Faculty of Engineering

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STUDY OF THE EFFECTS OF DRYER MACHINE ON KNIT FABRIC PROPERTIES

Course Code: **TE4214** 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 Wet Processing Technology

Spring-2018

STUDY OF THE EFFECTS OF DRYER MACHINE ON KNIT FABRIC PROPERTIES

DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Sumon Mozumder, Assistant Professor,** Department of Textile Engineering, Faculty of Engineering, Daffodil International University. We also declare that, neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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LETTER OF APPROVAL

This project report prepared by Md. Babul Hossen Howlader (ID: 152-23-4392) and F.M.A. Sayem (ID: 152-23-4305), is approved in Partial Fulfillment of the Requirement for the Degree of BACHELOR OF SCIENCE IN TEXTILE ENGINEERING. The said students have completed their project work under my supervision. During the research period I found them sincere, hardworking and enthusiastic.

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ACKNOWLEDGEMENT

Firstly, we express our gratefulness to almighty Allah for his divine blessing makes us possible to complete this project successfully.

We are grateful to our supervisor **Sumon Mozumder,** Assistant Professor, Department of Textile Engineering, Faculty of Engineering, Daffodil international University. Deep knowledge and keen interests of our supervisor in the field of textile dyeing and finishing influenced us to carry out the project work. His endless patience, scholarly guidance, continual encouragement, energetic supervision, constructive criticism, valuable advice, reading many inferior draft and correcting these at all stages have made it possible to complete this project.

We would like to express our thanks to **Prof. Dr. Md. Mahbubul Haque**, Head, Department of Textile Engineering, Faculty of Engineering, Daffodil international University for his kind help to finish our project report. We would like to express our thanks to **Prof. Dr. Md. Zulhash Uddin**, Dean, BUTex and **Prof. Dr. S.M. Mahbub Ul Haque Majumder,** Dean, Department of Textile Engineering for providing us necessary information to complete the report on time.

We would like to deliver thanks to our entire course mates in Daffodil International University, who took part in the discussion while completing the course work.

Finally, we would like to express a sense of gratitude to our beloved parents and friends for their mental support, strength and assistance throughout writing the project report.

This projects report is dedicated to our respected Parents

ABSTRACT

Dryer machine is a very important machine in textile finishing process. Dryer machine is commonly used in textile finishing sector because of having many advantages such as drying the fabric & controlling of fabric GSM, width, shrinkage, spirality and shade variation. Drying process is a mechanical process which is done by the dryer machine. It was very important to observe the effects of drying on knit fabric properties. The project title was hereby designed as "Effect of Dryer Machine on the knit fabric properties". We have selected nine different knit fabric samples including single jersey, terry fleece, Lacoste, (1x1) rib, pique, stripe, interlock and collar fabric those were used in this research work. The aim of our work was to assess the effects of drying machine on knitted fabric properties. GSM and WPI, CPI, SL of those knit fabrics were calculated before and after drying and the effects have been observed. By this work it has been seen that after drying the fabric GSM is decreased because the fabric comes from squeezer machine and here the fabric carry some water and to dry the fabric by dryer machine the GSM decreased after drying. But some of the fabric WPI, CPI, & SL are increased after drying. The process of changing these parameters is related with the machine speed, temperature and overfeed (%) and that were studied very carefully.

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1.1 Introduction:

After squeezing a process is coming that drying the fabric and yarn, is known as drying process. This process is done by a machine that name is dryer machine. Dryer machine (drying process) includes the finishing section. In textile finishing, drying process are very important. Drying process is used for dry the textile materials (fabric and yarn). Both fabrics, woven and knit fabric is dried by dryer machine. All form of knit fabric like open form and tube form is dried by dryer machine. Dyed yarn is also dried. But the process of drying and drying mechanism of fabric and yarn is different from each other. To reduce or eliminate the water from the fabric, drying process is necessary. From the fabric, the liquid portion of water is evaporated by dryer machine and is known as drying process. Not only removed water but also remove other solution or solvent by this machine. So it can be said that the main function of a dryer machine to dry the textile materials.

The broad objective of this work is to study the effects of Dryer Machine on the knit fabric properties.

The specific objectives of this work are:

- ❖ To know about dryer machine & how the dryer machine dry the fabric.
- ❖ To know how to control GSM and how to control shrinkage (%) that depends on the temperature, overfeed (%) & machine speed.
- ❖ To know the change of GSM percentage (%), the change of WPI percentage (%), the change of CPI percentage (%) & to know the change of Stitch length (SL) percentage (%).
- ❖ To know the relation between overfeed % with GSM, WPI, CPI & Stitch length (SL).

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CHAPTER-2

LITERATURE REVIEW

2.1. Dewatering Machine:

De-watering machine is used in case of tube or open form fabric after dyeing; in knit fabric finishing. For water removing, in case of piece goods fabric hydro-extractor machine is used. During de-watering process additional chemical is used for soften the fabric. There are many types of operational parameter are controlled during de-watering process [1].

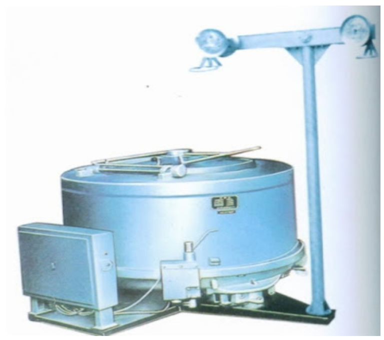


Figure 2.1: Dewatering Machine

Objectives of Dewatering Machine:

There are many objectives are achieved by the de-watering process. The main objectives of the de-watering machine are given below:

- By the de-watering machine excess or remaining water is removed.
- Sometimes softener is applying during de-watering process.
- To control GSM is controlled & overfeed is applied
- To control crease mark of the fabric
- To change the fabric form
- To do the width-wise stretch
- By this process, fabric is turn into plait form [1].

Main Feature of De-watering Machine:

- ✓ The machine is made of high quality stainless steel.
- ✓ Smooth running with superior performance.

- ✓ Dewatering rate is high.
- ✓ It is made by Germany technology according to international standard
- ✓ High capacity, low consumption.
- ✓ Shock proof, timing, automatic and safety control.

Different Parts name of Dewatering Machine:

1. Hand Wheel
2. Turn Tube
3. Squeezing Roller
4. Guide Wheel
5. Spreader
6. Security Shield
7. Air Injection Switch
8. Photocell

Softener is applying to the knit fabric; during de-watering process. Also, there are many types of chemicals can be applied on the fabric by this de-watering machine. It's important to maintain uniform tension during operation otherwise GSM of the can be vary in different parts of the fabric [1].

2.2. De-watering machine for open fabric:

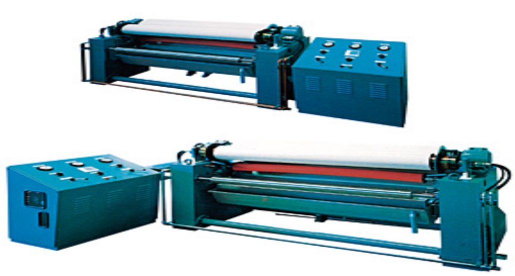


Figure 2.2: Water Removal Padder Machine

Main Parts of Padder machine:

- o Padder Roller- To remove water
- o Over Feeding Wheels- To control GSM
- o Delivery Roller - To deliver the fabric in folded form

- Padder for softener – This roller is used for only when softener is used that make the fabric is soft [1].

2.2.1. Work Instruction of Padder Machine:

Table2.1: Work instructional parameter of padder machine [4].

Fabric Type	GSM	Speed m/min	Pad Pressure 01 bar	Pad Pressure 02 bar	Overfeed (%)
100 % Cotton Single jersey	130-150	28-30	2.0-2.5	2.5-3.0	40
100 % Cotton Single jersey	160-200	23-27	2.5-3.0	3.0-3.5	50
CVC Terry fleece Fabric	250-300	18-22	3.0-3.5	3.5-4.0	50
50/50 PC D/Lacoste	210-240	20-23	2.5-3.0	3.0-3.5	50
100% Cotton (1 x 1) Rib	190-210	23-25	2.5-3.0	3.0-3.5	40
100% Double Pique Fabric	200-250	22-23	3.0	3.0-4.0	50
100% Cotton Stripe Fabric	120-160	28-30	20-2.5	2.5-3.0	40
100% Cotton Interlock Fabric	180-200	22-25	2.5-3.0	3.0-3.5	40
100% Cotton Collar Fabric	220-250	22-23	3.0	3.0-4.0	50

2.2.2. Limitation of Water Removal Padder Machine:

- Worker does not record the pressure, in dia and out dia of different fabric in record book.
- Worker sets the pressure of squeeze roller for different fabrics same. But higher GSM fabric needs more pressure than lower GSM fabric and removal of excess water is not sufficient.

2.3. De-watering Machine for Tube Fabric:

For tube fabric there are two types of machine is use. They are –

1. Squeezing Machine
2. Hydro-extractor

2.3.1. Squeezing Machine:

Basically, it is used in tubular fabric. After dyeing process from the dyeing machine then the fabrics are ready for squeezing. It is a process to remove the water from the fabrics partially by squeezing. It plays an important role in knit finishing section of the knit fabrics. Squeezing machine is also give pressure for reducing water from the wet fabric. It reduces the water content of the fabric. Here is also a softener bath [4].

Figure 2.3: Squeezer Machine

Objectives of Squeezer Machine:

- To remove water from the fabric.
- To control the width of the fabric.
- To control the length of the fabric.
- To control the over feeding system.
- To increase the softness of the fabric.
- To remove the crease mark of the fabric.
- To reduce fabric surface water content.
- Squeezing the fabric for proper softening chemical penetration.
- Applying softening chemicals to the fabric.

Specification of Squeezer Machine:

Brand name	: CORINO MACHINE
Type/model no	: -ST2-
Origin	: Italy

No of motor	: 11
Price of machine	: 1.5 core
Year	: 2007
Capacity	: 7 tons / shift.

2.3.2. Function of Squeezer Machine:

- After dyeing squeezer machine is used to remove excess water.
- By squeezing machine; delivered fabric to create free state.
- Before squeezing balloon is formed with the help of compressed air passing by a nozzle or air spray.
- By over feeding mechanism it can control the diameter of fabric and GSM.
- I t also be controlled Shrinkage Percentage.
- By using required softener; it imparts soft finish to the fabric.

Function of Squeezer machine Parts:

1) **Turn Table:** Turn Table controls the fabric rotation.
2) **De-twister:** By the de-twister rope formed fabric become untwists form.
3) **Motor:** Produce compressed air in tubular fabric.
4) **Padder roller:** To create pressure into the fabric by this rubber coated roller that is called padder roller.
5) **Tanky:** Two tanky are placed in this machine. They are - Chemical Tank and Water Tank.
6) **Pressure Meter:** This meter is controlled by the pressure of squeezer.
7) **Monitor:** To control all process of this machine.
8) **Spirality roller:** By this roller spirality and twisting is controlled.
9) **Conveyor belt:** By conveyor belt the fabric passes into spirality roller to folding roller /delivery roller.

10) **Folding/ Delivery roller:** By folding roller fold the fabric and keep into the fabric carries.

2.3.3. Working Principle of Squeezer Machine:

After completing the dyeing process then the fabrics are ready for de-watering. The de-watering machine tubular fabrics are mainly processed. There is a magnetic sensor which scene the twist of the fabric and it's direction and turn the fabric in opposite direction to remove twist automatically. Here dewatering is performed. De-watering is the process to remove the water from the fabric completely by squeezing and by the padder; it is done. A suitable expander is used before the fabric is passed through the nip of the padder, which expands fabric flat wise and adjust the width [5].

2.3.4. Hydro Extractor Machine:

Hydro-extractor is a machine which is used in textile processing industry. And it is also known as centrifugal machine. By centrifugal extraction; hydro extractor machine is used for removing excess water from fabric. By this process; about 65% water is removed. It is playing an important role after passing dyeing section [2].

Figure 2.4: Hydro-extractor Machine

Hydro extraction process is removed water (the water quantity varies according to the type of fiber) by dispersed in the fibers by mechanical action; this process aims at reducing energy consumption and is carried out before the final fabric drying or between the various wet processing stages (washing, dyeing).

Function of Hydro-extractor Machine:

- By using centrifugal extraction; hydro extractor machine used for removing excess water from fabric or garments.

- By this process; about 75% water is removed.
- After extraction we can find out the efficiency of the hydro extractor and the extraction time is about 5-10 min.

Working Principle of Hydro-extractor Machine:

- Squeezing: The water dispersed on the surface and in the spaces of the fabric is removed by means of the pressure applied by two cylinders.
- Centrifugation: This process eliminates the greatest quantity of water dispersed on the surface of the textile by centrifugal force. It is applied above all to resistant yarns, knitted goods and fabrics.
- Steam pressure: A high-speed steam jet blown on the whole width of the stretched fabric passes through the cloth and eliminates the water in excess. Extracted water and steam are condensed and reused.
- Vacuum: This method applies vacuum technology and is used to dry very wet fabrics or delicate fabrics that do not stand up to the pressure of the cylinders of a squeezing unit, which could negatively affect the surface structure. The stretched fabric slides open-width above the opening of a cylinder-shaped structure connected to a suction system. The air drawn from outside removes the exceeding water when passing through the textile cloth.

2.4. Dryer Machine:

After squeezing a process is coming that drying the fabric and yarn, is known as drying. This process is done by a machine that name is dryer machine. Dryer machine (drying process) is including the finishing section. In textile finishing, drying process are very important because drying process is used for dry the textile materials (fabric and yarn).In finishing section of wet processing industry drying machine is used after de-watering of fabric. In textile finishing unit; dryer is used for dry the knit, woven fabrics and dyed yarn. We can be defined drying is a process where the total liquid portion of the solution is evaporated from the textile materials. The water dispersed in a textile material by chemical-physical process that is generally eliminated by the action of hot air which makes the water or liquid portion is evaporated; during the drying process. Drying process is used to remove the water and dry the fabric with the help of steam. Besides drying is controlled the shrinkage %, GSM, dia etc. and prepared the fabric for the next process. Another word, a dryer is a machine which is used to remove water from the garments and it is one of the common machines in finishing section. In finishing section it's important is more. Both fabrics, woven and knit fabric is dried by dryer machine. All form of knit fabric like open form and tube form is dried by dryer machine. Dyed yarn is also dried. But the process of drying and drying mechanism of fabric and yarn is different from each other. To reduce or eliminate the water from the fabric, drying process is necessary. From the fabric, the liquid portion of water is evaporated by dryer machine and is known as drying process. Not only removed water but also remove other solution or solvent by this machine. So it can be said that the main function of a dryer machine to dry the textile materials [14].

Figure 2.5: Dryer Machine

2.4.1. Features of Drying Process:

- To dry the fabric
- To maintain the temperature and speed that depend on color shade
- To control shrinkage percentage (%)
- To control GSM (Gram Per Square Meter)
- To control vibration of the fabric
- To maintain overfeed
- To control the color shade
- To adjust the tone of the fabric
- Basically, it is used for wet tube fabric

- To improve the finishing requirement
- To march the fabric color shade.

Important Feature of Dryer Machine:

- Steam dryer
- 3 chamber
- In heating zone; vibration is occurred.
- Air pressure switch is present.
- Steam control switch is also present.
- Maximum temperature; up to 170(°C)
- 5 Conveyor belt present
- 2 burner is also be present
- It has also 4 cylinders.

2.4.2. Considering Points for Selecting a Dryer Machine:

Following points should be considered during by a dryer [13].

- ✓ Heating Method: The textile material may be heated by gas burner or steam.
- ✓ Chamber : Number of chamber.
- ✓ Burner : Number of burner.

2.4.3. Different Parts Name of Dryer Machine:

1) Flower
2) Inverter
3) Contact
4) Motor
5) Temperature Meter
6) Monitor
7) Limit Switch
8) Emergency Sensor
9) Emergency

10) Stop
11) Roller
12) Ring
13) Gear Box
14) Net
15) Burner Gas
16) Alarm Switch
17) Screw
18) Adjust Fan
19) Thermometer
20) Nozzle
21) Gas Pipe
22) Gas Meter
23) Pressure Meter
24) Cylinder
25) Chain
26) Bearing
27) Belt
28) Plain Board
29) Wheel
30) Electric Wear

Main Parts of a Dryer Machine:

- Chamber – 3
- Burner – 2 pieces
- Conveyor Belt – 5 pieces
- Blower Fan – 6 pieces
- Blower Motor – 15 pieces
- Cylinder – 4pieces
- Exhaust Fan
- Total Roller – 22 pieces
    1. Hot Roller – 3 pieces
    2. Delivery Roller – 3 pieces
    3. High Roller – 2 pieces
    4. Folding Roller – 2 pieces

5. Normal Roller – 12 pieces.

2.4.4. Function of Different Parts of a Dryer Machine:

- Flower: To flow the wind and cool the chamber by the help of motor. By the flower; to clean the textile materials.
- Inverter: To adjust the motor that motor works freely.
- Contact: It is adjust with switch that's result motor is running.
- Temperature Meter: By this meter we control the temperature. And also increase or decrease the temperature by this meter.
- Monitor: To show the all information of dryer machine, that's why we get all information very easily like – temperature, overfeed, speed, compaction % etc.
- Limit Switch: To control the net, that's why net is running freely.
- Emergency Sensor: If any problem occurs in dryer machine then emergency sensor gives a signal automatically.
- Emergency: This part work automatically when problem occurs.
- Stop: By this part dryer machine is stopped.
- Roller: By roller fabric pass. There are many types of roller. They are – hot roller, delivery roller, input roller, high roller, normal roller etc.
- Ring – To catch the fabric that the dia is controlled according buyer requirement.
- Gear Box: In these box; gear is present and these gear give energy to run the roller.
- Net: By the help of net; textile material passes and going to the chamber.
- Burner (Gas): Burner produces heat that's why liquid portion is evaporated from the fabric.
- Alarm Switch: If any problem creates, then this switch gives signal.
- Adjust Fan: To give air and cool the textile material and cylinder and roller.

- Thermometer: By this meter; temperature is measured.
- Nozzle: By this part air and gas is passed.
- Gas Pipe: Gas is passed by this pipe; that's why burner gets energy and produce required amount of heat.
- Gas Meter: By this meter we measure the amount of gas is passed by the gas pipe and how amount of gas is required for burning and also see the pressure of gas.
- Cylinder: There are 4 cylinders. It helps to remove water from the textile materials and dry the fabric.
- Chain: To give energy that's why rollers and conveyor belts are running and fabric is passing in front.
- Bearing: To give the reciprocating motion of roller, cylinder, motor and that's why roller, cylinder, motors are running easily.
- Belt: By the help of a belt conveyor belt runs. And also by the help of motor and belt roller is also running easily.
- Plain Board: In this board monitor is set up.
- Wheel: To give the running motion of belt. That's why roller, cylinder, motor, conveyor belt gets the motion is automatically.
- Electric wear: By the electric wear; electricity is present. That's why machine gets energy and for this reason machine runs.
- Folding Roller: By folding roller to fold the fabric and that's why fabric carries and store easily.

2.4.5. Various Drying System:

- Hot air dryer
- Radio frequency dryer
- Pressure dryer
- Infra-red dryer

- Cylinder dryer-

    1. Float dryer / Loop dryer
    2. Tensionless dryer / Shrink dryer
    3. Stenter Machine.

2.4.6. Special Drying Systems:

The water dispersed in a textile material by chemical-physical process that is generally eliminated by the action of hot air which makes the water or liquid portion is evaporated; during the drying process. It is very important to carefully consider the way of heat is directed on the fabric. The drying process can be carried out:

- By heat convection
- By contact with heated metal surfaces
- By infra-red radiation
- By means of microwaves or high frequency waves e.g. fabric and yarn package dryer
- By combustion

Yarns and textile materials in bulks are generally dried inside hot air compartments. For the drying of piece fabrics and manufacturers have designed different drying units which apply different principles [15].

Drying by Heat Convection:

Drying is defined as a process where the liquid portion of the solution like water is evaporated from the fabric. The heat diffusion onto the wet fabric is carried out by means of hot air circulating inside the drying unit [15].

Employment: Relax dryer for knit fabric, Stenter.

Figure 2.6: Relax Dryer Machine

Contract Drying:

By this system the fabric moves forward arranged on several heated drums or cylinders. The drying temperature range between120-130 (°C) and the cylinders are heated by means of stem at a pressure of 1-3 atm [15].

Figure 2.7: Cylinder Drying Machine

Infrared Radiation Drying:

Infrared radiation (near and medium infrared field) can be absorbed by the fabric and transformed into heat which helps to the drying of fabric [15].

Employments: Woven fabrics and yarn package drying.

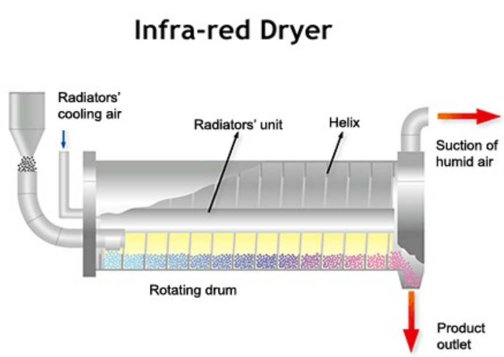


Figure 2.8: Anatomy figure of Infrared dryer

Microwave Drying:

By means of radio frequency waves, heat develops inside the fabric in a quality that is proportional to the water dispersed in it. Radio frequency penetrates to the core of the product and heats every part evenly to dry the product especially used for yarn in package form [15].

Employment: Yarn package drying.

Figure 2.9: Yarn Package Drying

2.4.7. Working Principle of Drying Machine:

After de-watering process; then the fabric is passing through the dryer machine. The main function of the dryer machine is given below-

- To remove water and dry the fabric
- To control the overfeed system
- To control the vibration
- To control GSM

This machine contains 3 chambers. Two mesh endless conveyors are placed lengthwise to the chamber named conveyor belt (net) and filter net, each chamber contain a burner, which is supplied hot air .This hot air guides the ducting line by the suction fan .There are a nozzle that is placed in between filter net and conveyor net. When the fabric pass on the conveyor net, hot air is supplied to the wet fabric and this fabric dry it. There is exhaust fan which such the wet air and deliver to the atmosphere through the ducting line. The speed of the dryer machine depends on the temperature of the machine and the G.S.M of the fabric . If the machine temperature is high then machine speed also high and the machine temperature is low then machine speed is low [6].

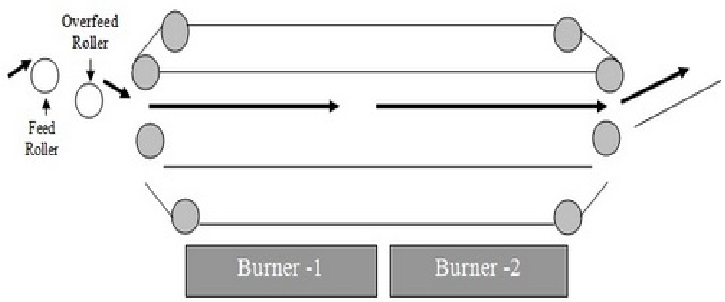


Figure 2.10: Passage Diagram of the Fabric in Dryer Machine

Working Procedure of Drying Machine:

1. After de-watering process, at first the fabric is feed in feed roller from the trolley. Here 2 rings are present that catch the fabric and that's why to control diameter of fabric.
2. Then the fabric passes through the conveyor belt from the feed roller.
3. Then the fabric is going to the chamber by the help of conveyor net. In the down of chamber 2 burners are present and these burners give heat. And that's why water is removed and dry the fabric. The main work of a dryer machine occurs here.
4. After removing water; the fabric goes to outside from the chamber.
5. Then the fabric passes the conveyor belt which is running by the help of roller.
6. And then the fabric passes different guide roller and goes to folding roller.
7. At last, by the help of folding roller the fabric fold and then the fabric is delivered by the help of delivery roller. And finally the fabric is going to the next process.

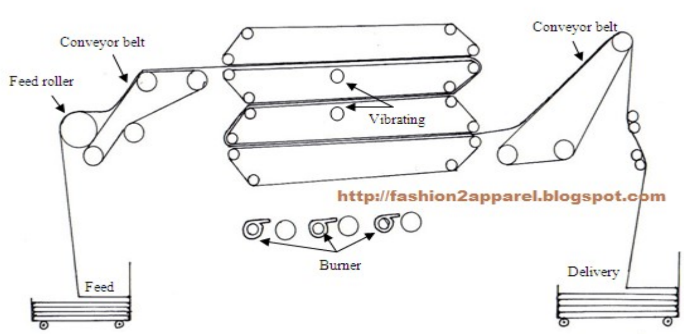


Figure 2.11: Fabric Path Diagram of Dryer Machine

2.5. The Temperature of Different Chamber in Dryer Machine:

The temperature of different chamber that depend on shade and that is given below-

Table2.2: Temperature of Different Chamber in Dryer Machine [6].

Sl.No.	Shade	Chamber 01	Chamber 02	Chamber 03
01	Light	120(°C)	125(°C)	130(°C)
02	Medium	135(°C)	140(°C)	145(°C)
03	Deep	150(°C)	160(°C)	170(°C)
04	Torques	160(°C)	170(°C)	180(°C)

Operating Parameters of Dryer Machine:

1. **Temperature:** To set the temperature between 120(°C) -130(°C) for white and 150(°C) -170(°C) for color fabric. GSM temperature Or, moisture content temperature.
2. **Overfeed:** To set the over feed up to 10~20% or as required to get finish G.S.M.
3. **Speed:** To set the speed as much as possible (5~20m/min).

2.5.1. Work Instruction of Gas Dryer Machine:

Table2.3: Work Instruction of Gas Dryer Machine [6].

Sl. No.	Color	Speed (m/min)	Temperature (°C)
01	Light	8-10	120-130
02	Medium	8-10	120-130
03	Deep	3-4	170-180
04	Torques	5-6	160-170

2.5.2. Parameter Used for Different Types of Fabric in Dryer Machine:

Table2.4: Parameter Used for Different Types of Fabric in Dryer Machine.

Sample No.	Fabric Name	GSM	Speed (rpm)	Overfeed (%)	Temperature (°C)
01	100 % Cotton Single Jersey	145	15.5	5	140
02	100 % Cotton Single Jersey	210	11	12	160
03	CVC Terry fleece Fabric	280	7.5	15	170
04	50/50 PC D/Lacoste	217	10.5	15	170
05	100% Cotton (1 x 1) Rib	190	9	5	160
06	100% Double Pique Fabric	220	10	8	170
07	100% Cotton Stripe Fabric	150	10.5	10	140
08	100% Cotton Interlock Fabric	229	10	5	170
09	100% Cotton Collar Fabric	240	7.5	5	170

Following things are also be considered in case of Dryer Machine:

- If fabric is more **Redder** than the standard one or required sample, then the temperature is reduced.
- If fabric is more **Yellower** than the standard one, then the temperature is increased.
- If fabric is more **Bluer** than the standard one, then the temperature is increased.

All this data's are practiced in mills which may be varied factory to factory [12].

2.5.3. Checking Parameter of Dryer Machine:

During drying of fabric, various types of quality test are done for getting good quality fabric and meet the buyer requirement. Dried knit sample is stored for future proof. Following parameters should be checked. They are-

- Shade Check: After drying of the fabric, dried fabric sample is checked with the buyer given swatch card that is approved by buyer. If any problem or faults are found then the operator informs the supervisor who takes some necessary steps to overcome the identification problem. In dryer; shade of the fabric is adjusted by changing the machine parameter that is depending on the shade type. Experienced personnel is required for identification this problem and take some necessary steps and to overcome this problem.

- Diameter Check: Diameter check or width of the fabric adjust in drying process. Operator measure fabric width by using measuring tape and compare with required width or diameter.
- Weight (GSM) Check: Weight of the fabric is checked by cutting a sample by GSM cutter. And then it measure by electrical balance and at last compares this sample with buyer requirement sample.
- Fabric Fault: Various types of knitting and dyeing faults or problem are checked after the drying process. If any problems are found then take some necessary steps to overcome this problem [12].

Controlling points or Control system:

- Overfeed control – As per required. Higher the GSM higher the over feed.
- Speed control - As much as possible (5~20 rpm). Higher the GSM lower the speed.
- Width control (Diameter) - Fabric width is adjusted as per required width [15].

Standard Operating Procedure:

- Machine should be cleaned.
- Setting of machine as per process requirement.
- Roller should be cleaned.
- Tray of each chamber should be cleaned.
- Function of auto chamber should be checked.
- Function of burner should be checked.
- Any problem should be checked.
- Conveyor belt should be cleaned.
- Air and gas supply should be regularly.
- Parameter set up as per requirement [15].

Utility:

1. Water
2. Electricity

3. Compressed air

4. Gas

Faults of the Machine:

- Create shade variation due to over high temperature and low speed and irregular overfeed of the machine.
- If the direction of the machine is not right for required shade.
- Sometimes; fabrics are burnt for high temperature and low speed for low GSM of the fabric [15].

2.6. Tumble Dryer Machine:

Tumble dryers regularly draw in the ambient air around them and heat it before passing it through the tumbler. The resulting hot, humid air is usually vented outside to make room for more air to continue the drying process. This design is making no effort to recycle the heat put into the load, and thus is considered environmentally wasteful. Nevertheless, it is simple and reliable, and therefore has been widely used. Improvised methods of salvaging this heat for in-home heating, by use of inline vent boxes equipped with a flapper valve to redirect moist heated air to indoor areas, and also be increased humidity within a dwelling [7].

2.6.1. Feature of Tumble Dryer Machine:

- A main feature that is built in to most tumble dryers is the automatic drying function.
- The automatic dryer feature keeps drying your clothes until the sensor detects that it has reached a certain level of dryness [7].

Specification of Tumble Dryer Machine:

- Manufacturer Name :Machinery works Co .Ltd
- Brand :DRYER 160
- Origin :Taiwan

- Capacity :400 ps /hour Or 2 Tons /Shift

Figure 2.12: Industrial Tumble Dryer

2.6.2. Work Instruction of Tumble Dryer Machine:

If quantity is less, then time is also be less.

Table2.5: Work instruction of tumble dryer machine [7].

Sample No.	Fabric Type	Temperature (°C)	Run Time	Cooling Time	Total Time
O1	100 % Cotton Single Jersey	100	40	10	50
02	100 % Cotton Single Jersey	110	40	10	50
03	CVC Terry fleece Fabric	120	40	10	50
04	50/50 PC D/Lacoste	120	40	10	50
05	100% cotton (1 x 1) Rib	120	40	10	50
06	100% Double Pique Fabric	120	40	10	50
07	100% cotton Stripe Fabric	100	40	10	50
08	100% cotton Interlock Fabric	120	40	10	50
09	100% Cotton Collar Fabric	120	40	10	50

2.7. Tensionless & Air Vibration Dryer Machine (BRIO):

2.7.1. Function of BRIO:

- ❖ To dry the texture
- ❖ To keep up the temperature and speed that rely upon shading shade
- ❖ To control shrinkage rate (%)
- ❖ To control GSM (Gram Per Square Meter)
- ❖ To control vibration of the texture
- ❖ To keep up overload
- ❖ To dry forbidden and open width texture without pressure [8].

BRIO Machine Specification:

- ❖ Brand name : Biancalani
- ❖ Company : Italy
- ❖ Speed range : 10-30m/min
- ❖ Temperature range : 110-160(°C)
- ❖ Heating system : Gas fired
- ❖ Capacity : 09-10- tones/shift

Figure 2.13: BRIO Machine

2.7.2. Parameters utilized for various sorts of texture in BRIO:

Table2.6: Parameters for BRIO machine [10].

Sample No.	Types of Fabric	GSM	Speed (m/min)	Temperature (°C)
O1	100% Cotton Single Jersey	130-150	10-20	110-120
02	100% Cotton Single Jersey	150-155	10-20	120-140
03	CVC Terry Fleece Fabric	220-250	20-30	150-160
04	50/50 PC D Lacoste Fabric	190-220	15-25	120-140
05	100% Cotton (1 x 1) Rib	190-210	15-25	120-140
06	100% Cotton Pique Fabric	210-250	20-30	140-160
07	100% Cotton Stripe Fabric	130-150	10-20	110-120
08	100% Cotton Interlock Fabric	210-220	10-20	150-160
09	100% Cotton Collar Fabric	220-250	15-25	120-140

Limitation and Faults of the Machine:

I) Selvedge drying framework isn't appropriately working.

ii) Maximum over encourage of the machine is +60%.

iii) When the steam temperature is 100(°C)-120(°C), at that point conveyed fabric temperature is 45-50(°C). Yet, there is no cooling zone in this machine to lessen the abundance temperature. So a cooling zone in conveyance zone can be appended [8].

Saftey:

Dryers open combustible materials to warm. Guarantors, laboratories, prescribes cleaning the build up channel after each cycle for wellbeing and vitality effectiveness, arrangement of sufficient ventilation, and cleaning of the conduit at customary interims. Guarantors, laboratories. Additionally prescribes that dryers not be utilized for glass fiber, elastic, froth or plastic things, or any things that has had a combustible substance spilled on it [8].

2.8. Production Procedure: Checklist before Production:

Table2.7: Checklist before production [9].

Parameters/Items	Value/Checking

Machine setup	a) Threading of machine according to process prerequisite b) Parameters set up ought to be according to process necessity.
Fabric availability	As per program plan and the course card having test status "alright"
Preparation of Chemical	Checking of planning and furthermore the moving of alcohol to the conveyance tanks.
Tape fabric	Availability
Batches for winding	Availability
Accessories, necessities and utilities	Availability
Machine	Clean Condition
Manpower	Availability

CHAPTER-3

METHODOLOGY

CHAPTER-3

METHODOLOGY

3.1. Materials:

In this project, we used different types of knit fabric. At first we fixed nine samples. That is single jersey, terry fleece, Lacoste, (1 x 1) rib, pique, stripe, interlock and collar fabric. We collected this sample from dryer machine. When a fabric trolley sets on the loading side of dryer machine, in this time we collected before dryer fabric samples from the trolley [9].

3.1.1. Sample Specification:

We have taken the following samples for our study-

Table 3.1: Sample specification

Sample No.	Type of Fabric With Composition	CPI	WPI	Stitch length (in mm)	GSM
01	100 % Cotton Single jersey	55	40	2.5	145
02	100 % Cotton Single jersey	65	44	2.54	210
03	CVC Terry fleece Fabric	45	32	2.81	280
04	50/50 PC D/Lacoste	32	23	2.69	217
05	100% Cotton (1 x 1) Rib	45	33	2.72	190
06	100% Double Pique Fabric	52	33	2.42	220
07	100% Cotton Stripe Fabric	45	31	2.64	150
08	100% Cotton Interlock Fabric	60	37	3.11	229
09	100% Cotton Collar Fabric	33	20	4.05	240

3.2. Method:

3.2.1 Method of data collection

In the end of coloring the dyed sample goes to the squeezer machine then next the dyed sample goes to the dryer machine. We have taken nine samples for our testing. We have measured the GSM and distance across (Dia), WPI, CPI, stitch length before drying of the fabric. Then all fabrics are stored for our testing. After the drying we have collected the same nine fabric samples. And also collected for our testing the machine speed, overfeed (%), temperature that are applied in that nine samples drying. All of this data is input for our study. Then we measured GSM. GSM is measured by electrical balance. For GSM measure, at first cut the fabric by GSM cutter and then it is measured by electrical balance. Then the distance across of the fabric (Dia) was measured by measuring tape before and after drying. Also, by the use of counting glass scissor and needle we are measured WPI and CPI of the fixed sample before and after drying. And furthermore by the use of measuring scale and the formula of stitch length we are measured stitch length in mm. By this we are collected this data for our study. The process flow chart of our project given below:

Before drying sample

↓

Machine parameter collection from machine

↓

Drying process

↓

Collection after drying sample

↓

Calculate GSM, WPI, CPI and SL of all samples

↓

Listed all data in different tables

↓

Analysis the data of fabric with the help of suitable bar diagram and scatter chart

Specification of Dryer Machine:

❖ Brand Name : LK & LH CO; LTD

- Type : 0F42500NG
- Origin : W/W 2350, 41-1 EAST CHIUIU, TAOUAN, TAIWAN.
- Capacity : Maximum 10 Ton
- MFG NO : C00377
- Fax : 886-3-3292488~9
- Date : 2007-08
- Used Utilities : Water Electricity and Compressed air
- Certified : ISO 9001 CERTIFICATE APPR

Figure 3.1: Textile Dryer Machine

3.2.2 Method of testing:

→ Calculation of grams per square meter (GSM):

To calculate the Fabric's GSM before drying first, we collected the sample from the loading side of dryer m/c. Then we cut the sample by GSM cutter. Diameter of the GSM cutter is 11.2 cm. Then we weighted the cut sample by electronic balance and then we multiply the value by 100 and got desired GSM of the fabric. This process is required for both initial fabric (Fabric before drying process) and for final fabric (Fabric after drying process). Here we get two GSM of the fabric. By follow the formula of Percentage (%) of variation in GSM we find the change of percentage of variation in GSM.

Percentage (%) of change in GSM = (GSM after drying – GSM before drying) x 100 / GSM before drying

→ Calculation of wales per inch (WPI):

Wales per inch (WPI) indicates the total numbers of wales in one inch of linear fabric. WPI is one of the important parameters to determine GSM of knit fabric and other fabric properties. To calculate WPI, we took 1 inch of sample and then count the wales widthwise. Then we calculate percentage of change in WPI after drying. Following formula was used to calculate the percentage (%) of variation of WPI.

Percentage of variation in WPI = (WPI after drying – WPI before drying) x 100 / WPI before drying

→ **Calculation of course per inch (CPI):**

Course per inch (CPI) indicates the numbers of course in one inch of linear fabric. In the some manner, CPI is one of the important parameters to determine GSM of knit fabric and other fabric properties. To calculate CPI, we took 1 inch of sample and then count the course lengthwise. Then we calculate percentage of change in CPI after drying. Following formula was used to calculate the percentage (%) of variation of CPI.

Percentage of variation in CPI = (CPI after drying – CPI before drying) x 100 / CPI before drying

→ **Calculation of stitch length (SL):**

Stitch length is theoretically the single length of yarn which include one needle loop and half of a sinker loop between that needle loop and the adjacent needle loop. Then length is measured in millimeter (mm). It influences fabric dimension other properties including weight. To find out stitch length we open a yarn from 1 inch of sample. Then stretch the yarn and measure the length in inches and convert it to millimeter (mm). Divide the length by the wales number in one inch of that sample to get stitch length (SL). Then we calculate percentage of change in stitch length (SL) after drying. Following formula was used to calculate the percentage (%) of variation of SL.

Percentage (%) of variation in SL = (SL after drying – SL before drying) x 100 / SL before drying

3.3. Instrument:

1. Counting Glass**:** By the use of counting glass we can be measured the ends per inch (EPI) and picks per inch (PPI) for woven fabric and for knit fabric we can be measured wales per inch (WPI) and courses per inch (CPI) very easily.

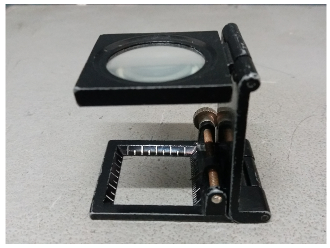


Figure 3.2: Counting Glass

2. Needle: By the use of needle we can count the fabric threads easily.

Figure 3.3: Needle

3. GSM Cutter: By the use of GSM cutter we can cut the GSM of a fabric. It is widely used in any section where GSM is cut and measured.

Figure 3.4: GSM Cutter

4. Electrical Balance: It is widely used for measuring weight. By electrical balance we can be measured weight easily.

Figure 3.5: Electrical Balance

5. Measuring Scale: By measuring scale we measure the length of thread.

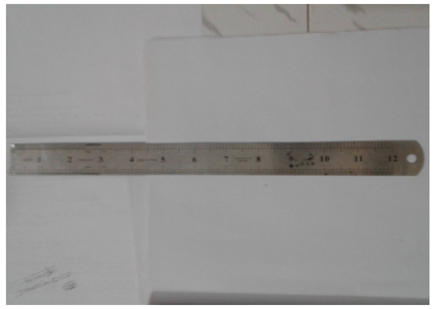


Figure 3.6: Measuring Scale

6. Measuring Tape: We measure the dia and length of fabric by using measuring Tape.

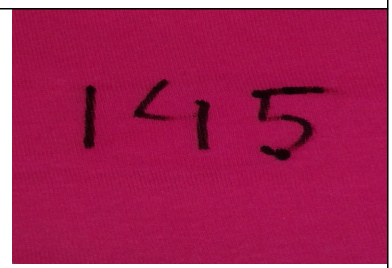
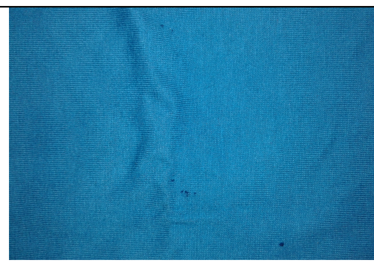
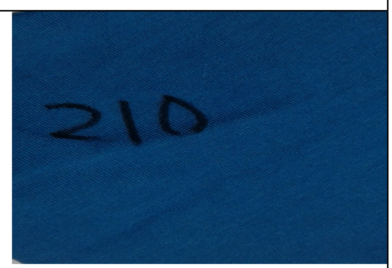
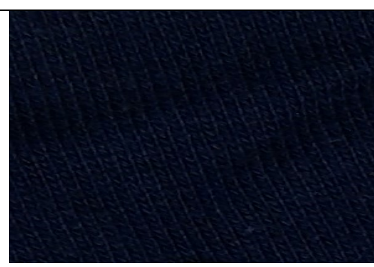
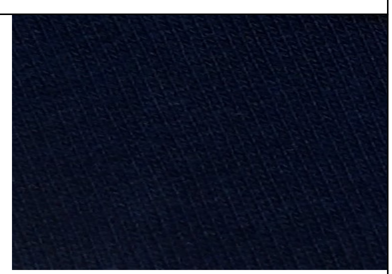
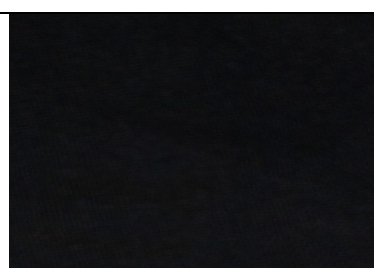
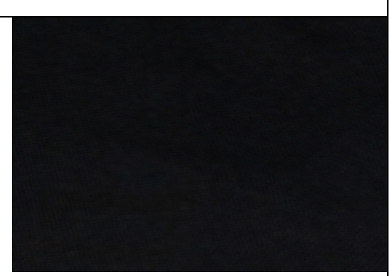
Figure 3.7: Measuring Tape

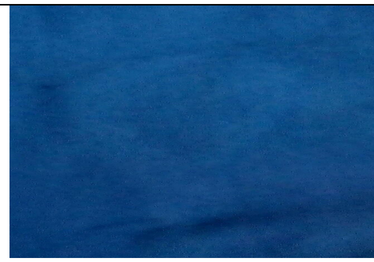
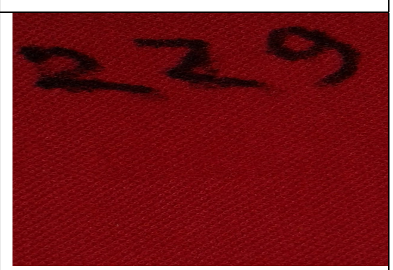
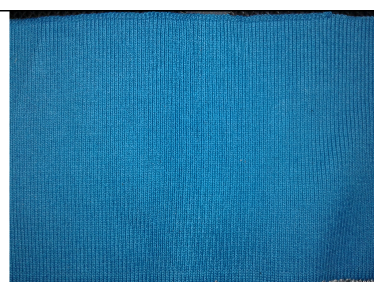
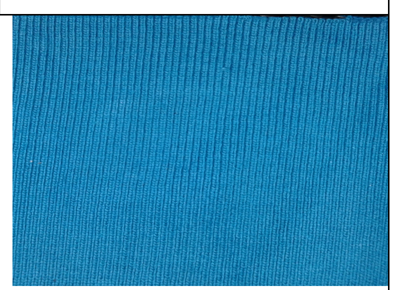
7. Scissor: It is widely used for cutting. When we count WPI, CPI, Stitch length of fabric, then we need scissor for cutting threads.

Figure 3.8: Scissor

3.4. Attached Sample Before and After Drying:

Table 3.2: Sample Attachment

Sample No.	Type of Fabric With Composition	Before Drying	After Drying
01	100 % cotton Single jersey		
02	100 % cotton Single jersey		
03	CVC Terry fleece Fabric		
04	50/50 PC D/Lacoste		

05	100% cotton (1 x 1) Rib		
06	Double Pique Fabric		
07	100% cotton Stripe Fabric		
08	100% cotton Interlock Fabric		
09	Collar Fabric		

CHAPTER-4

DISCUSSION OF RESULTS

CHAPTER-4

DISCUSSION OF RESULTS

4.1. Variation in GSM of the fabric samples after drying:

In this work, we have selected some samples and before dryer; GSM of the samples are taken. Then the samples are passed in the dryer machine for further processing. And after dryer; by the GSM cutter we are cut GSM samples in the same fabric and measured by electrical balance. And then we can see that some variation or change in here before and after drying. According to the formula of GSM change percentage (%) we can get the variation in GSM of the fabric samples after drying. And this results are input are following table.

4.1.1. Change of GSM after the Drying:

After drying the change of GSM of different fabrics were recorded in the Table A.1. The change of GSM has been used here to drawn the following figure.

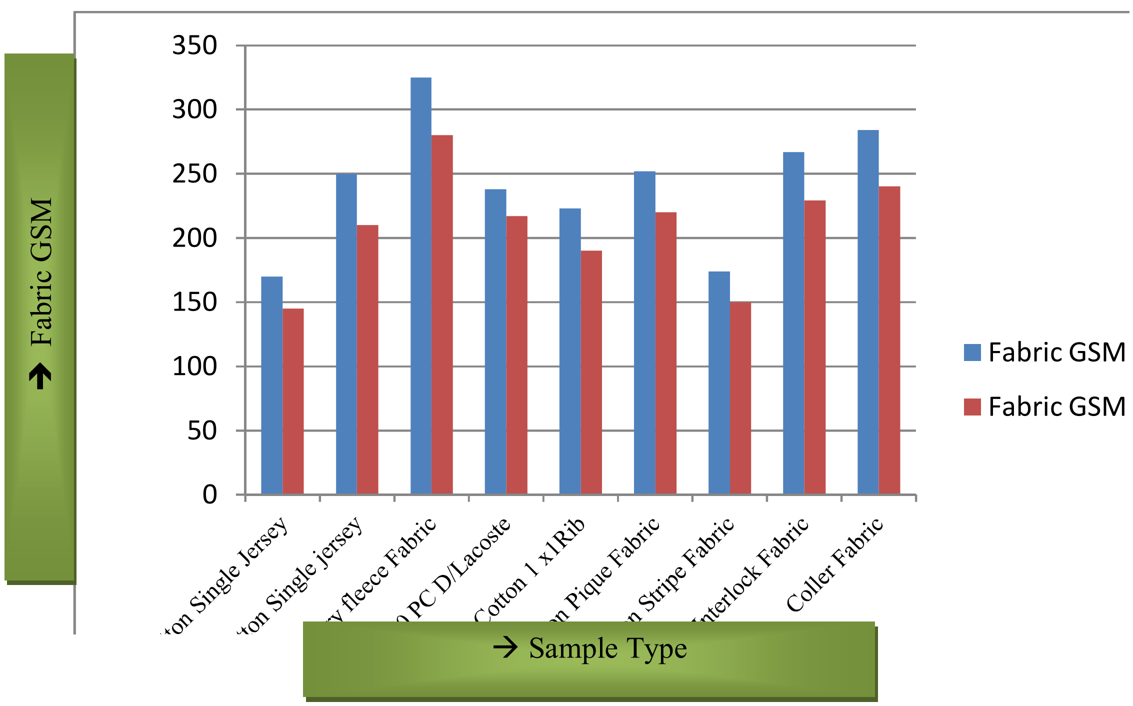


Figure 4.1: Bar diagram represents the change of GSM of knit fabrics after the drying

In this bar diagram "X" axis represents the Sample type and "Y" axis represents the Fabric GSM. The blue bars represent the „GSM before drying" and the red bars represents the „GSM after drying" of the fabric. We see that for every sample GSM raises before drying process. Because the fabrics come from squeezer machine and carry on water for this reason the GSM of before drying is more. For example sample 3 Terry fleece fabric the GSM before dryer raises higher than any other sample. For samples1, 5 & 8 (single jersey, 1 x1 rib & stripe fabric) the GSM after drying is lesser than any other sample [10].

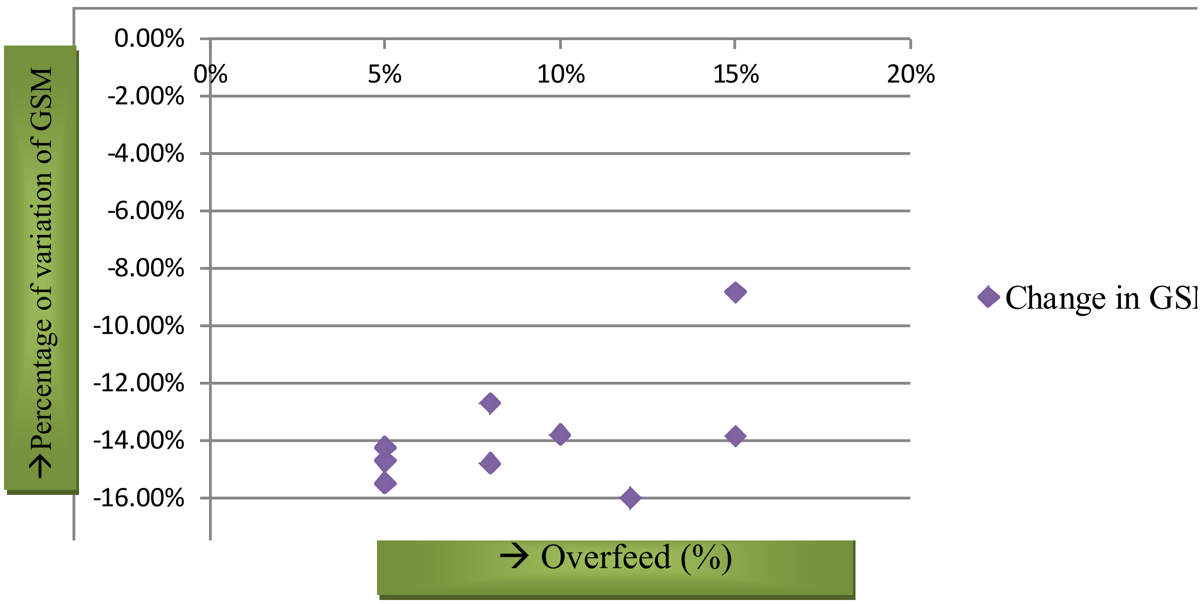


Figure 4.2: Correlation between overfeed% and change of GSM

In this chart "X" axis represents "Overfeed (%)" and "Y" axis represents,, Percentage of variation of GSM‟. We used different types of fabric and those fabrics had different GSM. Form the chart we can see that the percentage of variation of GSM increased slightly with the increase of overfeed (%). Here, for 15% overfeed% the change of GSM is -8.82 (%) and -13.84% because here the two samples change in GSM percentage are same and this fabrics are Lacoste and Terry Fleece. We can also see that the lowest change in GSM is -16% and this fabric is name is Single Jersey & where overfeed (%) is 12%. And for low overfeed 5 (%) where the change of GSM percentage (%) is -14.70 %, -14.79 %, -14.23 %, -15.49 %. We can seen that for low overfeed% the change of GSM is few change and that is more & for high overfeed% the change of GSM is low [11].

4.2. Variation in WPI of the fabric samples after drying:

To calculate WPI, we took 1 inch of sample and then count the wales widthwise. By this way, we got initial and after drying WPI for each sample. Then we compared the after drying WPI with the initial WPI of the sample.

From the table (A.2), we can see that the knit fabric WPI increasing or decreasing is depending on machine speed, temperature and overfeed (%). Changing this parameter of dryer machine, we can change in WPI after drying. From this table, we can see maximum percentage (%) of change in WPI after drying is 5.40% for sample no.8. Initially the WPI of this sample was 37. After drying WPI increase to 39. For this sample, the machine speed was 10 rpm, temperature was 170(°C) and overfeed was 5% of this dryer machine. Here we also see that the minimum percentage (%) of change in WPI after drying is -6.25% for sample no.3. Initially the WPI of the sample was 32. After drying WPI decrease to 30. For this sample the machine speed was 7.5 rpm, temperature was 170(°C) and overfeed 15%. Here we can see that for sample no.8 and sample no.3 the temperature is same but the machine speed of sample no.8 is higher than sample no.3 and also the overfeed (%) of sample no.8 is lower than the sample no.3.

4.2.1. Change of WPI after the drying:

After drying the change of WPI of different fabrics were recorded in the Table A.2. The change of WPI has been used here to drawn the following figure.

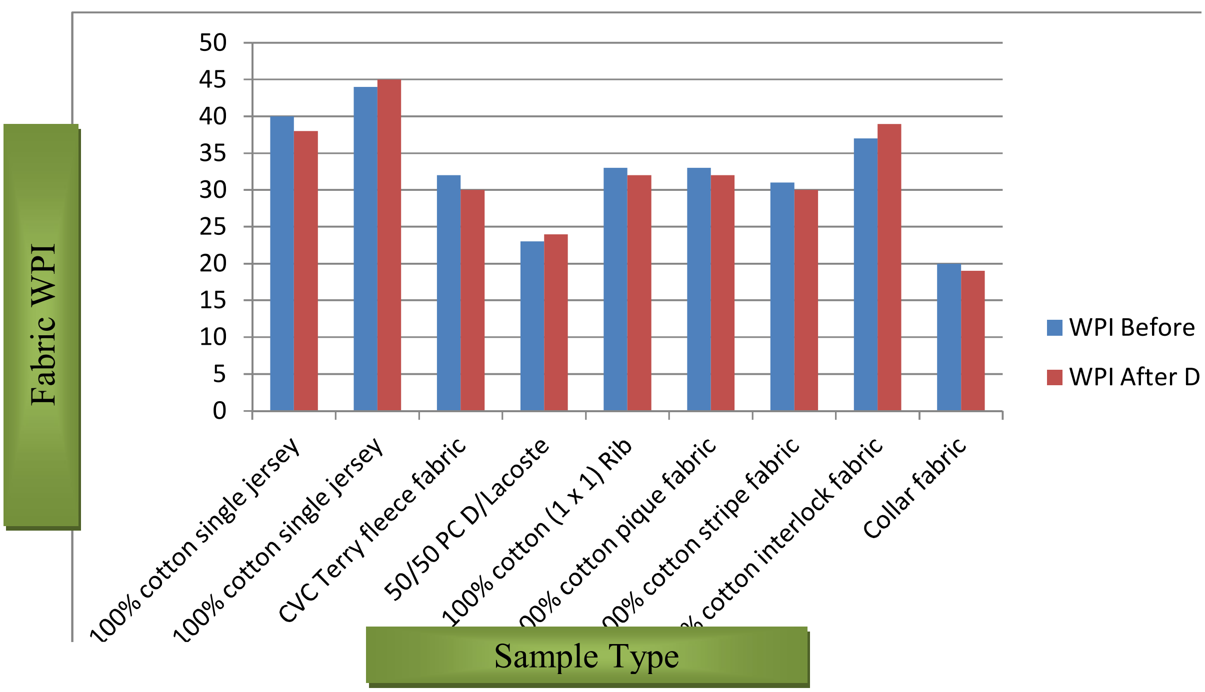


Figure 4.3: Bar diagram represents the change of WPI of knit fabrics after the drying

In this bar diagram "X" axis represents the Sample type and "Y" axis represents the Fabric WPI. The blue bars represent the WPI before drying" " and the red bars represents the WPI after drying" of the fabric. Here we can see that the WPI before drying is more than WPI after drying of the sample no.1, 3, 5, 6, 7 & 9. Also we can see that the WPI before drying is less than WPI after drying of the sample no.2, 4, & 8.

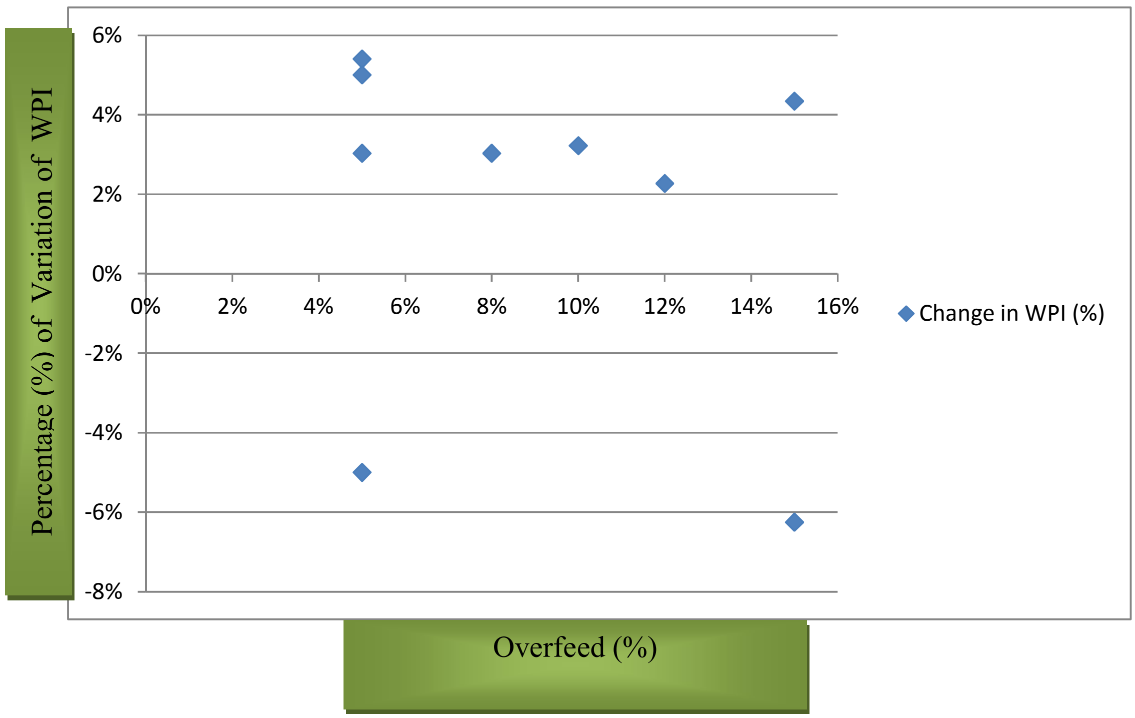


Figure 4.4: Correlation between overfeed% and change of WPI percentage (%)

In this chart "X" axis represents "Overfeed (%)" and "Y" axis represents,, Percentage of variation of WPI". We used different types of fabric and those fabrics had different WPI. Form the chart we can see that the percentage of variation of WPI decreased slightly with the increase of overfeed (%). And some variation of WPI (%) is increased slightly with the increase of overfeed (%). Here, for 10% overfeed% the change of WPI is 5.40 (%) that is maximum change and -6.25% of WPI is minimum change of WPI (%) where the overfeed 15% is also more used. And here the two samples change in WPI percentage are same and this fabrics are Rib and Double pique fabric where the overfeed (%) used are not same. And overfeed (%) is 5% and 8%.

4.3. Variation in CPI of the fabric samples after drying:

To calculate CPI, we took 1 inch of sample and then count the course lengthwise. By this way we got initial and after drying CPI for each sample. Then we compared the after drying CPI with the initial CPI of the sample. From the table of A.3, we can see that the knit fabric CPI increasing or decreasing is depending on machine speed, temperature and overfeed (%). Changing this parameter of dryer machine, we can change in CPI after drying. From this table, we can see maximum percentage (%) of change in CPI after drying is 3.03% for sample no.9. Initially the CPI of this sample was 33. After drying CPI increase to 34. For this sample, the machine speed was 7.5 rpm, temperature was 170(°C) and overfeed was 5% of this dryer machine. Here we also see that the minimum percentage (%) of change in CPI after drying is -6.25% for sample no.4. Initially the CPI of the sample was 32. After drying CPI decrease to 30. For this sample the machine speed was 10.5 rpm, temperature was 170(°C) and overfeed 15%. Here we can see that for sample no.9 and sample no.4 the temperature is same but the machine speed of sample no.9 is lower than sample no.4 but also the overfeed (%) of sample no.9 is higher than the sample no.4.

4.3.1. Change of CPI after the drying:

After drying the change of CPI of different fabrics were recorded in the Table A.3. The change of CPI has been used here to drawn the following figure.

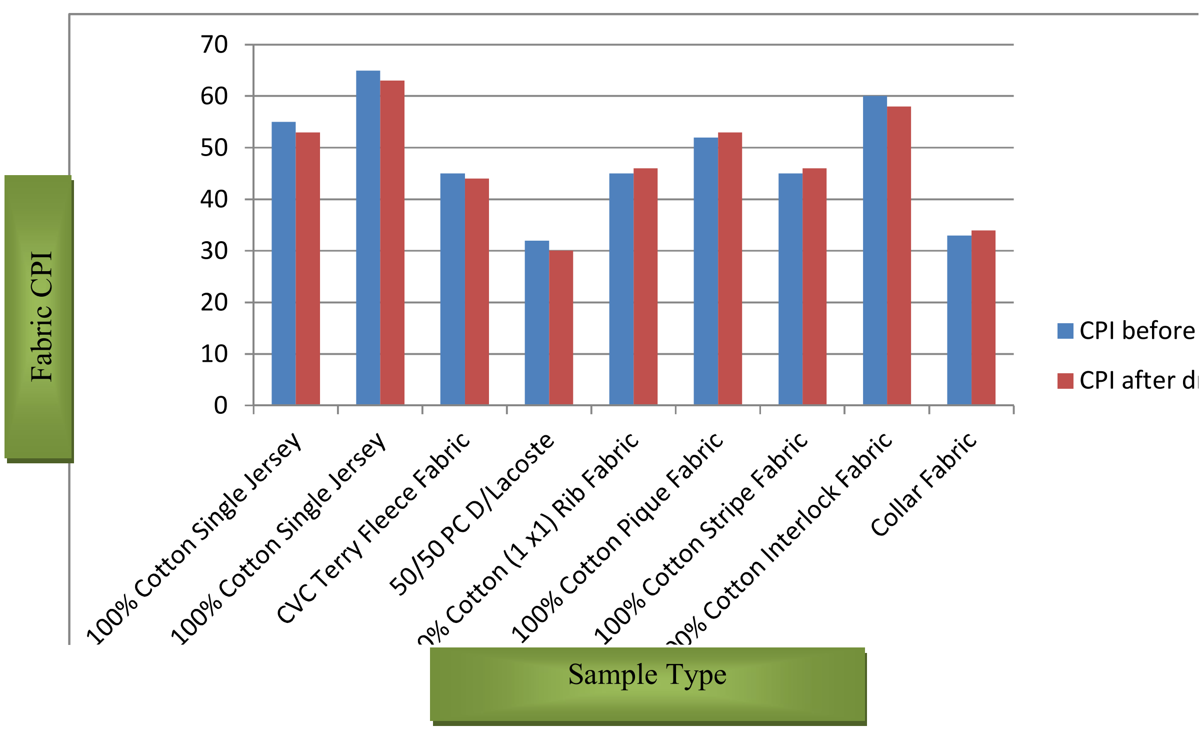


Figure 4.5: Bar diagram represents the change of CPI of knit fabrics after the drying

In this bar diagram "X" axis represents the Sample type and "Y" axis represents the Fabric CPI. The blue bars represent the CPI before drying" " and the red bars represents the CPI after drying" of the fabric. Here we can see that the CPI before drying is more than CPI after drying of the sample no.1, 2, 3, 4 & 8. Also we can see that the CPI before drying is less than CPI after drying of the sample no.5, 6, 7 & 9.

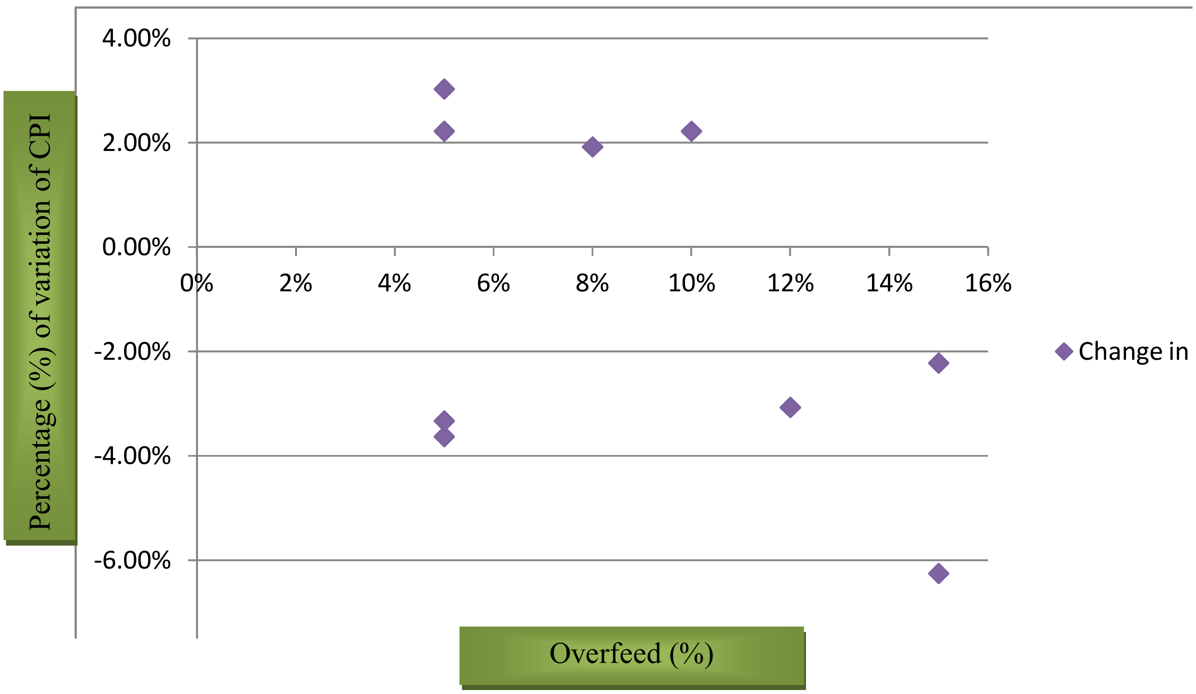


Figure 4.6: Correlation between overfeed% and change of CPI percentage (%)

In this chart "X" axis represents "Overfeed (%)" and "Y" axis represents,, Percentage of variation of CPI". We used different types of fabric and those fabrics had different CPI. Form the chart we can see that the percentage of variation of CPI decreased slightly with the increase of overfeed (%). And some variation of CPI (%) is increased slightly with the increase of overfeed (%). Here, for 5% overfeed% the change of CPI is 3.03 (%) that is maximum change and -6.25% of CPI is minimum change of CPI (%) where the overfeed is 15% used. And here the two samples change in CPI percentage are same and this fabrics are Rib and Stripe fabric where the overfeed (%) used are not same. And overfeed (%) is 5% and 10%.

4.4. Variation in Stitch length (SL) of the fabric samples after drying:

To find out stitch length we open a yarn from 1 inch of sample. Then stretch the yarn and measure the length in inches and convert it to millimeter (mm). Divide the length by the wales number in one inch of that sample to get stitch length. Then we compared the after drying SL with the initial SL of the samples. From the table A.4, we can see that the knit fabric SL increasing or decreasing is depending on WPI, machine speed, temperature and overfeed (%). Changing this parameter of dryer machine, we can change in SL after drying. From this table, we can see maximum percentage (%) of change in SL after drying is 1.57% for sample no.2. Initially the SL of this sample was 2.54. After drying SL increase to 2.58. For this sample, the machine speed was 11 rpm, temperature was 160(°C) and overfeed was 12% of this dryer machine. Here we also see that the minimum percentage (%) of change in SL after drying is -2% for sample no.1. Initially the SL of the sample was 2.5. After drying SL decrease to 2.45. For this sample the machine speed was 15.5 rpm, temperature was 140(°C) and overfeed 5%. Here we can see that for sample no.2 and sample no.1 the temperature is not same. The temperature of sample no.2 is more than sample no.1. And also the overfeed (%) of sample no.2 is higher than higher sample no.4. But the machine speed of sample no.2 is lower than sample no.1.

4.4.1. Change of SL after the drying:

After drying the change of SL of different fabrics were recorded in the Table A.4. The change of SL has been used here to drawn the following figure.

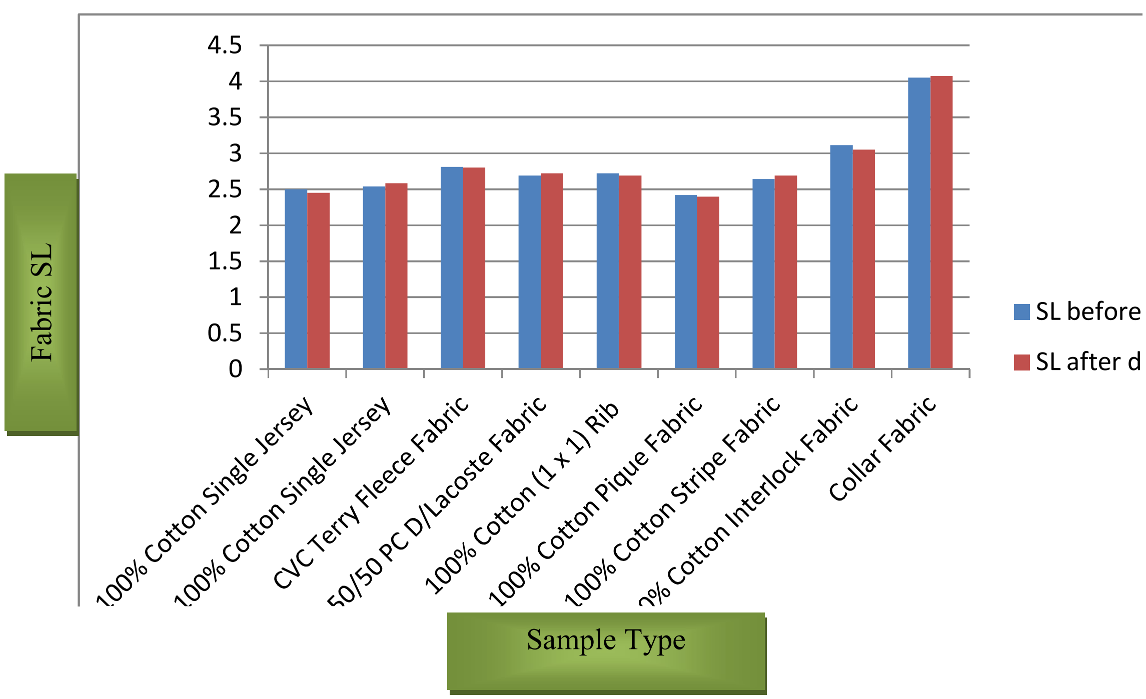


Figure 4.5: Bar diagram represents the change of SL of knit fabrics after the drying

In this bar diagram “X” axis represents the Sample type and “Y” axis represents the Fabric SL. The blue bars represent the SL before drying” ‟ and the red bars represents the SL after drying” of the fabric. Here we can see that the SL before drying is more than SL after drying of the sample no.1, 3, 5, 6 & 8. Also we can see that the CPI before drying is less than CPI after drying of the sample no.2, 4, 7 & 9.

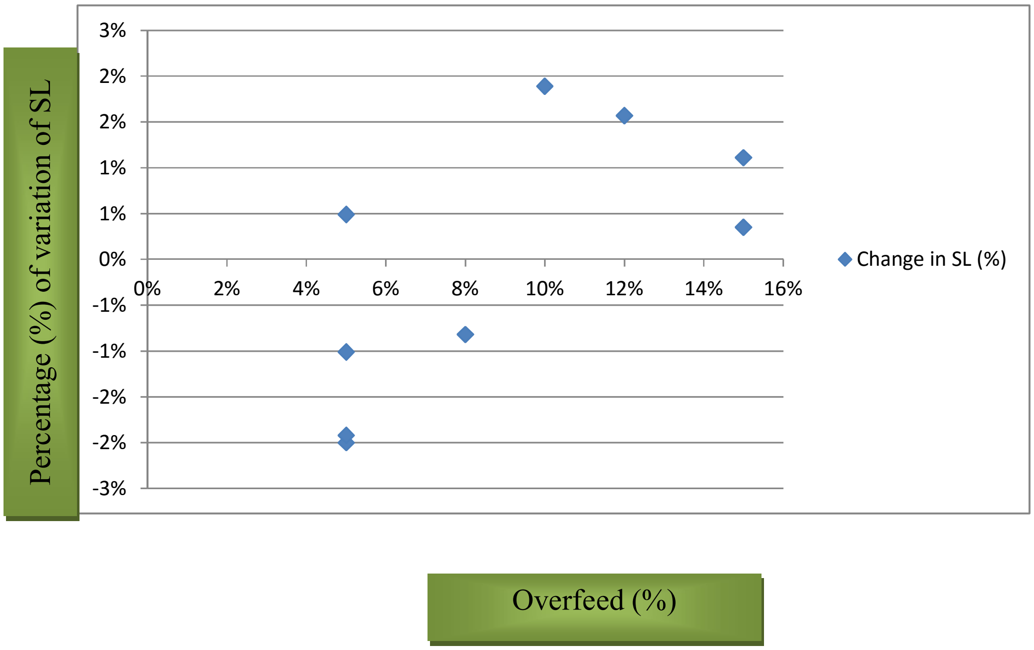


Figure 4.6: Correlation between overfeed% and change of SL percentage (%)

In this chart “X” axis represents “Overfeed (%)” and “Y” axis represents,, Percentage of variation of stitch length (SL)‟. We used different types of fabric and those fabrics had different stitch length (SL). Form the chart we can see that the percentage of variation of SL increased slightly with the increase of overfeed (%). And some variation of SL (%) is decreased slightly with the decrease of overfeed (%). Here, for 10% overfeed% the change of SL is 1.89 (%) that is maximum change and -2% of SL is minimum change of SL (%) where overfeed is used 5%. But here the two samples change in SL percentage are nearly same and this fabrics are CVC Terry Fleece and Collar fabric where the overfeed (%) used are not same. And overfeed (%) is 15% and 5%.

CHAPTER-5

CONCLUSION

CHAPTER-5

CONCLUSION

After completing this report work we fully understood the working process of a dryer machine. Besides, the dryer machine we learnt about squeezer machine, de-watering machine and different machines those are related with dryer machine. This project work basically helps us to meet the knowledge about drying machine. We learnt about different parts and parameters of the machine (like temperature, machine speed and overfeed %). By this study, we get the result of variation in the change of GSM (%), WPI (%), CPI (%) and SL (%). That's are given below-

- For low overfeed% the change of GSM (-8.82%) is few change and that is more & for high overfeed% the change of GSM (-16%) is low.
- The percentage of variation of WPI decreased slightly (-6.25%) with the increase of overfeed (%). And some variation of WPI (%) is increased slightly (5.40%) with the increase of overfeed (%).
- Form this study, we can see that the percentage of variation of CPI decreased slightly (3.03%) with the increase of overfeed (%). And some variation of CPI (%) is increased slightly (-6.25%) with the increase of overfeed (%).
- Also, the percentage of variation of SL increased slightly (1.89%) with the increase of overfeed (%).And some variation of SL (%) is decreased slightly (-2%) with the decrease of overfeed (%).

It is an important study in the field of wet processing technology. The study confirmed that drying machine for fabrics and always so obvious for finished fabric. Finally, we can say that this study will help us in our future life.

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APPENDIX

(Information that We Get about WPI, CPI & Stitch Length)

Table A.1: Percentage of change in GSM after drying:

Sample No.	Sample Name with Composition	Required GSM	GSM Before Drying	GSM After Drying	Change in GSM After Drying	Percentage (%) of change in GSM after drying	Machine speed (rpm)	Temperature (°C)	Overfeed (%)
01	100 % Cotton Single jersey	150	170	145	-25	-14.70	15.5	140	5
02	100 % Cotton Single jersey	220	250	210	-40	-16	11	160	12
03	CVC Terry fleece Fabric	290	325	280	-45	-13.84	7.5	170	15
04	50/50 PC D/Lacoste	220	238	217	-21	-8.82	10.5	170	15
05	100% Cotton (1 x 1) Rib	200	223	190	-33	-14.79	9	160	5
06	100% Cotton Pique Fabric	230	252	220	-32	-12.69	10	170	8
07	100% Cotton Stripe Fabric	160	174	150	-24	-13.79	10.5	140	10
08	100% Cotton Interlock Fabric	230	267	229	-38	-14.23	10	170	5
09	100% Cotton Collar Fabric	250	284	240	-44	-15.49	7.5	170	5

Table A.2: Percentage of change in WPI after drying:

Sample No	Sample Name	Required GSM	Before drying WPI	After drying WPI	Change in WPI after drying	Percentage (%) of change in WPI after drying	Machine speed (rpm)	Temperature (°C)	Overfeed (%)

01	100 % Cotton Single jersey	150	40	38	-2	-5	15.5	140	5
02	100 % Cotton Single jersey	220	44	45	1	2.27	11	160	12
03	CVC Terry fleece Fabric	290	32	30	-2	-6.25	7.5	170	15
04	50/50 PC D/Lacoste	220	23	24	1	4.34	10.5	170	15
05	100% Cotton (1 x 1) Rib	200	33	32	1	3.03	9	160	5
06	100% Cotton Pique Fabric	230	33	32	1	3.03	10	170	8
07	100% Cotton Stripe Fabric	160	31	30	1	3.22	10.5	140	10
08	100% Cotton Interlock Fabric	230	37	39	2	5.40	10	170	5
09	100% Cotton Collar Fabric	250	20	19	1	5	7.5	170	5

Table A.3: Percentage (%) of change in CPI after drying.

Sample No.	Sample Name with Composition	Required GSM	CPI Before Drying	CPI After Drying	Change in CPI After Drying	Percentage (%) of change in CPI after drying	Machine speed (rpm)	Temperature (°C)	Overfeed (%)
01	100 % Cotton Single Jersey	150	55	53	-2	-3.63	15.5	140	5
02	100 % Cotton Single Jersey	220	65	63	-2	-3.07	11	160	12
03	CVC Terry fleece Fabric	290	45	44	-1	-2.22	7.5	170	15
04	50/50 PC D/Lacoste	220	32	30	-2	-6.25	10.5	170	15
05	100% Cotton (1 x 1) Rib	200	45	46	1	2.22	9	160	5
06	100% Cotton Pique Fabric	230	52	53	1	1.92	10	170	8
07	100% Cotton Stripe Fabric	160	45	46	1	2.22	10.5	140	10

08	100% Cotton Interlock Fabric	230	60	58	-2	-3.33	10	170	5
09	100% Cotton Collar Fabric	250	33	34	1	3.03	7.5	170	5

Table A.4: Percentage (%) of change in Stitch length (SL) after drying.

Sample No.	Sample Name with Composition	Required GSM	SL Before Drying	SL After Drying	Change in SL After Drying	Percentage (%) of change in SL after drying	Machine speed (rpm)	Temperature (°C)	Overfeed (%)
01	100 % Cotton Single jersey	150	2.5	2.45	-0.05	-2	15.5	140	5
02	100 % Cotton Single jersey	220	2.54	2.58	0.04	1.57	11	160	12
03	CVC Terry fleece Fabric	290	2.81	2.80	-0.01	0.35	7.5	170	15
04	50/50 PC D/Lacoste	220	2.69	2.72	0.03	1.11	10.5	170	15
05	100% Cotton (1 x 1) Rib	200	2.72	2.69	-0.03	-1.10	9	160	5
06	100% Cotton Pique Fabric	230	2.42	2.40	-0.02	-0.82	10	170	8
07	100% Cotton Stripe Fabric	160	2.64	2.69	0.05	1.89	10.5	140	10
08	100% Cotton Interlock Fabric	230	3.11	3.05	-0.06	-1.92	10	170	5
09	100% Cotton Collar Fabric	250	4.05	4.07	-0.02	0.49	7.5	170	5