Faculty of Engineering
Department of Textile Engineering

# "Study on Stenter Machine in Knit Fabric Finishing Process"

Course code: TE 4214  Course title: Project (Thesis)


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A thesis submitted in partial fulfillment of the requirements for the degree of **Bachelor of Science in Textile Engineering**

Advance in Textile Wet Processing
April, 2018

# Study on Stenter Machine in Knit Fabric Finishing Process

# LETTER OF APPROVAL

April 18 , 2018

To

The Head

Department of Textile Engineering.

Daffodil International University.

102 Sukrabad, Mirpur Road, Dhaka- 1207.

Subject:- Approval of final year project ( thesis ) report.

Dear Sir,

I am writing to let you know that this project report titled as "Study and Application of Stenter Machine in Knit Fabrics Dyeing Industry" is completed for final evaluation. The whole report is prepared based on proper investigation and understanding though critical analysis of empirical data with required belongings. The student was directly involved in his project activities and the report becomes vital to spark off many valuable information for the readers.

Therefore, it will highly be appreciated if you kindly accept this project report and consider it for final evaluation.

Yours Sincerely.

Mr.Tanvir Ahmed Chowdhury

Assistant Professor

Department of TE

Daffodil International University.

# DECLARATION

We hereby declare that the work which is being presented in this thesis entitled, **"Study on Stenter Machine in Knit Dyeing Industry"**is original work of our own, has not been presented for a degree of any other university and all the resource of materials uses for this project have been duly acknowledged.

Nazia Sultana Ria Date:

Tarek Hassan Date:

This is to certify that the above declaration made by the candidate is correct to the best of my knowledge.

Tanvir Ahmed Chowdhury Date
Supervisor

Dedicated

To

“Our Parents & Teachers”

# ACKNOWLEDGEMENT

Firstly, we express my heartiest thanks and gratefulness to almighty Allah for his divine blessings which makes possible to complete this project successfully.

I am grateful and feel indebtedness to my supervisor **Tanvir Ahmed Chowdhury, Assistant Professor,** Department of Textile Engineering, Faculty of Engineering, Daffodil International University. Deep Knowledge and keen interest of my supervisor in the field of textile dyeing and finishing influenced me to carry out this project smoothly. His endless patience, scholar guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior draft and correcting them at all stages have made it possible to complete this project finally.

I also wish to express my gratitude to **Prof. Dr. S.M. MahbubUlHaqueMajumder,** Department of Textile Engineering, Daffodil International University for his continuous guidance to prepare this project report. I would like to express our thanks to **Prof. Dr. Md. MahbubulHaque,** Department of Textile Engineering, Faculty of Engineering, Daffodil International University for his kind help to finish our project report.

I would like to thank my entire course mates in Daffodil International University, Who took part in the discussions while completion of the course works.

Finally, I must acknowledge with due respect for the constant supports and blessings of my parents and family members.

# ABSTRACT

The aim of my research work was to "**Study on Stenter Machine in knit dyeing Finishing Process"**This study makes an assessment on the effect of stenter machines on knit fabric (single jersey, rib, interlock). To continue this process work we have taken seven samples of three different knit fabrics. At first we have done the all of dyeing process and then for the mechanical finishing we have used stenter machine. Then we see all the procedure of stenter machine what actually happen in this machine during fabric treatment or finishing. To perform this work standard procedure was followed. After critical analysis, we have found that the changes of fabric quality after stenter finishing.

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# CHAPTER-1
# INTRODUCTION

## 1.1.Introduction:

Stenter machine is electrical machines used in textile industry for stretching or stentering thin fabrics such as muslin. Stenter electrical machines are called as stenter hook. In stenter open compactor fabrics enter. Here Cotton fabric shrinks widthwise & weft are distorted due to bletching& dyeing process. Stenter machines are important drying machines that are used in the process of making woolen fabric. The drying of dyed fabric is one of the main tasks in the dyeing process, and it determines the quality of the dyed product. After the fabric is woven, it still contains oil from the fleece and some dirt. The fabric is cleaned in a fulling mill and then has to be dried carefully since wool can shrink. To prevent this shrinkage, the wet fabric is placed on a frame and left to dry. The lengths of wet fabric are stretched on a stenter using hooks all around the perimeter of the frame, to which the fabric's edges are fixed so that it retains its shape and size as it dries. The chamber of the stenter machine contains a heater, ducts, and fans. The fabric passes between the upper and lower ducts, and the heater supplies high-temperature drying air, which passes through the ducts and is injected through holes. A fan discharges the injected air after passing through the fabric. A stenter has various problems regarding waste heat recovery, hot air circulation in the chamber, and over-feeding of the

device by an electronic controller and narration controller. Thus, performance evaluation is needed for these machines.Developing options for stenter machines helps to save energy. The injection duct system is one of the important parts of the stenter machine for injecting air. The duct and nozzle shapes have been investigated numerically and experimentally to correct the inclination angle of injection. Porous media have been used to analyze the drying process with partial differential equations describing the time-dependent heat and mass transfer. The injection duct systems of a stenter machine were investigated to obtain a uniform flow rate across the air-injecting holes. The flow field of the injection duct systems with planetype and mountain type ducts was analyzed for different heights of the duct end and hole shapes. The stenter performance was evaluated based on the mass flow rate, velocity, and pressure using ANSYS CFX . The developed duct systems had more uniform mass flow rates at the air-injecting holes than the original duct systems.

## 1.2. Function of stenter Machine:

- Spirility measured by the stenter m/c
- It works as textile machinery and equipment
- Stenter m/c control shrinkage property
- Stenter mc is used for curing treatment for resin, water repellent fabric
- Heat setting is controled by the stenter for lycra fabric, synthetic and blended fabric.

- Drying the fabric after dyeing or wet chemical finish processes.
- Heat setting of the Thermo Plastic material.
- Chain mercerizing.
- To have the fabric in roll or other suitable package form in the delivery section of the m/c which then can be dispatched to the customers.

**1.3.Significance of the Study:**

The importance of the study is given below:

i. Well known about knit fabric and different finishing process by stenter machine

ii. Different parts of stenter machine and its mechanishm

iii. Deep knowledge about Dia and gsm change process by stenter machine

To achieve the above mentioned knowledge, I have observed a lot of processes of finishing.

# CHAPTER-2
# LITERATURE REVIEW

**2.1. Stenter Machine:** A machine or apparatus for stretching or stentering fabrics. The purpose of the stenter machine is to bringing the length and width to pre determine dimensions and also for heat setting and it is used for applying finishing chemicals and also shade variation is adjusted. The main function of the stenter is to stretch the fabric widthwise and to recover the uniform width.

**2.2. History of Stenter Machine :** One of the most important pieces of textile finishing machinery is the stenter, which is also called tenter; it is sometimes referred to as the stenter frame, and in the U.S.A. the word "frame" alone is used. The chief function of the machine is to stretch the fabric, and some stenters are devoted to this purpose alone, but the great majority combines stretching and drying.

The oldest form of stenter was the fixed hand-frame, which comprised two parallel rails on which were mounted rows of pins to hold the cloth; when the fabric had been impacted on the pins by hand the rails were caused to move apart by cross rail, so that the cloth dried in the stretched state, free from creases, and further, some control over the final dimensions was released. This system is still used for lace and net fabrics where widths of 400 inches may be encountered; cloths as the crepe georgette are also often dried on the hand –frame, which gives control of length as well as width. The hand-frames are generally placed in warm rooms, a gentle current of air is provided by large flaps over the frames; narrower hand-frames are sometimes arranged in tiers.

The first continuous stenters were also multilayer drying machines, and this type persists in the wool and worsted trade, the first tentering machine being made in 1854 by Whiteley of Huddersfield; the single layer or stenter is generally used for cotton, silk, and rayon, although some two tier or return stenters are in operation for silk and rayon fabrics.

## 2.3. Different Types Of Stenter Machine

2.3.1 Hot Air Stenter (Quadra) It has been continuously upgraded machine to keep up with the growing demands of the industry.

Today, due to its special features, Quadra is preferred among other brands.

**Features that outsmart Quadra are:**

- Varioflow air circulation system- with separate blowers for top and bottom nozzles, impinges hot air throughout the chamber in absolutely uniform manner from center to selvedge, selvedge to selvedge. Air ratio between the top and bottom is controlled electronically as each blower motor is driven by VFD.(There are no mechanical dampers and therefore the airflow is very smooth). These high speed blowers are specially designed to increase the air flow which has increased productivity. Even one side flow is

possible with increased or decreased air pressure depending upon fabric construction and air permeability. Especially, utilized when heat setting lycra based fabrics and also for coating applications. Filtering of circulated air and insulations are very effective to reduce fuel consumption etc

- The Stenter is fully equipped with requisite capacity of reduction gear box with direct coupled motors avoiding chain & belt drive. The system helps in increasing the efficiency of individual drive console besides reducing power consumption and maintenance cost.

- Tensions between Padder and Stenter draw roll and over feed roller are controlled by unique drive system with load cell feedback and PC controls makes it easy to set the machine tension to suit the fabric. With electronic control over the air flow, it is easily possible to handle lightest to heaviest fabric with the same efficiency.

- Other features of the machine include directly coupled geared motors to individual screws to adjust the width individually through PLC and self- lubricating type main chain. Especially for knitted fabrics, selvedge gumming, steaming, trimming, edge spreaders, driven stainless steel scroll rollers and fabric center support is provided. Available working widths are from 1200 to 4800 mm with oil heated, steam or direct gas fired systems.

### 2.3.2. Stenter10F :

The word 10 F stands for 10 flames.in stenter 10 F clips are used to stretch the fabric and this is a disadvantage that holes appears on the selvedge of the fabric and also uneven dyeing is achieved.

### 2.3.3. Stenter 8F:

Stenter 8 F has 8 flames and the main purpose of 8F stenter same as 10F stenter. The basic advantage of the machine is dyeing can also done on 8F machine and has I.R system. Finishing, dyeing can also done even we can dye pigment , heat setting and also we can control skew and bow problems and another advantage is using light shades no clip marks appears.

### 2.3.4. Knit Stenter:

The basic difference of the knit stenter machine is that it is used for knit fabric weft straightening, heat setting, dyeing and light shades and also for print and knit finishing chemicals applications. Pins are also provided with the clips. Flat rollers are present and a brush to hold the pin, the L-guide is also used for knit fabric and a selvedge cutter with suction.

**2.4. Specification of a Stenter Machine:**

| | |
|---|---|
| **Brand Name** | **Kranh** |
| **Serial no** | **72276-0463** |
| **Origin** | **Germany** |
| **Year of manufacture** | **2006** |
| **Speed range** | **15-30 m/min** |
| **Temperature range** | **50-250C** |
| **Used utilities** | **Electricity, Gas, Compress air, Steam** |
| **Production capacities** | **8 ton /day** |
| **No. of chamber** | **3** |
| **Maximum fabris width** | **102”** |
| **Minimum fabric witdth** | **30”** |
| **Steam pressure** | **2 bar** |
| **Air pressure** | **10 bar** |
| **Applied for** | **Open tube fabric** |
| **No. of ratamatic burner** | **7** |
| **Extra Attachment** | **Mahlo weft straightener** |
| **M/C parts** | **Burner,Nozzle, Exhaust air fan, Over feed roller, Suction fan, Chain arrangement** |

## 2.5. Working Procedure of Stentering Machine:

The fabric is collected from the batcher to the scary and then it is passed through the padders where the finishes are applied and sometimes shade variation is corrected. The fabric is entered into the mahlo (weft straightener) the function of the mahlo is to set the bow and also weave of the fabric is griped by the clips and pins are also provided but the pins has a disadvantage that they pins make holes at the selvedge but the stretching of the pins are greater than the clips. These clips and pins are joined to endless chain. There are 8 to 10 chambers provided on the machine each chamber contains a burner and filters are provided to separate dust from air. The circulating fans blow air from the base to the upper side and exhaust fans sucks all the hot air within the chambers. Attraction rollers are provided to stretch the warp yarn.

After stentering we can increase the width of the fabric up to 1.5-2 inch.

The speed of the machine is about 7-150 m/min.3 meters fabric can run in each chamber. Temperature is adjusted that according to the fabric as for,

1. PC 210 c

2. Cotton 110-130 c

## 2.6. Heat setting and stretching process in stenter machine:

### 2.6.1. Heat setting and stretching:

- **Heat setting** is a mechanical process before dying of TC+CVC fabric to give dimensional stability and shrinkage control.
- **Stretching** is also a mechanical process before dying of all cotton fabric to remove crease marks and to get required width for next process.

## 2.7. Material and chemical used:

Sometimes wetting agents (.e.g. mixture of surface active compound) are used as chemical for the heat setting and stretching process.

i. **Softening Agent**→ SMART SOFT CB 180, Taiwan.
ii. **Silicon finish** → Zero finish CT 9180

## 2.8. Different Types of Finishing Process by Stenter m/c:

I. Soft Finish: (chemical used –solosoft/softex/cationic softneretc) For Fabric Soft Hand Feel.

II. Resine Finish: (chemical used –Fixapet Eco, Condensol, Solia solution etc) For Wrinkle Free Fabric
III. Easy Cone Finish/ Wrincle Free Finish: (chemical used –Fixapet Eco, Condensol, Solia solution etc) For Wrinkle Free Fabric.
IV. Paper Touch Finish: (chemical used –V.HKN, Binder etc) For Fabric paper type Hand Feel.
V. Hard Finish: (chemical used –Bas, Binder etc) For Fabric Hard Hand Feel.
VI. Curing: High Temperature Method. Here No Chemical is used and Temperature range 180-200$^0$c
VII. Water Repeliency Finish: For One Side Coating Fabric
VIII. Water Proof Finish : For Both Side Coating Fabric

**2.9. Checking points**

**2.9.1 (m/c parts):**

- To check m/c area clean
- To check m/c motor
- To check burner
- To check blower
- To check chain & roller
- To check delivery roller

**2.9.2 Fabric checking points:**

- To check GSM
- To check diameter
- To check fabric faults (crease mark, dye spot.)

**2.10. Use and Maintenance of Stenter Machine:**

- Mounting thread expander board and active threads expansion rate roll, you must be the central thread the arrow with the direction of movement of the fabric, otherwise, make the fabric wrinkle.
- Passive thread expansion rate roll during installation must be threaded in the center of the arrow and fabric running direction of the roll surface. The passive thread expansion rate force poor only wrinkle role.
- When using roll bending expansion amplitude should be noted that the roller surface cleaning and the rotation of the roll bending flexible or not, to prevent abrasion of fabric.
- Compared with the threaded expansion amplitude expansion rate of the expansion rate of the roll bending device capability. But its structure is complex, improper use, easy to produce by the dense uneven and lordosis arc of latitude bend.

## 2.11. Components of stenter machine:

- **Fabric Feeding:** The In-feed system can be supplied suitable to take up fabrics either from batches or loose folds. The machine can be supplied with a J-Scray or an Accumulator for continuous operation. OPTIMA 2510 Stenters are provided with very efficient un-curlers and Infra-Red Edge Sensors which actuate the in-feed device provided with Rack and Pinion system, ensuring perfect fabric holding in clips or pins even at high speeds exceeding 100 meters per minute.

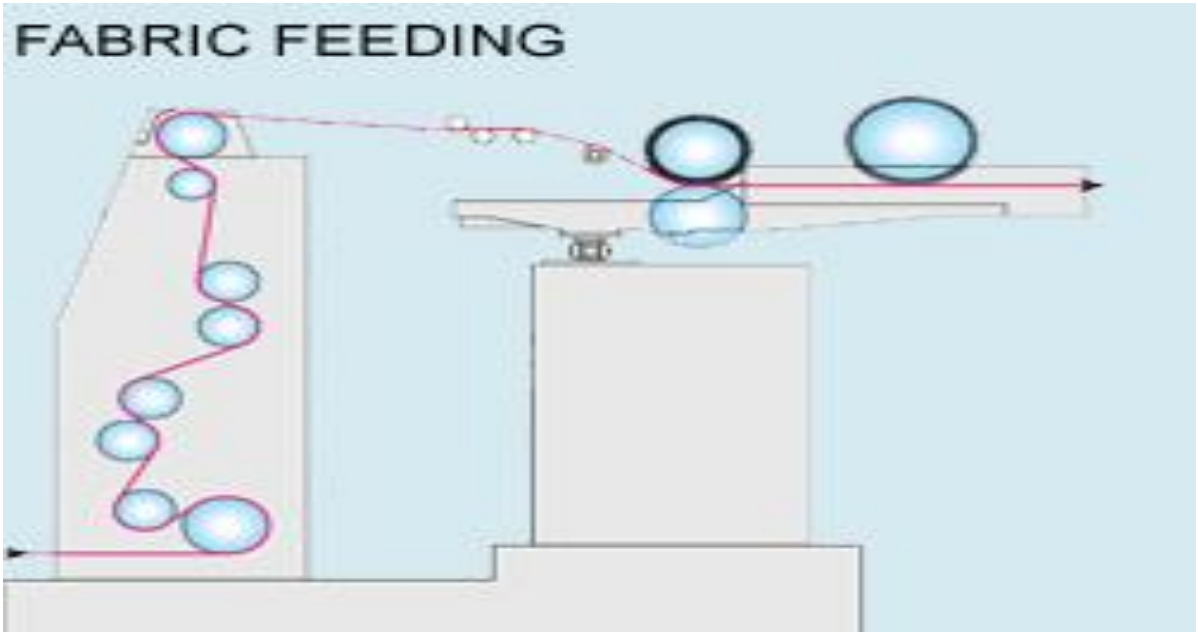



**Figure: 2.1 Fabric Feeding**

- **Feed roller :** this can be supply suitable to take up fabrics either from batches or loose holds.
- **Centering roller :** the fabric done the delivery and pass the fabric helps to front side.

- **Spandelroller :** the fabric helps to Spreading.
- **Webstar controller:** use for the loose fabric to completely ready to fabrie.
- **Dancinroller :** the fabric helps to move front side.
- **Dia program :** fabric width increase and decrease done.This devise holds the two sides of the fabric in tue form and two sensors are present here , which detect hole in the fabric.if any hle is appeared then the sensor will off the m/c
- **Padder :** It contains chemical trough, guide rollers and squeezing mangle. Fabric is dipped into the finish chemical then sent to squeezing mangle. During this time finish chemicals are applied on the fabric and squeezes out extra chemicals from the fabric.
- **Softener tank:**Softner are mixt with the water tank is to be help.
- **Chain gripping/ stretching unit:** Here by means of mechanical application fabric shrinkage & width is controlled. Fabric comes from skewing bowing control unit is passed below two short expander rollers which ensure fabric open width entry. There is also few wheel brush for brushing the selvedge & to ensure proper gripping if the stenter gripping unit is pin type. If the unit is clip type then that is gripped automatically. There are ten gripper, nine spindle roller, sixteen blowers.

- **Here in chain two options can be provide:**
  - **Under feed:** If the fabric width is lower than that required then under feed is given. It is also called stretching. Through that fabric width cam be increased as required.
  - **Over feed fabric:**Gsm increase and decrease. If the fabric width is higher than required &can not controlled in next stage then initially that is controlled slightly in this unit through over feed. Here the chain width is lower than the fabric width so that in heating zone fabric become relaxed. the over feed higher the shrinkage.

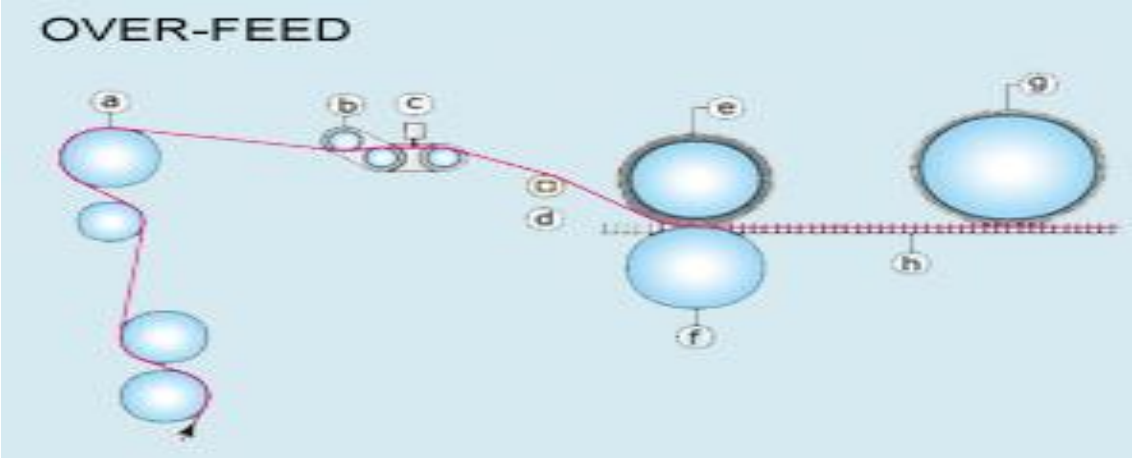



**Figure:-2.2 Over-feed**

- **Blower:** helps to dry the fabric and gives air. Blowing arrangement is present on the machine to remove dust produced during brushing. There is exhaust unit on the lower side of the brushing unit to exhaust dust.
- **Burnner :** works to produce heat and control the shade. After stretching unit fabric pass through heating unit. Here heat is provided according to finish. For Teflon finish temperature is around 180'c & for soft finish temperature is around 130-150'C. In this unit there are eight burners & sixteen blowers. Through hot air passing fabric is dried. Here there is a screening unit to make safe heating & blower unit.
- **Exhaust System:** Standard machines are provided with suitable number of exhausts to efficiently remove the moist and contaminated air. The exhaust blowers can be supplied with frequency controllers and moisture sensors to maintain uniform moisture and excellent drying results.
- **Operating monitor :**All program done Seating and control the machine.
- **Angle roller:** fabric are strait down helps.
- **Folding roller :** Fabrics are hold. folder delivers the fabric to the trolley. fabric feeding to the folder is controlled by delivery.
- **Ducting :** Extra heat pass through the machine.
- **Exhaust pipe**: Smoke pass through out side.
- **Free roller :** fabric can be easily helps to front side.
- **Middle point:** the work done operator on the middle point .

- **Cooling fan:**out side air pass through the inside.

- **Auto senteringroller :** fabrics are helps to down front side.

- **Chain:** Properly seasoned Cast Iron chain rail guides are provided to support the moving pin clip chain. They are strong and distortion free even when operating at elevated operating temperatures and at speeds in excess of 150 meters per min. Various combination of entry and exit chain rails are supplied for different applications. Extended entry rail track up to 6.3 meters can be provided which can support the Fabric feeding device, the Steaming device, Selvedge Gumming and pre-drying unit etc.

- **Brush:** helps to fabric hold on pin.Brushing action is done with the help of brushing roller which consists of 24 rollers with sharp pinned surface like carding r/ in carding m/c 12 rollers are move along with the fabric which have rpm more than the fabric.othre 12 rollres are move in the opposite direction of the fabric combine action of all brushing r/r will brush the loops in fleece fabric.

- **Delivery roller:** This zone delivered the fabric in a folded form. In this zone the fabric has to pass through several rollers in order to prevent the formation of crease mark in the finished fabric.

- **Motor :**The fabric then goes to the open width compactor. The fabric should be run natural through the compactor do not try to make the grain strait. The finished fabric should be off grain by about 8 inches out of the compactor.

- **Inlet J-scray:** This part is used to store the fabric during the batch change and Inlet unit contains various parts like tension device, draw roll, pressure roll and break roll. The important functions of the above rollers are to feed the fabric evenly throughout the machine.

- **Cooling roller:** After heating the fabric is passed over two stainless steel roller through which continuously cool water is passed. Due to this purpose fabrics become cool.

**2.2. Production procedure: Checklist before production:**

| Parameters / Items | Value / checking |
|---|---|
| Machine setup | a) Threading of machine as per process requirement<br>b) Parameters set up should be as per process requirement. |
| Fabric availability | According to program schedule and the route card having test status "OK" |
| Preparation of chemicals | Checking of preparation and also the shifting of liquor to the delivery tanks. |
| Tape fabric | Availability |
| Batches for winding | Availability |
| Accessories, necessities and utilities | Availability |
| Machine | Clean condition. |
| Manpower | Availability |

**2.18. Lint Filter:**A suitable filter is provided just above the heat exchanger or in case of direct fired Natural Gas Burners, in the duct. The filter is easily accessible and can be cleaned standing outside the chamber while the machine is in operation. A second security filter is also provided.

# CHAPTER -3
# MATERIALS & METHODS

### 3.1. Materials:

In this research, we have taken some pretreated (scouring, bleaching, dyeing/ printing)cotton knit fabric samples

### 3.1. Specification of these samples is mentioned in table:

| Sample NO | Sample Name | Yarn Count | Fabric Diameter | Fabric GSM |
|---|---|---|---|---|
| **1** | Single Jursy | 24 | 68” | 190 |
| **2** | Long inject Terry | 30 | 78” | 210 |
| **3** | 2*1 Rib | 26 | 22” | 210 |
| **4** | Lycra Terrry | 34 | 68” | 225 |
| **5** | Sluv Single Jursy | 26 | 62” | 170 |
| **6** | PK | 28 | 90” | 180 |
| **7** | Single Jursy Viscose | 34 | 71” | 140 |

### 3.2. Methods:

At first wet dyed fabric is feed on the stenter machine. Then the fabric is treated by stenter machine including overfeed, temperature and chemicals. After stentering the output fabric comes out with change in diameter and GSM. We noticed that for the different over feeding and temperature the GSM of fabrics are different. The dia of the fabric also can be increased or decreased by the process of stentering machine. After stentering, the yarn count of the fabric remain same.We get more luster and soft fabric after the process of stentering machine.

# CHAPTER -4

# DISCUSSION OF RESULTS

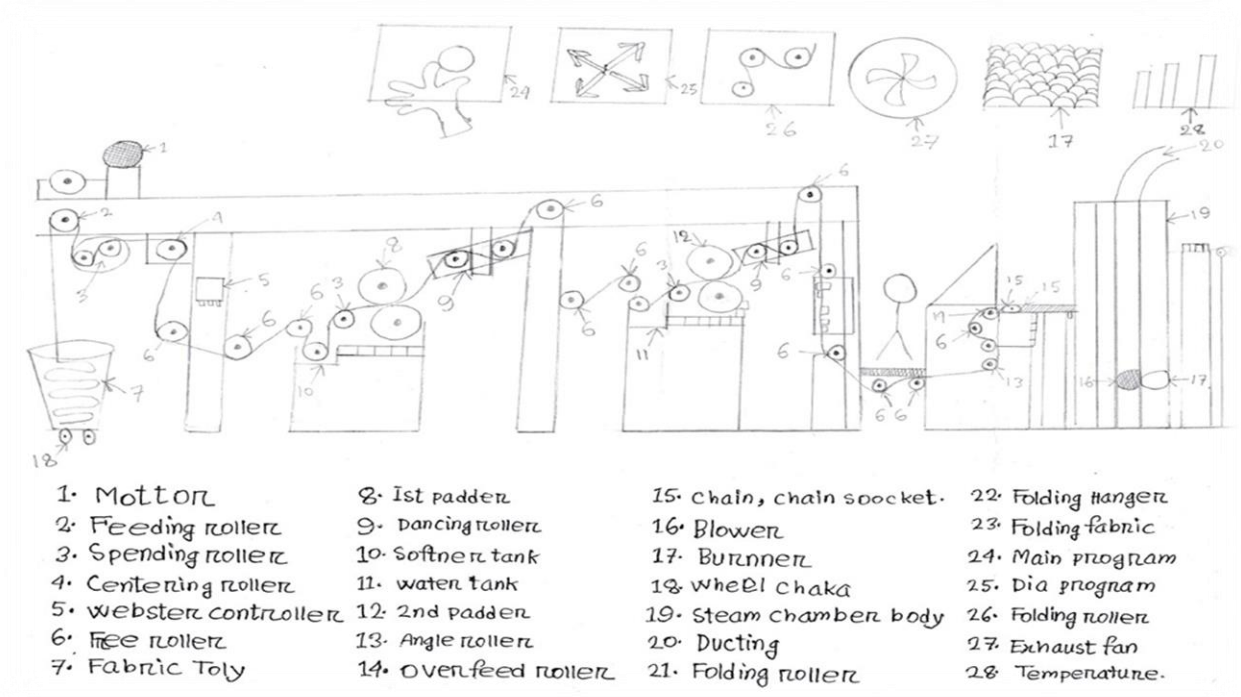


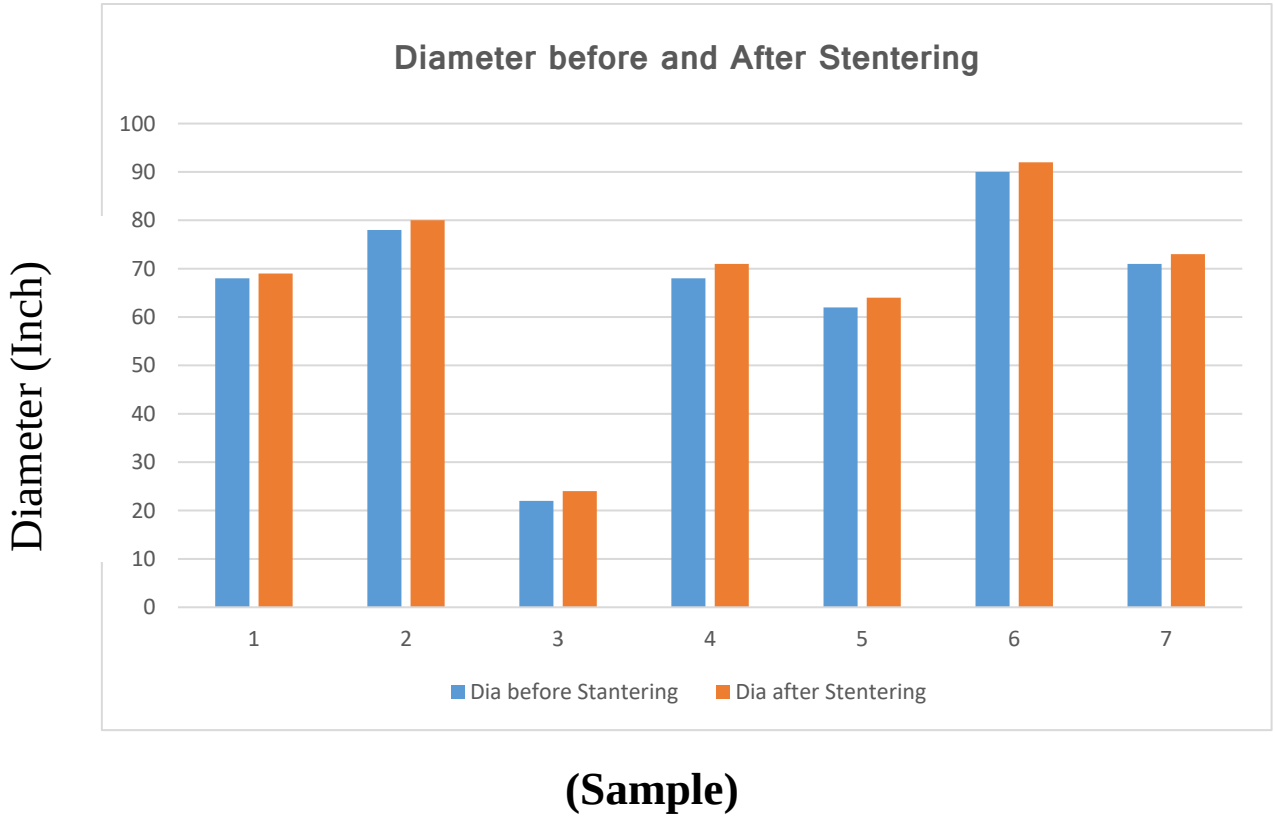

**Figure-2.3 :Stenter Machine**

### 4.1. Analysis for Diameter Change:

After comparing fabric Width before Stentering and fabric Width after Stentering of four samples we get percentage of changing Width.

### 4.1 Table : Diameter before and After Stentering.

| Sample NO | Sample Name | Dia before Stantering | Over feed% | Dia after Stentering | Change of Dia | Percentage change of Diameter |
|---|---|---|---|---|---|---|
| 1 | Single jursy | 68" | 60 | 69" | 1" | 1.47 |
| 2 | Long inject Terry | 78" | 30 | 80" | 2" | 2.56 |
| 3 | 2x 1Rib | 22" | 30 | 24" | 2" | 9.09 |
| 4 | Lycra Terry | 68" | 40 | 71" | 3" | 4.41 |
| 5 | Slub single jursy | 62" | 60 | 64" | 3" | 3.22 |
| 6 | Pk | 90" | 35 | 92" | 3" | 2.22 |
| 7 | single jursy Viscose | 71" | 30 | 73" | 3" | 2.81 |

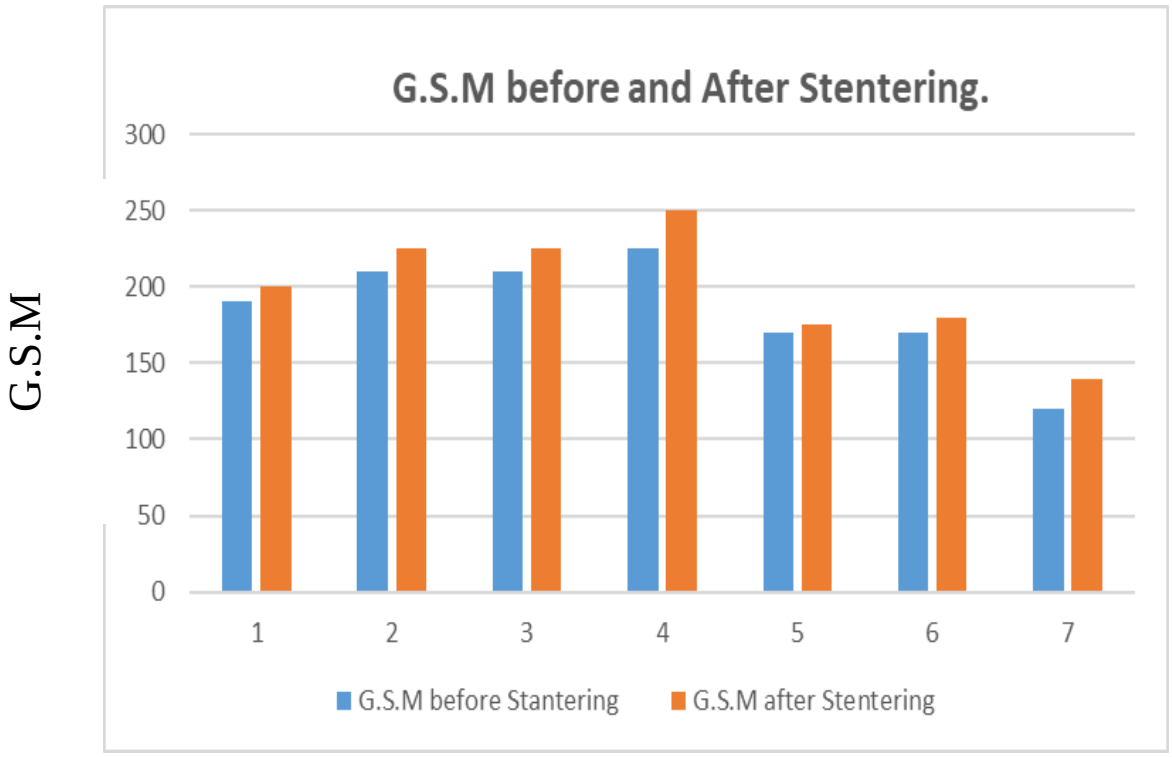


### 4.2. Analysis for GSM Change:

After comparing fabric GSM before Stentering and fabric Width after Stentering of four samples we get percentage of changing GSM

### 4.2. Table : G.S.M before and After Stentering.

| Sample NO | Sample Name | G.S.M before Stantering | Over feed% | G.S.M after Stentering | Change of G.S.M | Percentage change of G.S.M |
|---|---|---|---|---|---|---|
| 1 | Single jursy | 190 | 60 | 200 | 10 | 5.26 |
| 2 | Long inject Terry | 210 | 30 | 225 | 15 | 7.14 |
| 3 | 2x 1Rib | 210 | 30 | 225 | 15 | 7.14 |
| 4 | Lycra Terry | 225 | 40 | 250 | 25 | 11.11 |
| 5 | Slub single jursy | 170 | 60 | 175 | 5 | 2.94 |
| 6 | Pk | 170 | 65 | 180 | 10 | 55.88 |
| 7 | Single jursy Viscose | 120 | 30 | 140 | 20 | 16.67 |




**(Sample)**

# CHAPTER -5
# CONCLUSION

**Conclusion :**

This project work basically helps me to meet the knowledge about Stentermachine.It is a important study in the field of wet processing technology. The study confirmed that Stentermachine for fabrics and always so obvious for finished fabric. Stentermachine is used for bio-polish process which gives fabrics a clear, luster & even surface appearance. It important to identify which Stenter machine is more effective for GSM& Fabric diameter. Comparing the two different material of Stenter machine, it can be said that both not lead to same result. Our results show that the GSM & Fabric diameter of Stenter machine.

Finally once again thanks to our honorable teacher, I am still here as a reflection of your kind hard work. And my precious family for their never ending loves and inspire at every stages of my life. Without their continuous support I realized that I would not be a person I am right.

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