



Faculty of Engineering
Department of Textile Engineering

REPORT ON

Study on rope denim

Course Title: Project/ Thesis

Course Title: TE- 407

Supervised By

Professor Dr. Md. Mahbubul Haque

Professor

Department of Textile Engineering

Faculty of Engineering

Daffodil International University

E-mail: drhaque@diu.edu.bd, drhaque@alumni.manchester.ac.uk

Submitted By

<u>Name</u>	<u>ID</u>	<u>Major Subject</u>
Mohammad Mahmudun Nobi	162-23-4723	FMT
MD Azizul Haque	162-23-4667	FMT
Redwanul Islam	162-23-4669	FMT

Department of TE

Faculty of Engineering

Daffodil International University

This project presented in partial fulfillment of requirement for the degree of Bachelor of Science in Textile Engineering.



Letter of Approval

February 01, 2020

To

The Head

Department of Textile Engineering

102, Sukrabad, Mirpur Road. Dhaka – 1207

Subject: Approval of Thesis Report of B.Sc. in TE Program.

Dear Sir,

I am just waiting to let you know that this thesis 'Study on Rope Denim' has been prepared bearing ID's (162-23-4723, 162-23-4667, 162-23-4669) is completed for final evaluation. The whole report is prepared based on proper assessment and investigation. We were directly involved with our work.

Therefore it will be highly appreciated if you kindly accept the Thesis report and considered for final evaluation

Your Sincerely.

A handwritten signature in blue ink, appearing to read 'M. Haque', enclosed in a light blue circular stamp.

Dr. Md. Mahbubul Haque

Professor

Department of Textile Engineering

Daffodil International University



Declaration

We hereby declare that the work which is presented in this thesis entitled “Study on Rope Denim” has been done under the supervision of Professor Dr. Md. Mahbubul Haque, Professor TE, Daffodil International University. We also state that this project has not been presented in any other universities and all the resource of information are totally acknowledged.

Supervised By

Professor Dr. Md. Mahbubul Haque
Professor Department of Textile Engineering
Daffodil International University

Submitted By

Name of Student	ID	Signature
Mohammad Mahmudun Nobi	162-23-4723	Nobi
Md. Azizul Haque	162-23-4667	Aizul
Redwanul Islam	162-23-4669	Emu

Department of TE
Faculty of Engineering
Daffodil International

Acknowledgement

First we are grateful and express our most humble gratitude to almighty Allah for helping us and giving us the capability of making this project successful.

We are also very grateful and expressing thanks from the deepest of our heart to our respectable supervising teacher **Professor Dr. Md. Mahbubul Haque**, Department of Textile Engineering, Faculty of Engineering, Daffodil International University. His acquainted and vast knowledge in Textile sector inspired us to work with passion. With his guidance, encouragement and energetic supervision, we have become successful to complete this Thesis.

We are also in debt to our respected teachers of Daffodil International University for teaching us and making us capable throughout the whole time.

Dedication

The study is whole heartedly dedicated to our parents, who have been our source of inspiration and gave us strength when we thought of giving up, who continuously provide their moral, spiritual, emotional and financial support.

And lastly, we dedicated this book to the almighty God, thank you for the guidance, strength, power of mind, protection and skills and for giving us a healthy life. All of these, we offer to you.

Abstract

The thesis report entitled to ‘Study on Rope Denim’ at Amber Denim Mills Limited. The main objective of the study is to analyze the process of rope denim. It is the process of how the rope denim is made, what are process, what are raw material, what kind of machine used, what kinds of faults are happened and also what is the output.

Various tools are used for the study are fault ratio analysis, data sheet, regular assessment, through the experts, amount of waste.

Rope denim is preferred by the buyers worldwide, though there are many important disadvantages but there are lots of strong advantages as well. Perhaps the advantages are more preferable than the disadvantages. For this reason rope denim is very popular method of making denim.

Contents

CHAPTER-01	1
1.1 Introduction:.....	2
CHAPTER: 02	3
Literature Review.....	3
2.1- History of Denim	4
2.2- Types of yarn used:.....	4
2.3 Yarn count used:	4
2.4 Types of Denim:	4
2.4.1- Rope denim:.....	5
2.4.2 Sheet denim:.....	5
CHAPTER-03 Methodology	7
3.1 Methodology:.....	8
3.1.1 It can be also defined as bellow:	8
3.2 Process flow chart of Rope Denim:	9
Process flow chart: 01.....	9
3.2.1 Ball Warping:.....	10
3.2.1.1 Warping:	10
3.2.1.2 Objectives of warping:	10
3.2.1.3 Types of warping:	10
3.2.1.4 Name of the m/c used for ball warping:.....	10
3.2.1.4.2Machine Specification:	12
3.2.1.5 Main parts(karl Mayer)	13
3.2.1.6 Main parts (Morrison Denim system):.....	13
3.2.1.7 Yarn Breakage:	14
3.2.1.8Yarn waste:	14
3.2.1.9 Breaking System:	15
3.2.1.9.1 Reason to use Breaking system:.....	15
3.2.1.10 Different section of ball warping:	15
3.2.1.10.1 Creel section:.....	15
3.2.1.10.2 Reed section:	17
3.2.1.10.3 Head stock section :	18
3.2.1.11Trouble shoot:	18
3.2.1.12 Traverse :	19

3.2.1.13 Humidity control :	19
3.2.2 Rope Dyeing :	20
3.2.3.1 Dyeing:	20
3.2.2.3 Objectives of dyeing:	21
3.2.2.4 Machine Used for Rope dyeing in Amber denim:	21
3.2.2.5 Main parts:	22
3.2.2.6 Function of different section :	23
3.2.2.6.1 Creel section:	24
3.2.2.7 Chemicals used in dyeing:	25
3.2.2.8 Function of different chemicals:	26
3.2.2.9 Preparation tank:	27
3.2.2.10 Reserve tank:	27
3.2.2.11 Machines used in dyeing lab:	27
3.2.3 Long Chain Beam	28
3.2.3.1 Long Chain Beam:	28
3.2.3.2 Machine Specification:	28
3.2.3.3 Objectives	29
3.2.3.4 Standard chart of L.C.B tension setting:	30
3.2.3.5 Wastage:	30
3.2.3.6 Main parts of MDS:	30
3.2.3.7 Different section of L.C.B :	31
3.2.3.8 Working procedure	32
3.2.3.8.1 Reed length	32
3.2.3.8.2 Knotting:	32
3.2.3.8.3 Lease Cutting:	32
3.2.3.9 Trouble shoot:	32
3.2.3.10 Precaution:	33
3.2.3.11 Conclusion :	33
3.2.4 Sizing:	33
3.2.4.1 Sizing:	33
3.2.4.2 Objectives of sizing:	34
3.2.4.3 Process sequence Sizing:	34
3.2.4.4 Machine specification:	34
3.2.4.4.1 M/c no: 1:	34
3.2.4.4.2 M/c no : 2	35
3.2.4.5 Different zone of Sizing :	37

3.2.4.6 Pre-caution:.....	42
3.2.4.7 Conclusion:	42
3.2.5 Weaving	42
3.2.5.1 Weaving	42
3.2.5.2 Machine Specification:	42
3.2.5.3 Shedding Mechanism:.....	43
3.2.5.4 Machine Parts:.....	43
3.2.5.5 Basic Weave Designs:.....	45
3.2.5.6 Modern Weaving machine:	45
3.2.6 Finishing Section:	46
3.2.6.1 Finishing :	46
3.2.6.2 Objectives of Finishing	46
3.2.6.3 M/c no: 01	46
3.2.6.4 M/c no:02.....	47
3.2.6.4.1 Main Parts of Sanforizing Machine:	47
Chapter 4:.....	49
4.1 Discussion of Result.....	50
Chapter 5:.....	51
Conclusion of Results	51
5.1 Conclusion of Results	52
Reference	53

List of Figure:

FIGURE: 3. 1 KARL MAYER	11
FIGURE: 3. 2 MORRISON DENIM SYSTEM.....	12
FIGURE: 3. 3 PASSAGE DIAGRAM OF BALL WARPING MACHINE.....	14
FIGURE: 3. 4 CREEL SECTION.....	15
FIGURE: 3. 5 REED SECTION	17
FIGURE: 3. 6 HEAD STOCK SECTION.....	18
FIGURE: 3. 7 ROPE DYEING MACHINE.....	20
FIGURE: 3. 8 Recipe: indigo dye recipe	21
FIGURE: 3. 9 PASSAGE DIAGRAM OF ROPE DYEING MACHINE.....	23
FIGURE: 3. 10 CREEL SECTION	24
FIGURE: 3. 11 L.C.B MACHINE	29
FIGURE: 3. 12 Standard chart of L.C.B tension setting.....	30
FIGURE: 3. 13 Process flow chart:.....	34
FIGURE: 3. 14 KARL MAYER MACHINE.....	35
FIGURE: 3. 15 PASSAGE DIAGRAM OF SIZING MACHINE	37
Figure : 3. 16 CREEL SECTIOIN	38
FIGURE: 3. 17 SIZING ZONE.....	39
FIGURE: 3. 18 REFLECTROMETER.....	40
FIGURE: 3. 19 BEAM SECTION	41
FIGURE: 3. 20 PASSAGE DIAGRAM OF WEAVING MACHINE	44
FIGURE: 3. 21 PASSAGE DIAGRAM OF SANFORIZING MACHINE.....	48

List of Table:

Table: 3. 1 Ball Warping standard tension setting.....	17
Table: 3. 2 Chemicals used in dyeing	26
Table: 3. 3 Preparation tank.....	27
Table: 3. 4 Machines used in dyeing lab	27
Table: 3. 5 SIZED CHEMICAL USED	39

CHAPTER-01
INTRODUCTION

1.1 Introduction:

Denim is the oldest, most widely used, most fashionable and most versatile fabric of the world. Though, initially the fabric was developing for using as sail cloth but at present denim is mainly used for producing garments particularly trousers for the young people. The gross production of denim fabric is approximately 3000 million meters per year. This amount of fabric can surround the planet 70 times.

Bangladesh is well known for its knitting production. We are highly successful in this section. But in the woven section we are far behind. We have to import wove fabric from different country but now-a-days denim production is rising day by day.

There are two types of denim production system

- Sheet denim
- Rope denim

Sheet denim is the first ever process to produce denim fabric. But rope denim is the modern process of denim production. Though rope denim is a modern process so the demand of the fabric is also high.

In Bangladesh mills , in most cases substantial quantity of waste yarns are used. This is mainly done to reduce the cost of the production. Where only 20% fresh cotton is used

CHAPTER: 02
Literature Review

2.1- History of Denim

Denim is a type of cotton twill textile, where the weft passes under two or more warp yarn. Warp yarns are dyed in indigo while weft yarn remain plain white. That is why denim is blue on the one side and white on the other side. When used for jeans, denim is turned blue on the outside and because of the way it is made it fades in a characteristic way.

Word “denim” comes from fabric "serge de Nimes" made in France city of Nimes , where it originates. It has been used by the American since the late 18th century, colored blue with indigo dye to make blue "jeans", a type of cotton pants. Jeans come from "Genes" - a name given by French to Genoa and the people from Genoa where the cotton trousers were made. In the 1800s, in the time of the Gold Rush, American gold miners needed clothes that were strong, last longer and did not tear easily. Levi Strauss, a businessman, and Jacob Davis, a tailor, supplied miners with denim pants that were made from durable material and reinforced with pin at the places where pants tended to tear which increase long life of pants. This marked the beginning of the legend of jeans and brand Levi Strauss is still highly successful today.

2.2- Types of yarn used:

- Rotor yarn
- Ring yarn
- Slub yarn
- PCW yarn
- Polyester yarn
- Spandex yarn

2.3 Yarn count used:

- For warp: 6, 7, 8, 9, 10, 11, 12, 14, 16, 20, 30 (Slub + Normal) Ne.
- For weft: 14, 16, 20, 30 (Slub + Normal) Ne and Polyester.
- Spandex: 10L40D, 200L40D, 16L40D.

2.4 Types of Denim:

- Rope denim
- Sheet denim

2.4.1- Rope denim:

By warping process when yarns are formed into e rope formation and the yarn also dyed in the rope form is known as rope denim. It is considered as the best process. Though it is a discontinuous process.

2.4.1.1 Advantage of Rope denim:

- Shade variation low
- Wastage percentage low
- Quality good
- Fabric price high
- Capable of multi shade dyeing

2.4.1.2 Disadvantage of Rope Denim:

- Floor area required high
- More man power needed than sheet denim
- High utility charge
- High time required for producing weavers beam
- High amount of liquor needed

2.4.2 Sheet denim:

It is a continuous process. Slasher, or sheet combines dyeing and sizing into a single process. Warp yarns are repeatedly passed in warp beam form through several baths of indigo dye before being sized and wound for weaving. It has low quality than rope denim.

2.4.2.1 Advantage of Rope Denim:

- Floor area required less
- Less man power needed than sheet denim
- Low utility charge
- Less time required for producing weavers beam
- Less amount of liquor needed
- Less investment required

2.4.2.2 Disadvantage of Sheet Denim

- Shade variation high
- Wastage percentage high
- Quality moderate
- Fabric price low
- Not capable of multi shade dyeing

CHAPTER-03

Methodology

3.1 Methodology:

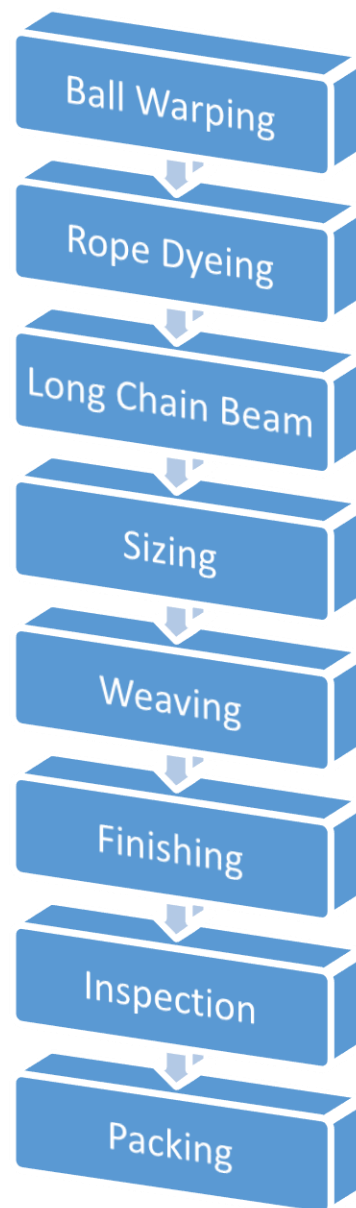
Methodology is the conceptual and systematic evaluation of the methods applied to a research field. This involves the systematic study of the body of knowledge-related approaches and concepts. This typically includes terms such as theory, theoretical model, stages, and techniques of quantitative or qualitative nature.

A methodology is not intended to provide solutions-hence it is not the same as a method. Instead, a technique provides the theoretical basis for understanding which procedure, collection of methods or best practices can be applied, for example, to determine a specific outcome.

3.1.1 It can be also defined as bellow:

The analysis of the principles of methods, rules, and postulates employed by a discipline.
The systematic study of methods that are, can be, or have been applied within a discipline.
The study or description of methods.

3.2 Process flow chart of Rope Denim:



Process flow chart: 01

3.2.1 Ball Warping:

3.2.1.1 Warping:

Warping is defined as the parallel winding of yarn from cone or cheese package on to a warp loom. It is needed to confirm that warp beam is made from good warp yarn. Otherwise weaving performance will be hampered. So its need to require to provide a good warp beam. Faulty weavers beam is one of the causes of wastage in weaving section.

3.2.1.2 Objectives of warping:

- To wound up fixed length of yarn to a warping beam.
- To increase the weave ability of yarn.
- To increase the quality of yarn.
- To increase the production.

3.2.1.3 Types of warping:

- Direct warping.
- Sectional warping.
- Ball warping.

3.2.1.3.1 Ball warping:

Ball warping mainly used in manufacturing of design fabric. The warp yarns are wounded on a ball beam in the form of a rope. The main object of ball warping is to prepare log for rope dyeing.

3.2.1.4 Name of the m/c used for ball warping:

- Karl mayer.
- Morrison denim system

3.2.1.4.1 Machine specification:

M/c name : Karl mayer.

Total m/c : 1

Origin : China

M/c speed : 400 rpm

Cone capacity : 528

Warping speed : 300 rpm

Log width : 1600 mm

Log dia : 225mm



FIGURE: 3. 1 KARL MAYER

3.2.1.4.2 Machine Specification:

M/c Name: Morrison Denim system

Total M/C : 4

Origin: USA

M/c speed: 450 rpm

Warping speed: (300-350) rpm

Creel capacity: 456

Log width: 1200 mm

Log diameter: 225 mm



FIGURE: 3. 2 MORRISON DENIM SYSTEM

3.2.1.5 Main parts(karl Mayer)

- Creel.
- Tensioner.
- Post.
- Cone holder.
- Post controller.
- Safety strings.
- Control panel.
- Reed -1
- Reed -2
- Monitor.
- Log holder.
- Adaptor.
- Tension pulley.
- Meter sensor.
- Log
- Safety brake.

3.2.1.6 Main parts (Morrison Denim system):

- Creel.
- Cone holder.
- Tensioner.
- Fan.
- Post controller.
- Post.
- Safety strings.
- Disk.
- Monitor.
- Reed.
- Tension pulley.
- Log adaptor.
- Motor roller.
- Hook.
- Meter sensor.
- Log.



FIGURE: 3. 3 PASSAGE DIAGRAM OF BALL WARPING MACHINE

3.2.1.7 Yarn Breakage:

While ball warping breakage cause several time. So breaking causes need to find out to solve the problem.

There are some reason,

- Weak place
- Weak splice
- Snarling
- Tail end entanglement
- Open from thick place
- Damaged cone.

3.2.1.8 Yarn waste:

Waste of yarn is less. In the ball warping section everything is used. But when the cone needs to change the total length of the machine equal yarn is waste. Because when cone is changed at end of the yarn is knotted. If it is not done when weaving will done this effect will be on the fabric. So total cone yarn is waste.

3.2.1.9 Breaking System:

It is mainly a pneumatic system. Air cylinder is set under the breaking system. when machine needs to be stopped the cylinder released the pressure of the air and the machine stop. This is called the breaking system.

3.2.1.9.1 Reason to use Breaking system:

- If traverse is not ready.
- For lease setup.
- For yarn breakage.
- If ball hook is not in run position.
- When ball is ready.

3.2.1.10 Different section of ball warping:

- Creel section
- Reed section.
- Head stock section.

3.2.1.10.1 Creel section:

Different parts of creel section does different things. There are some important parts to be described.

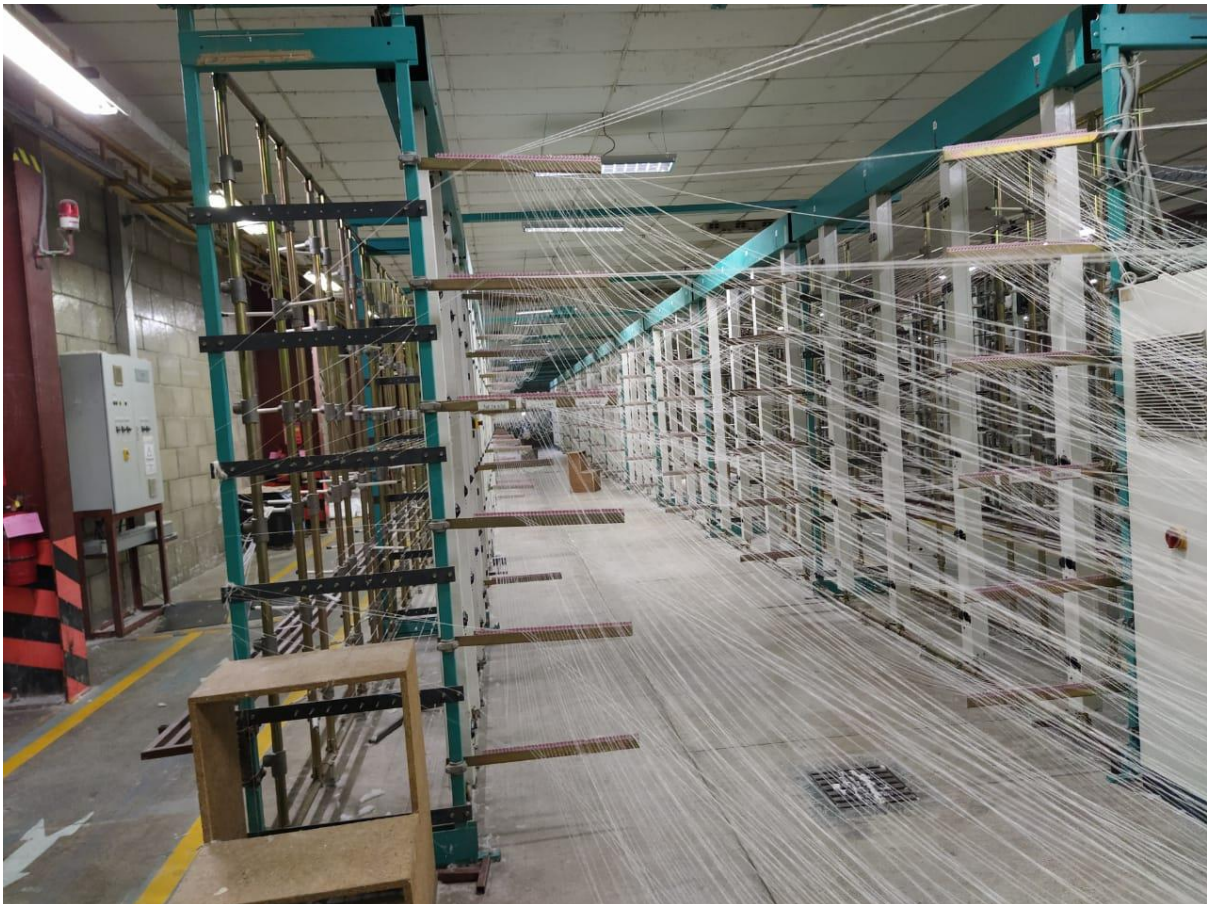


FIGURE: 3. 4 CREEL SECTION

3.2.1.10.1.1 Disk:

When the yarn are unwinding from the cone its need to form balloon like shape or else unwinding will not done properly. It is also to stop the cone to displace from its original position.

3.2.1.10.1.2 Post controller:

Every yarn pass by a individual post. The post controller control the post.

3.2.1.10.1.3 Tensioner:

It control the tension on the yarn.

For Karl Mayer,

For Morrison Denim System,

Post : (1-16) Exit.

Post : (1-19) Front

Post : (17-32) center.

Post : (20-38) Rear

Post : (33-44) end.

Post : (Creel- Reed section)

Ball Warping standard tension setting					
Yarn count		Tension %			Remarks
		JOG%	FRONT%	REAR%	
6,7	OE/MS/RS/RC	96	91	96	
8	OE/MS/RS/RC	89	84	89	
9,10	OE/MS/RS/RC	84	79	84	
12	OE/MS/RS/RC	69	64	69	For multi count
14,16	OE/MS/RS/RC	57	52	57	
20	OE/MS/RS/RC/R.COMBED	47	42	47	
24,26,28	OE/MS/RS/RC/R.COMBED	39	34	39	
30,32	OE/MS/RS/RC/R.COMBED	34	29	34	
34,40	OE/MS/RS/RC/R.COMBED	24	19	24	

Note	According to yarn characteristics above yarn tension maybe changed
------	--

TABLE: 3. 1 BALL WARPING STANDARD TENSION SETTING

3.2.1.10.2 Reed section:

- To individual the yarn.
- To maintain same count of yarn.
- To insure the yarn cleanness.



FIGURE: 3. 5 REED SECTION

3.2.1.10.2.1 Leasing:

Every 500 meter of passing yarn leasing is done. Every 500 m after the machine is stopped. Then weft yarn is imported. The yarn is inserted by interlacement. This is done when log go out for next.

3.2.110.3 Head stock section :

In the head stock section mainly yarn are rolled on the log. For rolling on the log many action needed to be done.



FIGURE: 3. 6 HEAD STOCK SECTION

3.2.1.10.3.1 Tension pulley:

It help to tension the yarn from the reel. For this every yarn roll on the log in a position.

3.2.1.10.3.2 Meter roller:

In here a sensor is set. Which calculate how much yarn is rolled on the log and also detect the breakage of the yarn and stop the machine. The machine is also stopped when. Leasing needs to be done and when the log rolled yarn reached its sets length.

3.2.1.11 Trouble shoot:

3 types of troubleshoot happened.

- Raw material troubleshoot.

- Machine troubleshoot.
- Process troubleshoot.

3.2.1.11.1 Raw material troubleshoot:

- Damaged yarn.
- Damaged Cone.
- Less twisted yarn.
- Count mixing

3.2.1.11.2 Machine troubleshoot:

- Improper tension from the tensioner.
- Rough surface of the reed.
- Breaking system is not working properly.
- Meter sensor is not working properly.
- If traversing is not working properly.

3.2.1.11.3 Process troubleshoot:

- If the broken ends are not knotted properly.
- If leasing is not done properly.

3.2.1.12 Traverse :

It is the main part of rolling the yarn on the log. the Traverse gives traversing motion that's why every part of the log have same length of yarn rolled on. The traverse is set the way that when it rolled the yarn it shaped in the cone formation.

3.2.1.13 Humidity control :

When the m/c runs humidity varies time to time. So it needs to be controlled. A/c plant,

- Inn system.
- Out system.

3.2.1.13.1 Inn system:

Where this system insert fresh air in the room.

3.2.1.13.2 Out system :

This system sucked out all the hot air from the machine and from the floor.

Maintain temperature - (25+/-2) c

Maintain humidity - (65+/-2)%.

©Daffodil International University

3.2.2 Rope Dyeing :

3.2.3.1 Dyeing:

Dyeing is the application of dyes or pigments on textile materials such as fibers, yarns and fabric with the goal of achieving desired color with desired color fastness.

3.2.2.2 Types of Denim dyeing:

- sheet dyeing
- Rope dyeing

3.2.2.2.1 SHEET DYEING:

Sheet dyeing contains dyeing and sizing into a single process. Warp yarns are repeatedly passed in warp beam through several baths of indigo dye. Slasher dyeing is considered to the lower quality than rope dyeing. The does not penetrate well and tends to uneven

3.2.2.2.2 ROPE DYEING:

Rope dyeing consists of twisting the yarn into a rope that is the quickly dipped into indigo baths. This dyeing considered as a superior dyeing technology where the dyeing uniformity achieved. However rope dyeing is a more difficult dyeing technology.

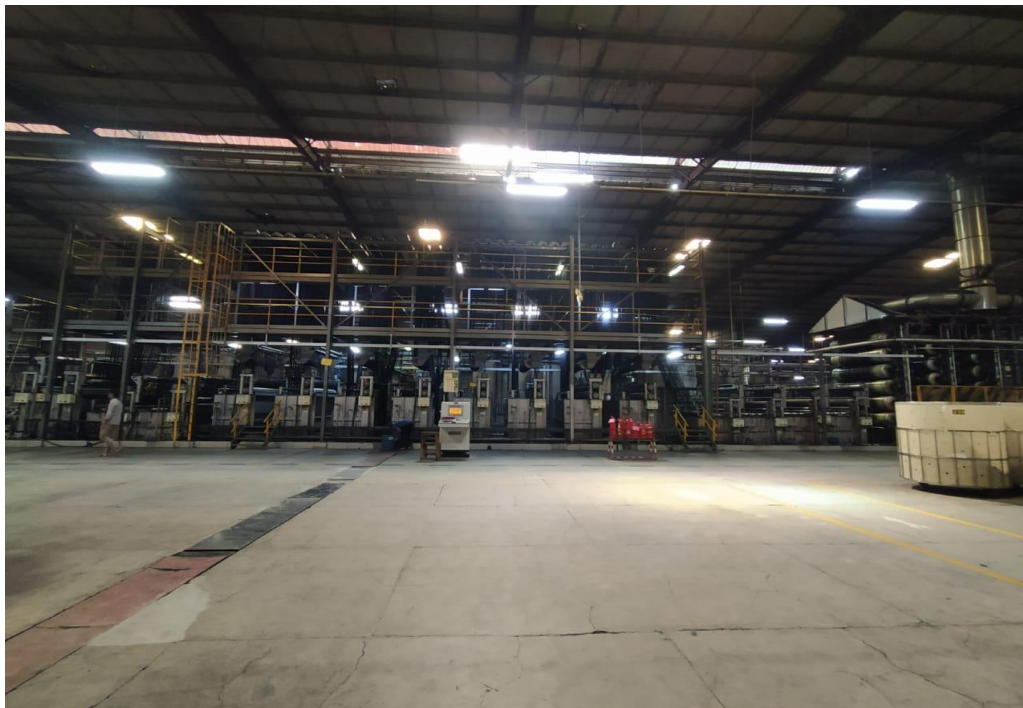


FIGURE: 3. 7 ROPE DYEING MACHINE

BUYER : M&S
ADML CODE : LP-52259 SF(100%BCI)
PI NO : 205,016

Indigo process
AMBER DENIM MILLS LTD.
BANGLA BAZAR, GAZIPUR.
ROPE DYEING PROCESS

Set No.	10-1703P+1704P	Count	MULTI	Ratio	FULL	Start time	11:50PM	Water Consum	276975	End	277132	Total	157		
Ref :	10-745P(13.05.18)	T. Ends	S300	T.Rope	28	Length	4600 MTR.	Speed	23 <td>Date</td> <td>02.02.20</td> <td>Moiture</td> <td>6%</td>	Date	02.02.20	Moiture	6%		
Box	M-1	W-1	W-2	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	W-3	W-4	W-5	W-6
Operation	MERC.	H.W	H.W	BY-PASS	DW1	DY	DY	DY	DY	DY	W	H.W	H.W	C.W	CHEM
Sq. Press	60	75	75		80	75	75	75	80	75	75	75	75	70	65
Temp.															45°C
MERCERISING				INDIGO RECIPE				Softner/Lubricant		RAW YARN DIPPING MEASURING (500 ml)					
Operation	MERC.	Indigo %	2.90%	Operation	Name		BENSOFIT	Color & Chemical		Yarn		Dipping		Dipping	
Cautic	14 BE+	Hydrog/l	0.60 G/L	Black %	Box	8		Name	MER	Weight	1.5"		Time	Time	
BENVADINE	06/12 G/L	Indigog/l	2.80 G/L	Ph	Feed	24		Avg Doss							
DEKOL	01G/L	pH	11.70	ORP											
POWDER INDIGO				Blk. Name		Dossing		LINE MARK NOT FOUND							
Temp.		D/Rate			Dossing Rate Lit/min		Soft pH		NOTE						
Time	Hydro	Indigo	pH	BAUME	DENSITY	D1W	INDIGO	HYDRO	CAUSTIC	INDIGO BOX PREPARATION:					
00 M	0.72	2.79	11.73	14BE+			5.30	2.50	40 G/L	CONTINUE WITH 10-1674P					
500M	0.67	2.81	11.71	"		10.35	"	"	"	Indigo Circulation: 1170 L/Min.					
1200M	0.65	2.84	11.70	"			"	"	"						
2000M	0.66	2.86	11.72	"			"	"	"						
2800M	0.68	2.85	11.72	"			"	2.30	"						
3500M	0.62	2.88	11.73	"		10.40	"	"	"						
4200M	0.68	2.90	11.72	"			"	"	"						
										SOFTNER Ph=5.5-6.0 DYE BOX 4+5+6 COMB OUT 5 KG PVA USE IN SIZING ONLY 10-1704P CREEL POSITION= SIDE CENTER. 10-1703P+1704P+1703P					
Shift			A	B	C										
Incharge name						SAKIB									
Officer name						SUHAN									

FIGURE: 3. 8 RECIPE: INDIGO DYE RECIPE

3.2.2.3 Objectives of dyeing:

- To obtain even shade
- To obtain require color fastness
- To make it as required color
- To make the fabric suitable for various purpose

3.2.2.4 Machine Used for Rope dyeing in Amber denim:

Creel M/C Name: Morison Textile Machinery Co.

Origin: USA

Capacity: 37

©Daffodil International University

Ball capacity: 74

M/C speed: 35 mpm

Run Speed: (25-28) mpm

3.2.2.5 Main parts:

- Creel
- Stand
- Taplen
- Eye pod
- Eye pod roller
- Guide roller
- Comb
- Tension wheel
- Measuring sensor
- Air pressure meter
- Dancer roller (16)
- Padder roller (32)
- Emergency switch
- Shower
- Dancer sensor
- Hot water tank (21000 ltr)
- Indigo reserve tank
- Dry stack (36)
- Coiler (36)
- Gear box
- Inspection box
- Steam pipe
- Blower
- Control panel box
- Scouring Box-1 (pre-wetting box)
- Wash Box-2
- Dye Box-8
- Wash Box-3
- Softener box
- Sky roller- 69

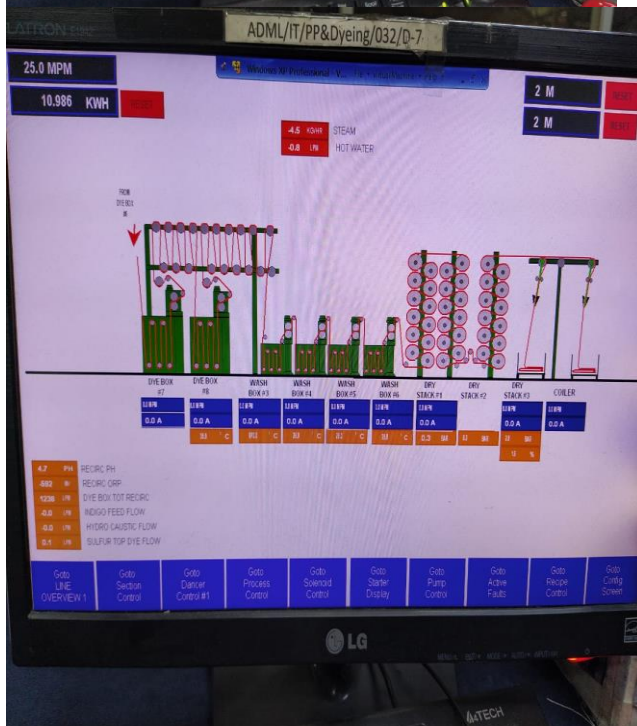


FIGURE: 3. 9 PASSAGE DIAGRAM OF ROPE DYEING MACHINE

3.2.2.6 Function of different section :

- Creel section
- Pre-wash section
- Dyeing section
- Post wash section
- Coiler section
- Dry stack section

3.2.2.6.1 Creel section:

Creel is the input system of rope dyeing mechanism. Here creel capacity is 37, some parts plays important role in this section.



FIGURE: 3. 10 CREEL SECTION

3.2.2.6.3 Leader rope:

It plays important role in the machine. When yarn path needs to be set, this leader rope plays an important role. This leader rope is made of waste rope yarn. When Dye process is changed the path of the yarn needs to be redirected. So leader rope is important in dyeing section. If leader rope is not use a lot of rope yarn wastage could have been done.

3.2.2.6.4 Different types of dyeing shade:

- Indigo
- Topping (Indigo+Black)

- Bottoming (Black+Indigo)
- Sulphur black/ pure black

3.2.2.6.5 Oxidization:

Vat dye are the insoluble dye. This dyes are made soluble by the vatting process. Reducer is used to made dye soluble. After the dyeing is needs to fix the dye so the dye needs to be insoluble again. Vat dye become insoluble again when it comes in the contract of air. This process is known by oxidization process. When the rope yarn comes out of the dyeing solution it passes the squeezing roller. It is sent to the upto comes in contract of air. The rope yarn stays in the contact of air or the oxidization time is 1 minute. The rope yarn immersion time is 20-26 seconds per bath, which is also varies according to shade.

3.2.2.6.6 Sky roller:

This roller is used to send the dyed rope yarn to the top of the machine for the oxidization. There are total 69 sky rollers in the machine.

3.2.2.6.7 Dancer roller:

These rollers are controlled by the pneumatic pressure. These rollers are mainly used to control the pressure on the rope yarn. For some reasons the rope yarn ball may rotate fast than the other ball which may cause loose yarn. If this happen dye shade may be changed. So the dancer rollers are used to control the loose yarn. When loose yarn is feed in the machine the dancer roller pulls the loose yarn up and make it equal pressure as the other. The dancer roller is controlled by the dancer sensor. There are total 16 roller in the machine.

3.2.2.6.8 Dosing:

When rope yarns are inserted into the liquid box, the yarns absorb some of the liquid and the squeezing roller squeezes out the excess liquid.

When the rope absorbs some liquid there will be some change of ratio in the liquid box which may cause shade variation or quality variation than we wanted. So to solve the problem, ratio in the box needed to be maintained. That's why certain quantity of liquid needed to be poured in the box in a certain time which is donated by dosing. There are 7 dosing motor in the machine. These motors pump the dosing liquid to the liquid box.

3.2.2.6.9 Bypassing:

Bypassing is done if any of the box is not needed to achieve the shade. If bypassing is not done it may take more time passing a batch. Bypassing also saves time. When pure black is used bypassing is done. It also depends on the shade percentage.

3.2.2.7 Chemicals used in dyeing:

Name	Origin	Function
Indigo blue granular	China	Dye
Denim blue 30	Singapore	Dye
Denisol indigo 30 liq.	Pakistan	Dye
Indigo bann 35 reduzido	Brazil	Dye
Sodium hydrosulphite	Korea	Dye
Caustic soda flake	India	Scouring/mercerizing
Dekol 1097SP TH liq.	Thailand	Sequestering agent
Benwet RD-999	Taiwan	Wetting agent
Benvadine MR-100	Thailand	Wetting agent
Mercerol QWXL liq.	Singapore	Wetting agent
Sulfotex black SN-155	Spain	Dye
MKS sulfur black RS	Turkey	Dye
Diresul black RDT-D-BD-Liq	Singapore	Dye
Sulphur black powder	China	Dye
Massul yellow brown	China	Dye
Reducer BP	China	Reducer (Indigo)
Sodium sulphite	China	Reducer (Black)
Bensoft M-8610	Taiwan	Softener
Acetic acid	China	P ^H controller

TABLE: 3. 2 CHEMICALS USED IN DYEING

3.2.2.8 Function of different chemicals:

3.2.2.8.1 Sequestering agent:

- Removing hardness of water
- React with Calcium and Magnesium and other ions, which stop them to react with other chemical.

3.2.2.8.2 Hydro (reducing agent):

- Reduction of the size of the dye particles
- Making the dye soluble

3.2.2.8.3 Wetting agent:

- Reduction of surface tension of water
- Improving wetting ability

3.2.2.8.4 Softener:

- Soften the yarn
- Improvement of hand feel

3.2.2.8.5 Acetic acid:

- Controlling P^H (11-12)

3.2.2.8.6 Caustic Soda:

- Removing wax
- Removing natural color

3.2.2.8.7 Bleach:

- Removing natural color of cotton

3.2.2.9 Preparation tank:

These tanks are mainly used for dosing purpose. Dosing is done when dosing process is ongoing. Workers continuously prepare dosing as much as they need.

Tank no	Volume (Ltr)	Purpose
1,2	2000	Scouring/ Mercerizing
3	4000	Indigo preparation
4,5	500	Hydro + caustic mix
6,7	1500	Indigo dosing tank
8,9	2400	Black
10	1000	Softener
11,12	1000	Caustic pit

TABLE: 3. 3 PREPARATION TANK

3.2.2.10 Reserve tank:

This tank reserves dyes/chemicals all the time. It reserves solution maintaining ratio. When solution is needed then it pours into the tank. If the ratio needs to be changed then mixing with water and other chemicals do it.

There are 12 reserve tanks:

Total 5 – Indigo reserve tank

Total 5- Black reserve tank

Total 1- Pre-mercerizing reserve tank

Total 1- Hot water tank

3.2.2.11 Machines used in dyeing lab:

Name	Function
Color assessment cabinet	Shade matching
Metrohm	Indigo gpl measurement and Hydro gpl measurement by titration process
Spectrophotometer	Measuring sulphur black gpl
Metrohm P ^H meter	Measuring P ^H
Manna P ^H meter	Measuring P ^H
Digital balance	Measuring weight
Note: liquids are collected from dye box in every 30 minutes later.	

TABLE: 3. 4 MACHINES USED IN DYEING LAB

3.2.3 Long Chain Beam

3.2.3.1 Long Chain Beam:

The yarn in the coiler are then affected at the back of a long beaming machine. The purpose of this machine is to convert all the yarn in the rope form into a warped form. The warped beam is then created at the back of a normal sizing machine to size and make the weavers beam.

3.2.3.2 Machine Specification:

No. Of m/c : 12

Origin: USA

Product name: Long chain beam

Model : MDS-RB550

Rated Voltage: 400 v AC3~

Rated frequency : 50/60 Hz

Operation air pressure: 4-6 kg

No. Of lent : 468

M/c speed: 550 rpm

No. Of machine : 02

M/c name: Karl mayor.

Description : Textile m/c.

Origin : Germany.

Made in : China.

Type: LCB titan.

No. Of lent: 567.

M/c speed : 550 rpm.



FIGURE: 3. 11 L.C.B MACHINE

3.2.3.3 Objectives

- To open the rope into a sheet form on of yarn and wind onto a beam.
- To prepare it for sizing process.
- To solve the Breakage which is done in warping and dyeing.
- To cut the lease which is given from warping and dyeing section.

3.2.3.4 Standard chart of L.C.B tension setting:

Yarn count	Tension	Remarks
7 OE/MS/R3/RC	75-80 bar	For multi-count set tension according to average count.
8 OE/MS/R3/RC	70-80 bar	
9 OE/MS/R3/RC	65-70 bar	
10 OE/MS/R3/RC	60-65 bar	
12 OE/MS/R3/RC	45-50 bar	
16 OE/MS/R3/RC	35-40 bar	
20 OE/MS/R3/RC	25-30 bar	
Note: According to yarn characteristics above yarn tension maybe changed.		

FIGURE: 3. 12 STANDARD CHART OF L.C.B TENSION SETTING

3.2.3.5 Wastage:

Wastage is done when beam or can needs to be changed. When the can is nearly empty then new can is placed and knot given to the end of the yarn with another can starting points. (3-5)

m of yarn is wasted in the process.

3.2.3.6 Main parts of MDS:

- Can.
- Accumulator.
- Can wheel.
- Tension roller.
- Dance roller 1.
- Dance roller 2.
- Reed
- Measuring roller
- Beam.
- Foot switch.
- Fan
- Safety brake

- Drum roller.
- Control panel
- Beam Holder
- Streamer.

3.2.3.7 Different section of L.C.B :

- Can section.
- Tension Zone.
- Head stock section.
- Strimmer Section

Function of different section:

3.2.3.7.1 Can section:

Dyed rope yarns are collected in the can. Those can are transferred to the LCD section. This cans are then set in the cam wheel, where the Can wheel are meant to rotate the Can as the yarns are feed. This is done so that the yarns comes out of the can without any entanglement.

From the can the yarn is feed to the accumulator. Where the accumulator is fixed on the ceiling and which can rotate 360 degrees. This control the tension on the yarn and which ensure the yarn is not insert in the machine with lose form.

Then the yarn is set to the tension Zone.

3.2.3.7.2 Tension Zone:

In the tension zone the yarn is passed by some drum roller and guide roller. After passing these the yarn is passed to the hydraulic tension controller. When the hydraulic tension controller control the tension by pneumatic pressure. The tension is adjust if the yarn is loose or light.

You there is any breakage in the yarn the hydraulic tension controller pull of the tension.

3.2.3.7.3 Head stock:

Then the yarn comes to the reed. Then the yarn is differentiate by the reed. From the reed the yarns will be rolled over the beam.

3.2.3.7.4 Strimmer:

This technology is used to separate the yarns from each other. After the allying yarns may be attached with other yarn. That's why streamer is used to individualize the yarn. The strimmer moves or circulate 360 degrees.

3.2.3.8 Working procedure

3.2.3.8.1 Reed length:

Reed length can be increased or decreased. This is done according to the number of ends needs to be LCB. If the number of end is high, then the reed length needs to be decreased. So that all the ends can set well in the beam and if there is less end then the reed length increased according to the width of the beam.

3.2.3.8.2 Knotting:

From the warping and dyeing section the yarn got damaged which result of breakage. so every machine have (5-6)m of extra yarn hanging on the headstock. When there is breakage the machine is stopped manually and individually knotting is done for every Breakage.

3.2.3.8.3 Lease Cutting:

The lease which is given in the warping section and dyeing is finally cut down in the LCB section.

3.2.3.9 Trouble shoot:

- Input travel shoot.
- machine trouble shoot.
- Process trouble shoot.
- Temperature trouble shoot

3.2.3.9.1 Process trouble shoot :

- If the yarn on the reed is not set serially.
- If the breakage is not solved.
- Lack of operator concentration.
- If the lease is not cut can be break.

3.2.3.9.2 Temperature troubleshoot :

A/c control panel is used to control the temperature and humidity. So there is two thing is done to control temperature, humidity.

Inn : Which insert cool here in the room as it is set.

Out : Where the hot air is sucked. The hot air is created from the machine.

Temp- (25+/- 2)%

Humidity- (75+/- 2)%

If it is not maintain yarn quality may be decreased.

©Daffodil International University

3.2.3.9.3 Input trouble shoot:

- If the leasing is not done properly.
- If there is missing ends.
- If the rope is entangled.

3.2.3.9.4 Machine trouble shoot:

- If the tension is not given properly.
- If there is broken ends.
- If the read length is not set properly.
- If the beam have sharp or broken edge.

3.2.3.10 Precaution:

- PPE needs to used.
- While running the machine we should not put our hand inside.
- Operator needs to concentrate.
- Temperature and humidity need to control.

3.2.3.11 Conclusion :

Long chain beam is mainly the preparatory part before going to the sizing. So here breakage in the yarn is fixed by individual mending. So proper inspection and concentration is needed in this section or else sizing may not done properly.

3.2.4 Sizing:

3.2.4.1 Sizing:

Sizing is a process by which an adhesive coating is applied around the surface of the yarn. The ingredients of a size recipe are very much depends on lot of factors like quality and type of fiber and yarns there reed and pick.

3.2.4.2 Objectives of sizing:

- To improve the weavability of warp yarn.
- Reducing hairiness.
- Increasing yarn strength.
- Improve smoothness.
- To increase tensile strength.
- To reduce electrostatic formation for synthetic or blended yarn.
- To remove static electricity.

3.2.4.3 Process sequence Sizing:

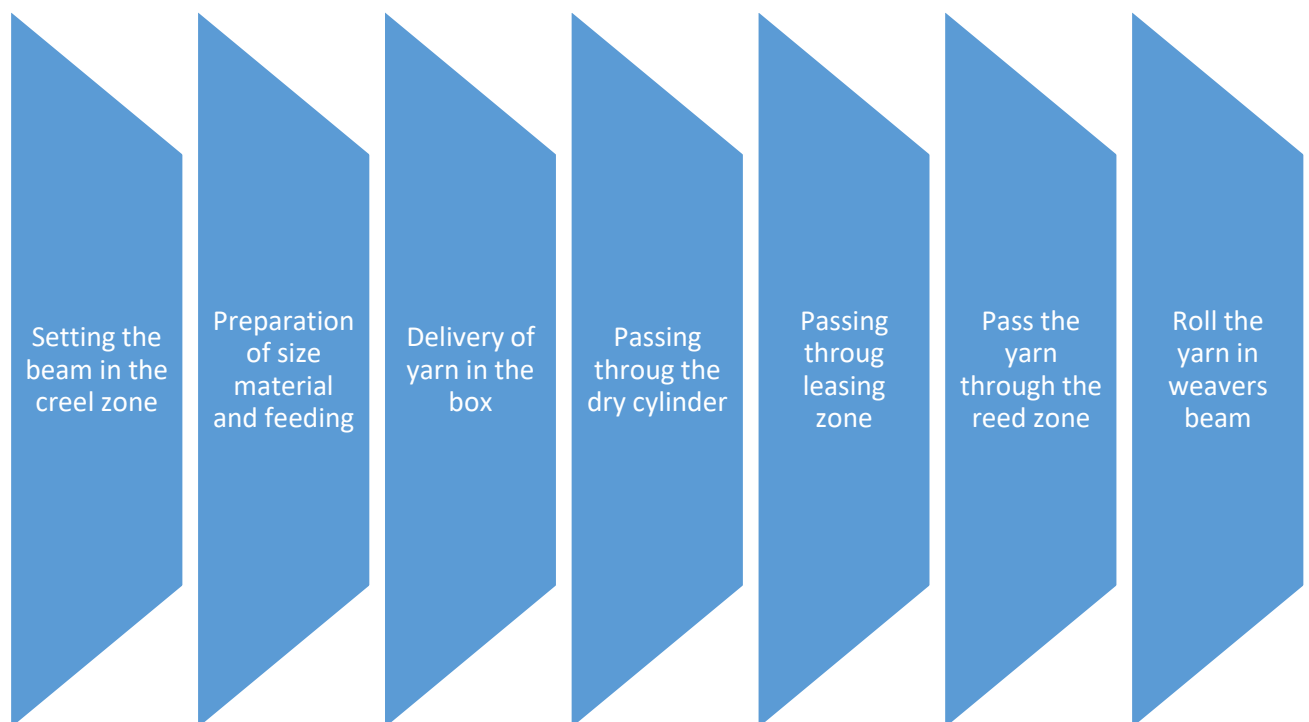


FIGURE: 3. 13 PROCESS FLOW CHART:

3.2.4.4 Machine specification:

3.2.4.4.1 M/c no: 1

Machine name: Karl Mayer

Description: Textile machine.

Type: CSB-1/180

Origin: Italy

Creel capacity: 20

Ball Capacity: 40

M/c speed:125 rpm

Cooking tank: 12000 ltr

Reserve tank: 2000 ltr

Reed Alert: 992

Dry cylinder: 18

Size box capacity: 200 ltr



FIGURE: 3. 14 KARL MAYER MACHINE

3.2.4.4.2M/c no : 2

Machine name: Ukil

Model name: GSSM-100 emportsizer

Origin: Korea

Creel capacity:16

Ball capacity: 32

M/c speed: 100 rpm

Run speed: (25-55)rpm

Reed speed :455

Main parts:

-Creel

-Beam

-Guide roller

-Size box

-Squeeze roller

-Circulation chemical pipe

-Chemical limit sensor

-Loose cell

-Dry cylinder-14

-Cooking tank- 2000 ltr

-Reserve tank – 2000 ltr

-Leasing rod

-Reed

-Pressure roller

-Nipple

-Emergency wire

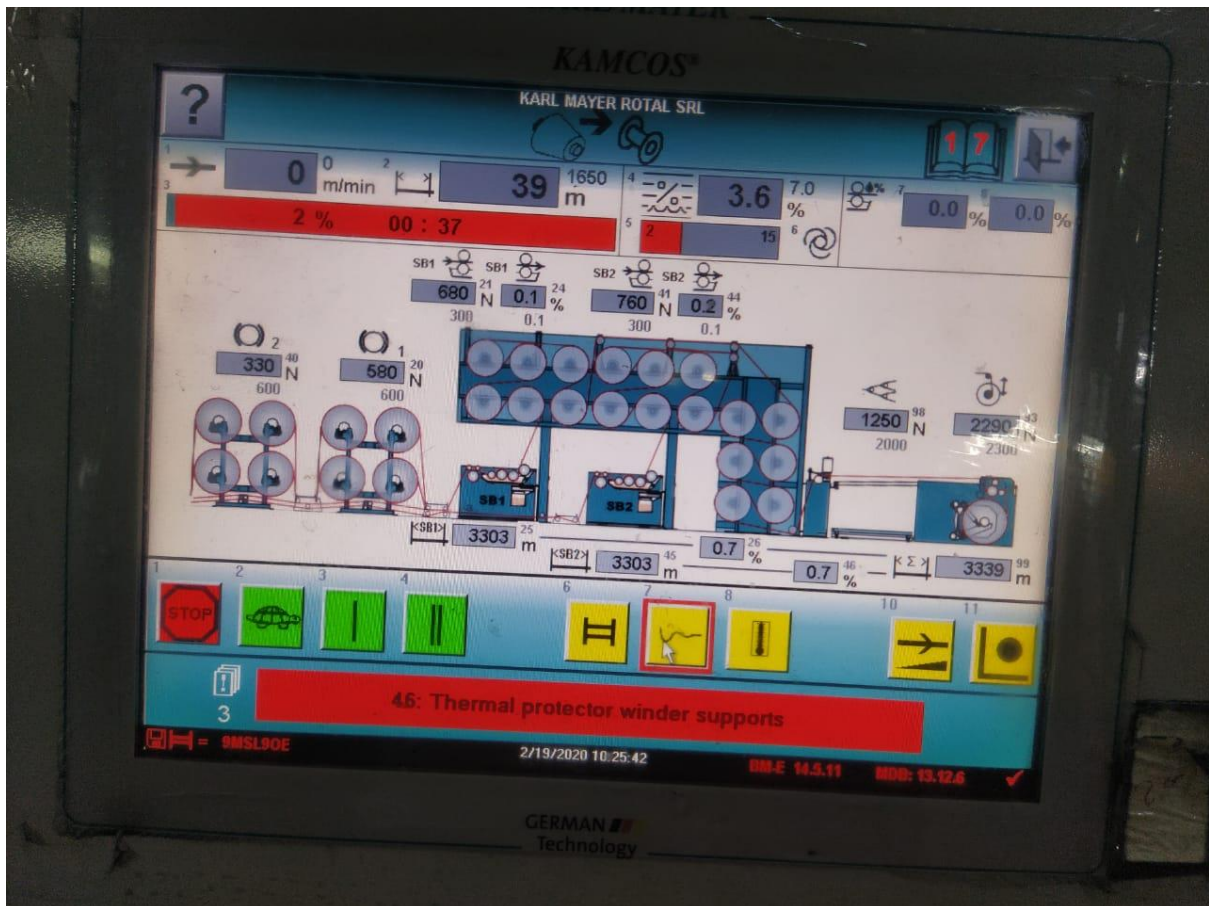


FIGURE: 3. 15 PASSAGE DIAGRAM OF SIZING MACHINE

3.2.4.5 Different zone of Sizing :

- Creel Zone
- Sizing Zone
- Drying Zone
- Leasing Zone
- Reed Zone
- Beam Zone.

3.2.4.5.1 Creel Zone:

In this zone the beam re set on the creel . From here the process of sizing is started.

For M/C no:1

Creel capacity – 20

Beam capacity -32

For Karl Mayer,

©Daffodil International University

Creel capacity – 20

Beam capacity -40



FIGURE : 3. 16 CREEL SECTION

3.2.4.5.2 Sizing zone:

This is where the sizing is done. This is where the sizing ingredients is inserted in the yarn.



FIGURE: 3. 17 SIZING ZONE

3.2.4.5.2.1 SIZED CHEMICAL USED :

Name	Chemical type	Origin
B60	Wax	Thailand
E850	Acrylic polymer	Thailand
K200	Modified starch	Thailand
B120	Modified starch	Thailand

TABLE: 3. 5 SIZED CHEMICAL USED

3.2.4.5.2.1 VISCOSITY:

After measuring viscosity the liquid is transfer to the reserve tank. Viscosity is measured by ford cup which capacity is 100 ml. The time required to empty the cup full of sized chemical is measure as viscosity. Viscosity depends on the use of sized chemical in the cooking tank.

3.2.4.5.2.2 PADDER ROLLER:

Which squeeze the access chemical from the yarn

3.2.4.5.2.3 SIZE BOX:

There are 2 size box in the . According to the quality factor number of size box can be added. Every size leox have ruleleer coated roller. For the leeftor handling of the yarn.

Size box capacity: 200 ltr

3.2.4.5.2.4 COOKING TANK:

Where all the sized chemical is cooked for some periods. When all the sized chemical is size and then cooked. After the cooking process solid percentage and viscosity.

3.2.4.5.2.5 REFLECTROMETER:

This machine measure the solid percentage present in the cooking tank. If the percent or the result is expected than it transferred to the leasing tank.



FIGURE: 3. 18 REFLECTROMETER

3.2.4.5.3 Dryer zone:

Where the yarn is pass along the cylinder where the cylinder is capturing steam inside it. Main objective of the dryer is to maintain the moisture percentage in the yarn.

14 Dry cylinder in – Ukil

18 Dry cylinder in – Kalmay

Moisture percentage – 6.5%

3.2.4.5.4 Leasing zone:

Here yarn from different beam is individualize by leasing road. Main objectives of the leasing is to separate one yarn from the other or after sizing yarn got stick with other yarn. If it is not done yarn may break in the reed section .

3.2.4.5.5 Reed section:

Here reed is used maintain yarn width according to the beam width. If it is not maintain it may cause problem in the weaving section.

3.2.4.5.6 Beam section:

Where all the sized yarn is rolled on a beam and send to the weaving section.

Where a pressure the yarn for the better position of the yarn on the beam.



FIGURE: 3. 19 BEAM SECTION

3.2.4.6 Pre-caution:

- P.P.E needs to be used.
- Should not put hand into any roller while m/c is running.
- Safety distance should maintain
- Viscosity and solid percentage should maintain properly.

3.2.4.7 Conclusion:

Sizing is mainly a process to prepare the warp for the next process, Which is weaving. In weaving yarn go through lot of tension. If the yarn is not sized mass breakage will happened. That's why sizing should be one properly or else quality fabric may not produce.

3.2.5 Weaving

3.2.5.1 Weaving

Weaving is called the heart of denim. The process of producing a fabric by interlacement of warp ends and weft threads is known as weaving.

The machine used for weaving is known as weaving machine or loom machine

3.2.5.2 Machine Specification:

Machine Name: Picanol

Model: Omini Plus-800

Origin: Belgium

Machine Speed: 850 RPM

Regular Speed: 650-700 RPM

Total Heald Frame: (Cam-08), (Dobby-16)

Breaking System: Auto

Total Machine: 180

No of Dobby M/C: 20

No of Air jet M/C: 154

No of Rapier M/C: 06



PICANOL WEAVING MACHINE

3.2.5.3 Shedding Mechanism:

Two Types:

- Cam
- Dobby

3.2.5.4 Machine Parts:

- Beam
- Back rest
- Heald Frame
- Reed
- Stand
- Creel
- Yarn
- Disk
- Tensioner
- Pre-winder
- Balloonbrakers
- Fixed Nozzle

- Moveable Nozzle
- Dropwire
- Healdwire
- Main fixed valve
- Take up roller
- PFT motor
- PFT finger
- Main Moveable valve
- Sub nozzle
- Free roller
- Filling cutter
- Filling Cutter
- Leno Holder
- Overhead
- Temple
- Easing Arm
- Catch bobbin

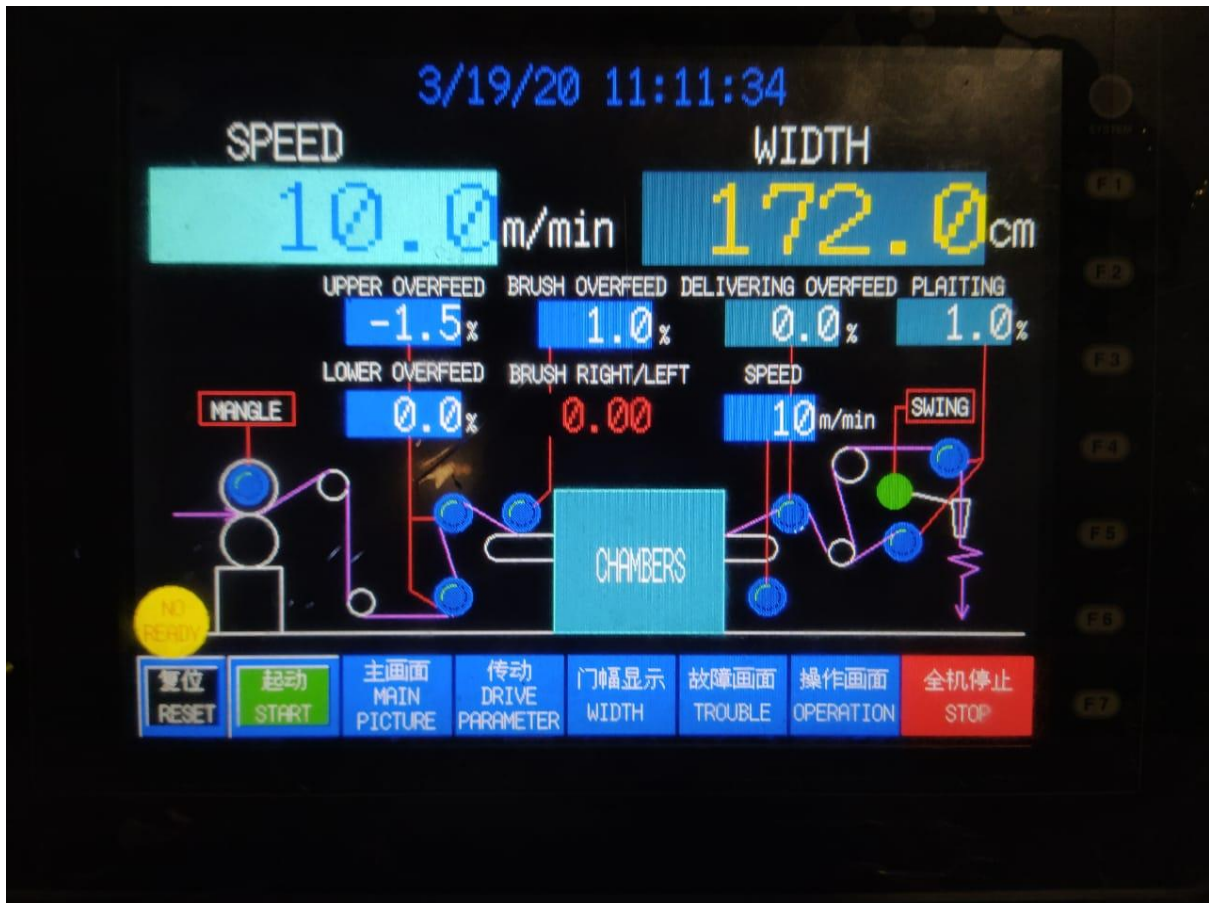


FIGURE: 3. 20 PASSAGE DIAGRAM OF WEAVING MACHINE

3.2.5.5 Basic Weave Designs:

- Plain weave
- Twill weave:
 1. -Herringbone twill
 2. -Broken Twill
 3. -Zigzag Twill

3.2.5.6 Modern Weaving machine:

Modern Weaving machines are classified according to their filling insertion mechanism.

The classification is as follows:

- Rapier
- Projectile
- Air-Jet
- Water-Jet

Reed count: There are different types of reed count, like 652DM, 869 DM, 739 DM, 1085 DM, 1190 DM, 931 DM.

Here, Matric system used for reed count.

Wastage of Weaving Section:

- Empty paper cone
- Selvedge
- Black Yarn
- Empty PVC woven bag
- Yarn wastage
- Wastage fabric
- Gara cone
- White sized yarn
- SMF
- Paper carton

Warp Yarn used in Weaving Section :

6 OE/RC/RS

7 OE/RC/RS

9 OE/RC/RS

10 OE/RC/RS

12 OE/RC/RS

14 OE/RC/RS

16 OE/RC/RS

20 OE/RC/RS

26 OE/RC/RS

Weft Yarn Used in Weaving Section

Cotton : 70E, 90E, 10L 40D, 16L 40D

75D- Polyester/spandex

Polyester: (poly-Lycra)

150L 70D, 200L 40D, 200L 70D, 300D 600D, 300L 40D, 300L 70D.

3.2.6 Finishing Section:

3.2.6.1 Finishing :

In textile manufacturing, finishing refers to the processes that convert the woven or knitted cloth into a usable material and more specifically to any process performed after dyeing the yarn or fabric to improve the look, performance, or "hand" (feel) of the finish textile or clothing.

3.2.6.2 Objectives of Finishing

- To improve the look
- To get the desired performance
- Good hand feel

3.2.6.3 M/c no: 01

Stenter Machine :

This Machine used for reducing Shrinkage %.

M/c Type: SMA6802-200

M/c No: 1500

Construction Year: 2015.03

Origin: China

3.2.6.3.1 Machine parts:

- Nip roller

- Chemical box
- Squeez roller
- Tension roller
- Denser roller
- Chemical Tank
- Steamer box
- Guider
- Clip Chain
- Heat Box (120-190)c
- Nozzel
- Burner
- Blower
- Cooling
- Net (Total- 80 pcs)

3.2.6.4 M/c no:02

Sanforizing Machine

M/c Speed : Min:10- Max:60

Singing Speed: Min:5- Max:88

Burner Regulator: 0-100.

MENZEL Part:

Machine Specification:

M/c Type: 80BR01

M/c No: 316

Construction NO: 11-10

Origin : USA

Morrison Part:

Origin: USA

Serial no: T-207

Construction yr: 2011

3.2.6.4.1 Main Parts of Sanforizing Machine:

- Loading Box
- J- box
- Brusher
- Guider
- Burner box
- Batcher
- Singening roller
- Siftener box

- Squeeze roller
- Delivery roller
- Dry cylinder (10*2=20)
- Boing roller
- Iron Box
- Platter

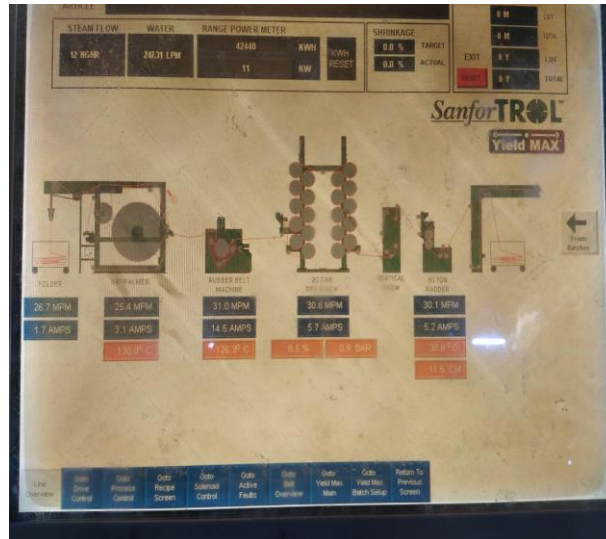


FIGURE: 3. 21 PASSAGE DIAGRAM OF SANFORIZING MACHINE

Chapter 4: Discussion of result

4.1 Discussion of Result

Rope denim is a very large and robust installation, capital investment is also high. Production rate is also very high. Time to get dyed and sized warp yarn is also longer than sheet denim. Some of the advantages of rope dyeing are Shade variation low, Wastage percentage low, Quality good, Fabric price high and capable of multi shade dyeing. The disadvantages of rope dyeing are Floor area required high, more man power needed than sheet denim, High utility charge, High time required for producing weavers beam and High amount of liquor needed.

Chapter 5:

Conclusion of Results

5.1 Conclusion of Results

Rope denim is preferred by the buyers worldwide, though there are many important disadvantages but there are lots of strong advantages as well. Perhaps the advantages are more preferable than the disadvantages. For this reason rope denim is very popular method of making denim.

Reference

- <http://www.historyofjeans.com/jeans-history/history-of-denim/>
- [https://en.wikipedia.org/wiki/Finishing_\(textiles\)#:~:text=In%20textile%20manufacturing%2C%20finishing%20refers,the%20finish%20textile%20or%20clothing.](https://en.wikipedia.org/wiki/Finishing_(textiles)#:~:text=In%20textile%20manufacturing%2C%20finishing%20refers,the%20finish%20textile%20or%20clothing.)

Rope Denim

ORIGINALITY REPORT

16%

SIMILARITY INDEX

14%

INTERNET SOURCES

3%

PUBLICATIONS

11%

STUDENT PAPERS

PRIMARY SOURCES

1

Submitted to Daffodil International University

Student Paper

3%

2

library.wub.edu.bd

Internet Source

3%

3

dspace.daffodilvarsity.edu.bd:8080

Internet Source

2%

5

textilefashionstudy.com

Internet Source

1%

6

Submitted to Universiti Teknologi MARA

Student Paper

1%

7

www.seattleoncanvas.com

Internet Source

1%

8

en.wikipedia.org

Internet Source

1%

9

www.absoluteastronomy.com

Internet Source

1%

10	textilelearner.blogspot.com Internet Source	<1%
11	www.wikizero.com Internet Source	<1%
12	www.fibre2fashion.com Internet Source	<1%
13	slideplayer.com Internet Source	<1%
14	Submitted to University of the Arts, London Student Paper	<1%
15	filadora.com Internet Source	<1%
16	Submitted to The Hong Kong Polytechnic University Student Paper	<1%
17	Submitted to University of Wales Institute, Cardiff Student Paper	<1%

Exclude quotes On
Exclude bibliography On

Exclude matches Off