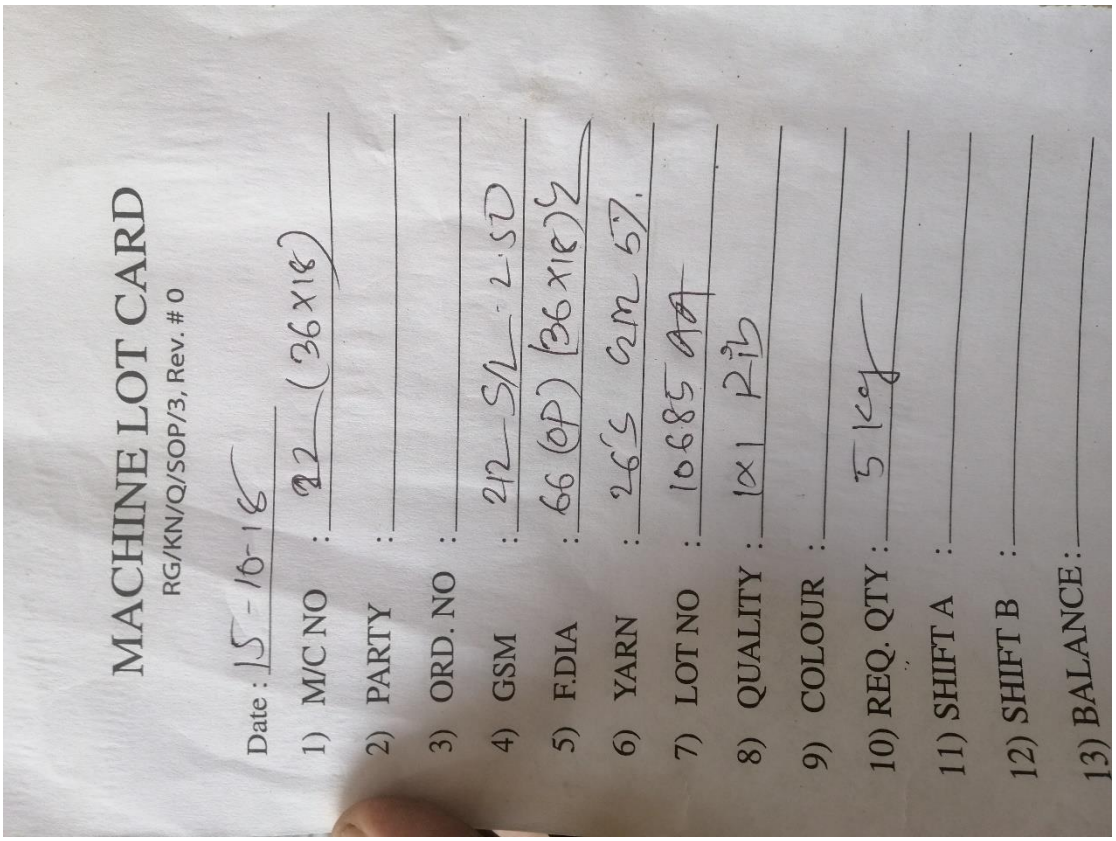
Like above, where 50 wales length 21 cm 23 cm there found the stich length 2.1 mm and 2.3 mm.

5.3. Analysis of Rib fabric:

Here experiment for Rib fabric and show relation within Count, GSM and Stich length. Hence, for 26, 28 and 34 count and stich length are selected 2.60 mm, 2.65 mm and 2.95.

Table 5. Count, Stich length and GSM of (1x1) Rib fabric

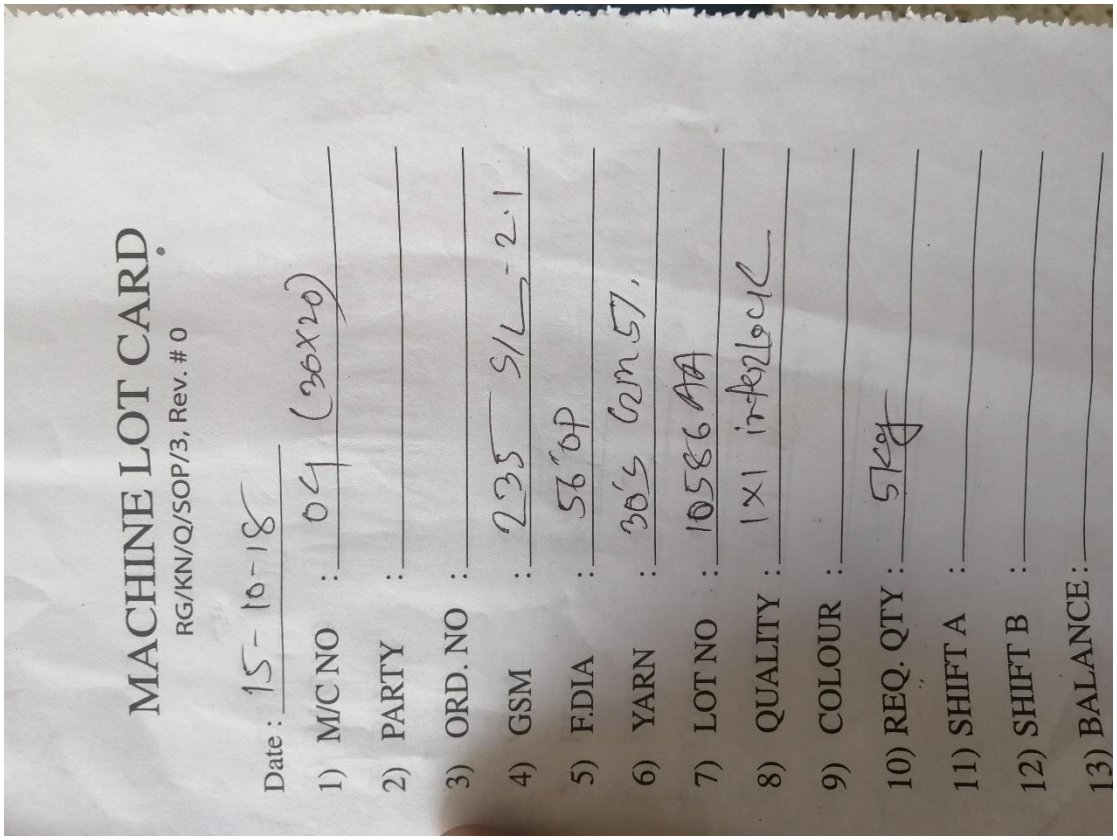
Count	Stitch length (mm)	GSM gm/m2
26	2.50	212
28	2.62	202
34	2.95	185



5.4. Analysis of Interlock fabric:

Table 6. Count, Stich length and GSM for (1x1) Interlock fabric

Count	Stitch length (mm)	GSM gm/m2
26	1.90	250
30	2.1	235
32	2.3	225


MACHINE LOT CARD
RG/KN/Q/SOP/3, Rev. # 0
Date : 15-10-18
1) M/C NO : 04 (30x20)
2) PARTY :
3) ORD. NO :
4) GSM : 235 S/L - 2.1
5) F.DIA : 58"DP
6) YARN : 30's Cm 57,
7) LOT NO : 105886 AM
8) QUALITY : 1x1 interlock
9) COLOUR :
10) REQ. QTY : 5Kg
11) SHIFT A :
12) SHIFT B :
13) BALANCE :

5.5. Relation between GSM and Count of rib fabric:

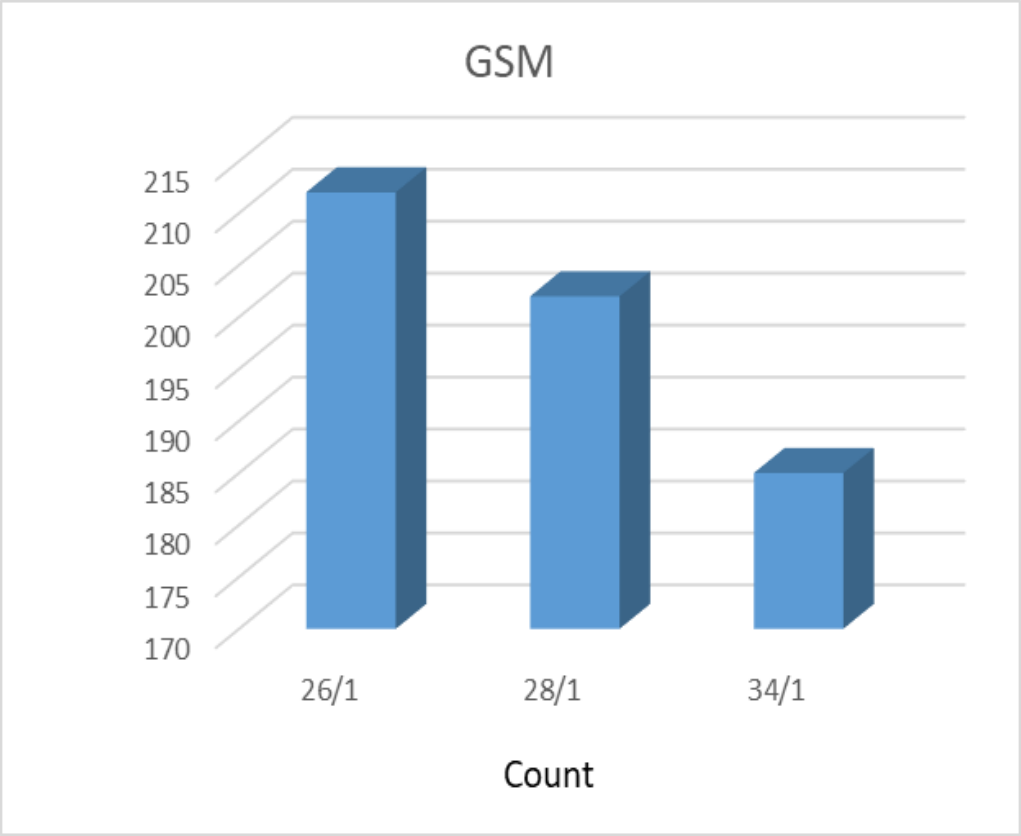


Fig 16: Relation between Count and GSM of rib fabric.

Above Fig 16 indicates that, the GSM are inversely proportional to the Count. That means when count are increase then GSM are decrease. From above Fig when the Yarn Count 26/1 then GSM will be 212, Like as when the Count 28/1, 34/1 then GSM will be 202 and 185.

5.6. Relation between GSM and Stich length of rib fabric:

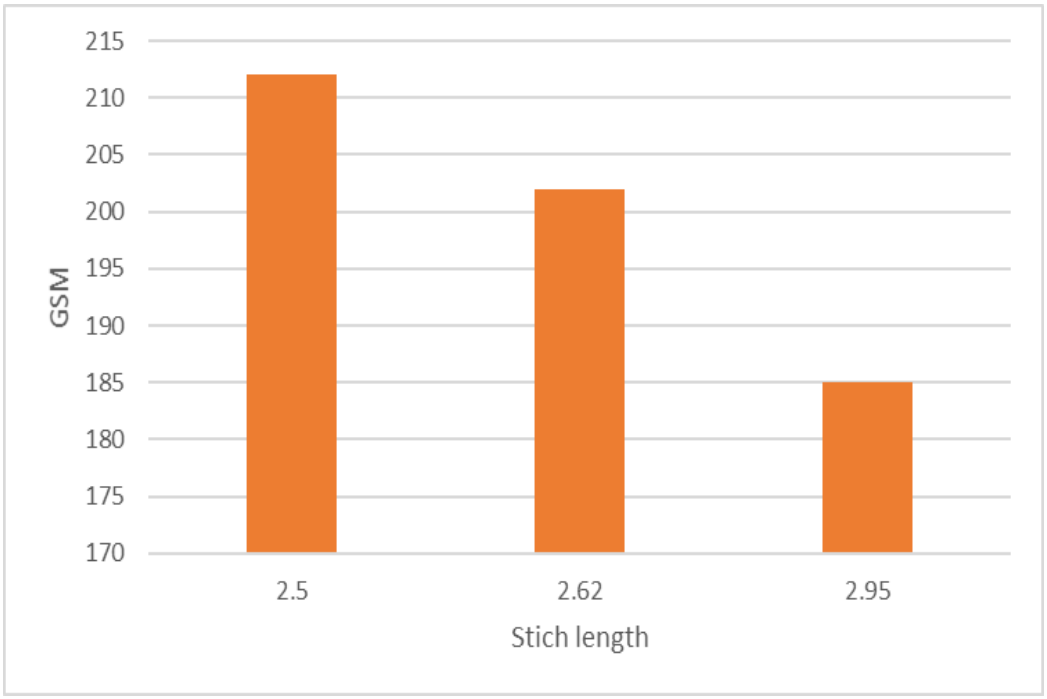


Fig 17: Relation between GSM and Stitch length of rib fabric

Above Fig 16 we can see that the relationship of GSM is inversely proportional to the Stich length same as Count. That means, if the stich length increase than the GSM will be decrease.

5.7. Relation among GSM and Count and Stich length of rib fabric:

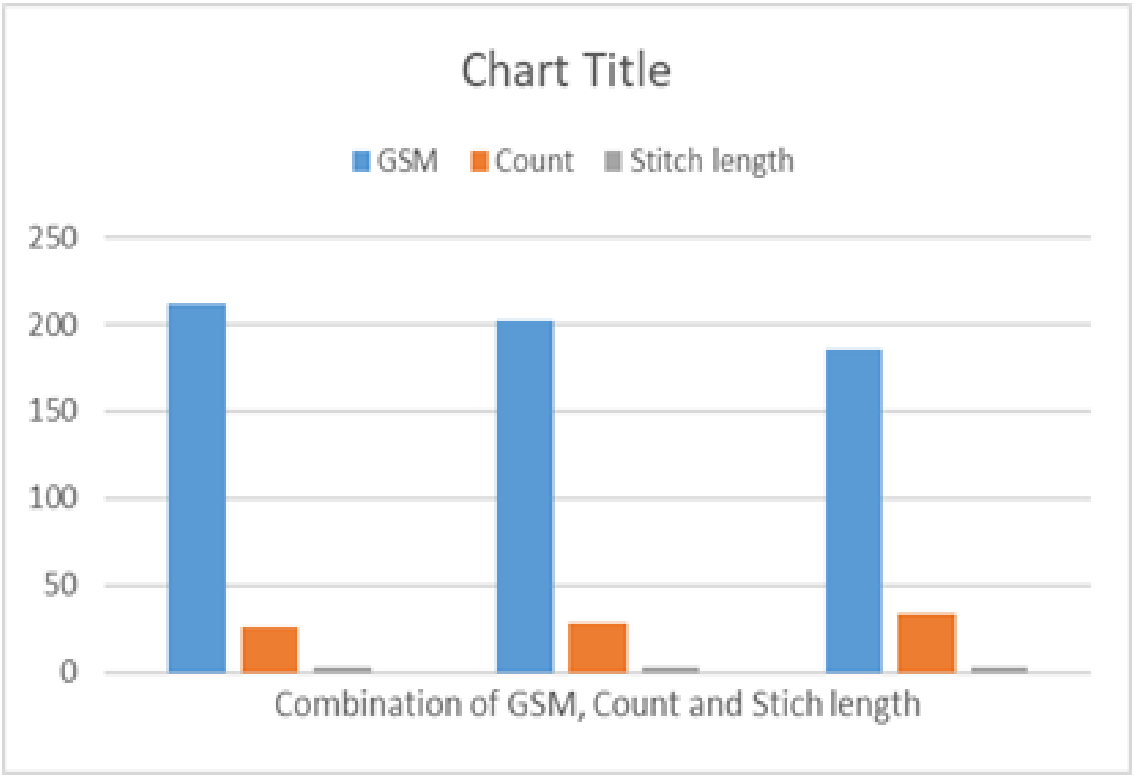


Fig 18: Relation among GSM, Count and Stitch length

From Fig 18 we can see that, the relation among GSM are inversely proportional to the Count and Stich length. That means, when stich length and count are increase then the GSM are decrease.

5.8. Relation between GSM and Count of Interlock fabric:

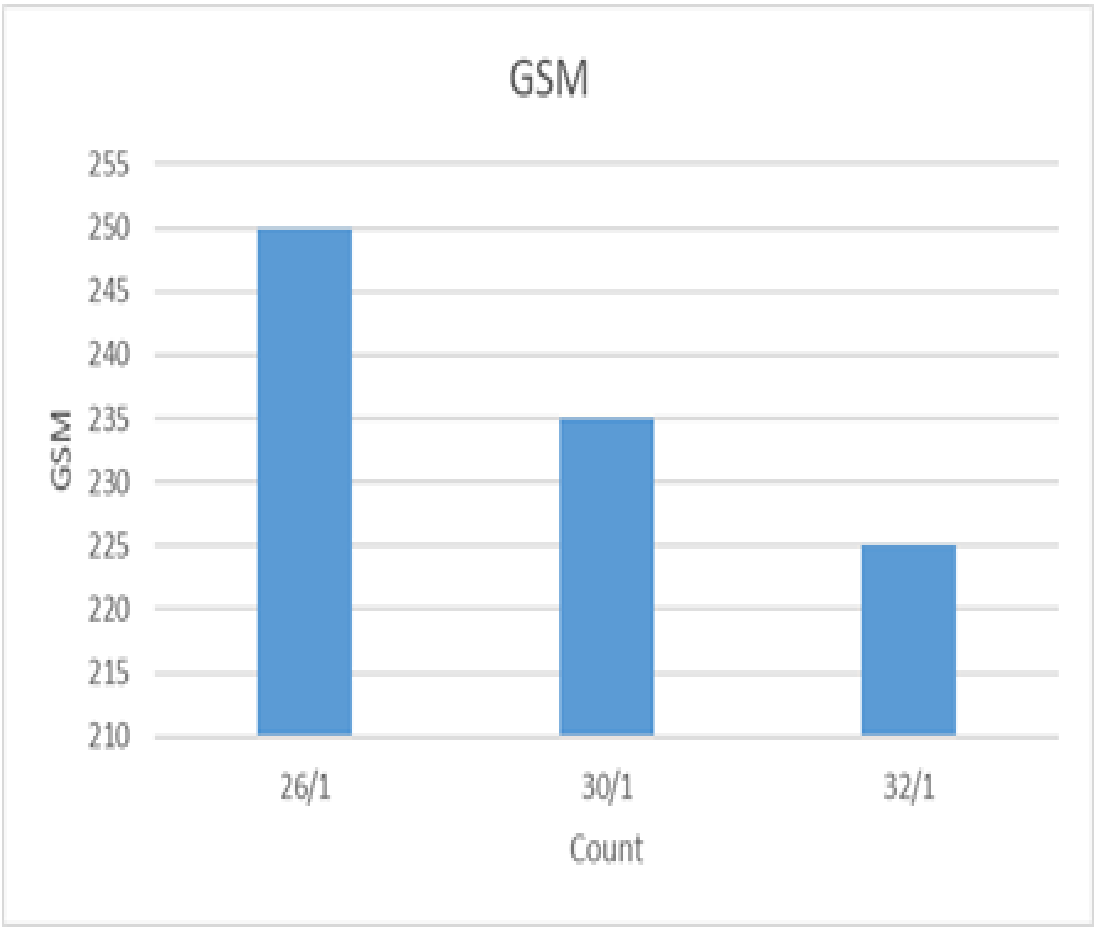


Fig 19: Relation between GSM and count of Interlock fabric

7.9 Relation between GSM and Stich length of Interlock fabric

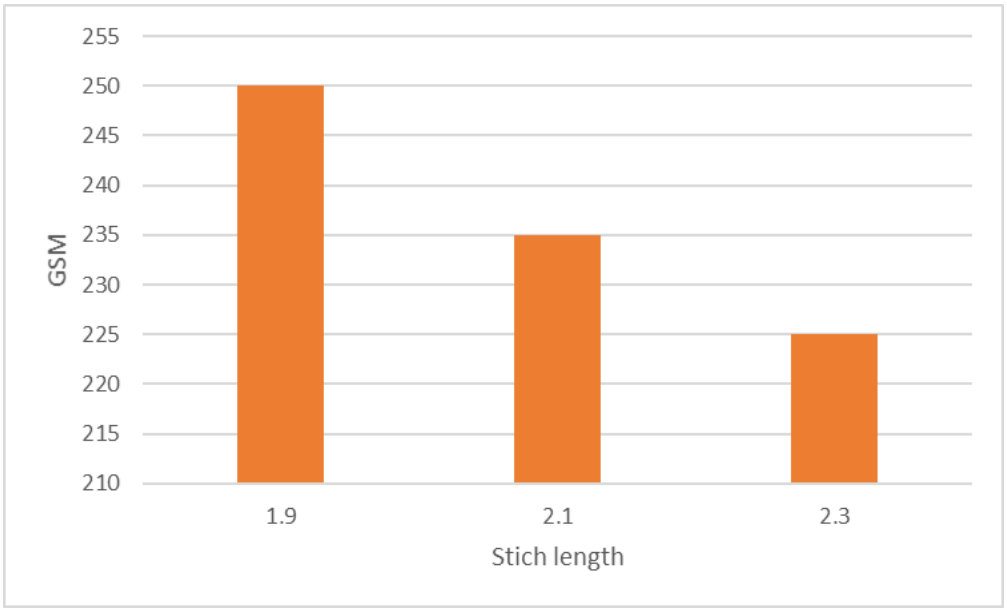


Fig 20: Relation between GSM and Stitch length of Interlock fabric

7.10 Relation between Stich length, GSM and Count of Interlock fabric.

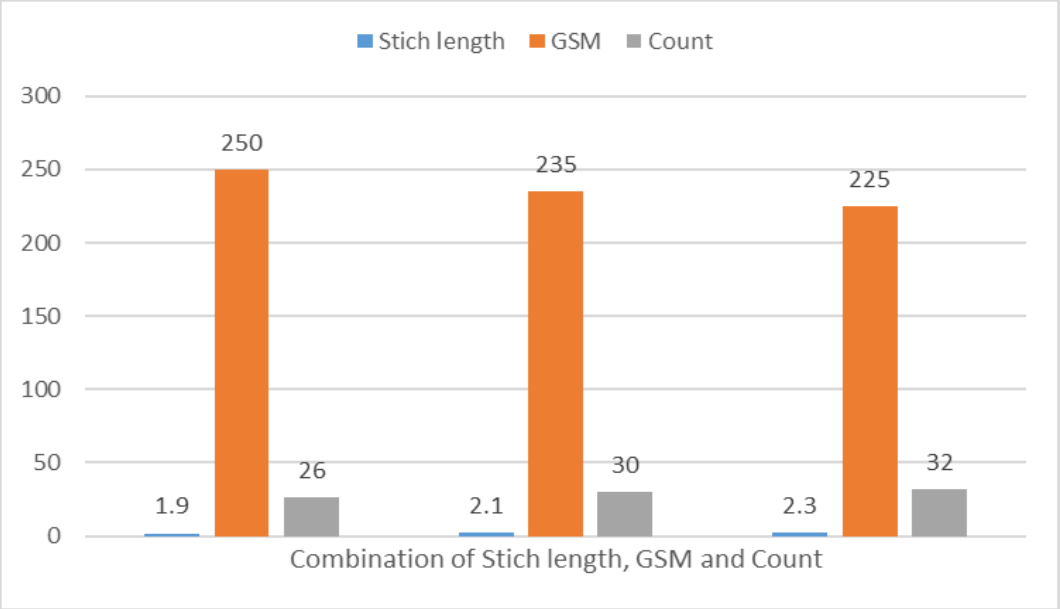


Fig 21: Relation between Count, Stitch length & GSM of Interlock fabric

From Fig 19, 20, 21 we can see that, the relation among GSM are inversely proportional to the Count and Stich length. That means, when stich length and count are increase then the GSM would be decreased. Same as rib fabric but parameters are different quality.

7.11. Empirical data of 1x1 rib fabrics:

Table 6: Empirical data of (1x1) rib fabric

No of Observation	**Count**	**Stitch Length (mm)**	**Grey GSM (gm/m2)**
01	*26*	*2.50*	*210-215*
		2.62	*200-210*
		2.95	*195-200*
02	*28*	*2.50*	*205-210*
		2.62	*200-205*
		2.95	*195-200*
03	*34*	*2.60*	*195-205*
		2.65	*190-195*
		2.75	*185-190*

7.12. Empirical data (1x1) Interlock fabric:

Table 7: Empirical data of (1x1) Interlock fabric

No of Observation	Count	Stitch length (mm)	Grey GSM (gm/m2)
01	*26*	*1.9*	*250-255*
		2.1	*245-250*
		2.3	*240-245*
02	*30*	*1.9*	*240-250*
		2.1	*235-240*
		2.3	*230-235*
03	*32*	*1.9*	*230-240*
		2.1	*225-230*
		2.3	*220-225*

7.13. Compare between Empirical and Experimental of 1x1 Rib fabric:

Table 8. Compare between Empirical and Experimental data of 1x1 Rib Fabrics

No of Observation	Count	Stitch length	Empirical GSM	Experimental GSM (gm/m2)
01	26	2.50	210-215	212
02	28	2.62	200-205	202
03	34	2.95	180-185	185

As shown above, from Table 8 when count 26 and stich length 2.50 mm then our experimental GSM 212 where industry GSM range 210-215. Like for the count 28 and 34 the stich length 2.62 mm and 2.95 mm then our experimental GSM respectively 202 and185, where the industry GSM range 200-205 and 180-185.Therefore, the above table we can find that GSM range and our experimental data are almost same. That means for rib fabric, this experiment is accurate.

7.14 Compare between Empirical and Experimental GSM of (1x1) Interlock fabric:

Table 9: Compare between Empirical and Experimental data of (1x1) interlock fabric

No of Observation	Count	Stitch length	Empirical GSM	Experimental GSM (gm/m2)
01	26	1.9	250-255	250
02	30	2.1	235-240	235
03	32	2.3	220-225	225

Finding from table 9 when the count26 then the stich length 1.9 then our analytical GSM 250 where industry experienced GSM range 250-260. Like when 30 and 32 the stich length respectively 2.1 and 2.3 then the experimental GSM got 235 and 225 where empirical range 235-240 and 220-225. Therefore, the above table, the empirical data and experimental data almost same. So, it proved that, this project experiment is accurately for both (1x1) Rib fabric (1x1) Interlock fabric, from table 6, table 7 and table 8, table 9 can easily say that, if count is increased then GSM would be decrease where stich is fixed.

$$GSM \propto \frac{1}{count}$$

It was experimented that, if stich length increased then GSM would be decreased.

$$GSM \propto \frac{1}{Stitch\ length}$$

Therefore, it has defiantly says that if stich length and count increased then the GSM would be decreased. Therefore,

$$GSM \propto \frac{1}{Count \times Stitch\ length}$$

CHAPTER 8

CONCLUSION

Conclusion

Basically the thesis work is done for Rib and Interlock fabric different quality parameters like as GSM, Count, and Stitch length. In this thesis we have to tried technical relationship among GSM, yarn count and Stitch length.

Due to short of fabrics it was not possible to discuss about different types of rib and interlock fabrics derivatives.

Yarn count and Stitch length is very essential parameters of weft knitted fabric. Count and stich length are vital role in knit fabric manufactured. This project concentrated only Rib (1x1), Interlock (1x1) fabric, from this thesis finding a better idea about selection of GSM, count, and stitch length, which is very important properties for Rib, and Interlock fabric in industries. Form the above experimental data it has been shown that when count increased and then stich length increases but the GSM will be decreases. From this project, it gives an idea about grey stage of knit fabric, which would be better performance for the proper selection of count, stich length and GSM.

CHAPTER 9

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REFERENCE

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