Faculty of Engineering

Department of Textile Engineering

"Effect of Machine Stoppage On Production Efficiency Of Circular Knitting Machine"

Course code: TE-417   Course Title : Project (Thesis)

Submitted By:

Name:	**ID:**
1) Md. Habibul Hasan	113-23-2673
2) Mohammad Mizanour Rahaman	113-23-2678

Supervised By :

Professor Dr. Md. Mahbubul Haque

Head of Department

Department of Textile Engineering

This thesis is submitted in partial fulfillment of the requirements for the Degree of **Bachelor of Science in Textile Engineering**.

Advance in Fabric Manufacturing Technology

July,2015

Letter of Approval

August 2nd, 2015

The Head of the Department
Department of Textile Engineering
Dafffodil International University 102,
Shukrabad, Mirpur Road, Dhaka 1207

Subject: Approval of project report of B.Sc. in TE Program .

Dear Sir

We are just writing to let you know that this project report titled as "Effect of machine stoppage on production efficiency of circular knitting machine" has been prepared by the students bearing ID: 113-23-2673 and ID: 113-23-2678 is completed for final evaluation. The whole report is prepared based on the proper investigation and interruption through critical analysis of empirical data with required belongings.

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

Yours Sincerely

Md. Habibul Hasan ID: 113-23-2673

Mohannad Mizanour Rahaman ID: 113-23-2678

....

Professor Dr. Md. Mahbubul Haque
Head of the Department
Department of Textile Engineering

ACKNOWLEDGEMENT

At first we express our heartiest thanks and gratefulness to almighty Allah to give us strength and ability to complete the project work and project paper.

We have made our life more bountiful. We fell grateful to and wish our indebtedness to **Professor Dr. Md. Mahbubul Haque,** Head of the Department, Department of Textile Engineering, Daffodil International University, Dhaka and **Ms. Shamima Akter Smriti** , Lecturer of the Department, Department of Textile Engineering, Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of Fabric Manufacturing influenced us to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior draft and correcting them at all stage have made it possible to complete this project.

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

Finally, we would like to acknowledge with due respect the constant support and patients of our parents.

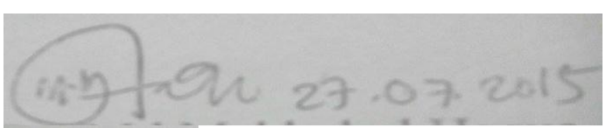
DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Professor Dr. Md. Mahbubul Haque,** Head of the Department , Department of Textile Engineering, **Daffodil International University** and **Ms. Shamima Akter Smriti** , Lecturer of the Department, Department of Textile Engineering, **Daffodil International University**, Dhaka.**.** We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree and it is submitted in partial fulfillment of the requirement of Bachelor of Science in Textile Engineering degree of Daffodil International University and we also remain responsible for the inadequacies & errors.

Paper Prepared By

Name of the Student's	Student's ID No	Signature
1.Md. Habibul Hasan	113-23-2673	……………..
2.Md. Mizanour Rahman	113-23-2678	………...….

Signature of supervising Teacher



………………………..

Prof. Dr. Md. Mahbubul Haque

Head, Department of Textile Engineering

Daffodil international university

ABSTRACT

This project is on **"Effect of Machine Stoppage On Production Efficiency Of Circular Knitting Machine"** .Textile Fabric materials are used to prepare different categories and types of Fabric products in the textile industry.

For machine stoppage many defect are produced and time are waste. To fulfill buyer delivery timeline and quality it is very important to detect, to identify and to prevent these causes from reoccurring. There are many kinds of knitting machine stoppage causes found in textile industries.

This Project deals with a major problem of production loss and causes of knitting machine stoppage in knitting industry. The knitting machine has to stop when defects occurred and then faults are corrected, which results in time loss and efficiency loss. Not only that the knitted fabric may be rejected if quality requirements are not met.

An effective monitoring is required to avoid defects and to avoid productivity and quality losses. The study identifies two main categories of defects (average time required for correcting defects and machine down time) are responsible for reducing productivity. The thesis reflects that due to yarn breakage machine stopped for seen minutes per days, for maintaining machine stopped for two hours per month, for needle breakage six minutes per day and for technical problem machine stopped for several times.

In order to produce quality product and increase efficiency we should find out the causes of machine stoppage and decrease the causes as far as possible .

Contents

Chapter -1

1.1 Introduction

Bangladesh is known as a land of Agriculture. In past and now also most of the people of Bangladesh are depend on agriculture But in resent past another sector is growing rapidly and that is textile . Now a days around 70% of our economy is depend on textile.

From 1947 to 1971 the textile industry like most industries in East Pakistan, were largely owned by west Pakistan. During that period in 1960, local Bangle entrepreneurs had set up there own large textile factories. Following its separation from East Pakistan the newly formed Bangladesh lost access to both capital and technical expertise. Until the liberation war of Bangladesh in 1971 textile sector was primarily part of the process of import substitution industrialization (ISI) to replace import. After the liberation Bangladesh adopted export oriented industrialization (EOI) by focusing on textile and clothing industry. Particularly the readymade garment (RMG) sector.

However the Ready–Made Garments (RMG) sector has emerged as the biggest earner of foreign currency. The RMG sector has experienced an exponential growth since the 1980s. The sector contributes significantly to the GDP. It also provides employment to around 4.2 million Bangladeshis, mainly women from low income families. It was started in the late 1970s. Soon it became one of the major economical strength for Bangladesh. The RMG sector has added very much in earning foreign exchange, balancing export and import, huge unemployment problem for the country and empowerment of women along with given them financial support.

Fabrics are the main and costly raw materials of a garment. So it is very important to use fabric efficiently and control wastage of fabric. In Bangladesh knitted fabric are more popular then woven fabric because of easy manufacturing process and its comfortable to wear. For knitting machine stoppage knitting industry face some problems and facing losses . So by this we can say machine efficiency are very important but it is affected by machine stoppage. There is some causes of stoppage the machine e.g. unskilled labor , yarn breakage ,inspection, doffing ,cleaning etc and those causes are mostly reducible.

A knitting machine contains different types of machine parts such as needles, cams, sinkers, Fabric take-down mechanism, creel, a yarn metering and storage device, yarn breakage indicator, feeders and lubricator. All those machine parts are responsible to increase or decrease the productivity of knit fabric production. Due to the problem of machine parts, machine has to shut down for certain period. For this it reduced productivity overall loss of efficiency of the machine. Unskilled labor is another major causes of knitting machine stoppage .

There are many other causes of stoppage knitting machine. This thesis object is to find out new causes and Reminders, efficiency of machine, variation in actual and calculated production, and percentage of cause’s due to 100% efficiency, How to improve the efficiency and decrease the time loss.

Chapter 2 Litarature servey

2.0 Recent Work:

In the book of D. J. Spencer, “Knitting Technology”, third edition, Wood head Publishing Ltd., April 2001 he wrote A knitting machine contains different types of machine parts such as needles, cams, sinkers, Fabric take-down mechanism, creel, a yarn metering and storage device, yarn breakage indicator, feeders and lubricator**[1].** All those machine parts are responsible to increase or decrease the productivity of knit fabric production. Due to the problem of machine parts, machine has to shut down for certain period. For this it reduced productivity overall loss of efficiency of the machine.

In the book of Iyer, Mammel, Schach “Circular Knitting”, second edition, 1995. The demand for knit garment products all over the world are rapidly growing because of more interest in knitted fabrics due to its simple production technique, low cost, high levels of clothing comfort and wide product range. Knitting technology meets the rapidly-changing demands of fashion and usage. Knitted fabrics not only possess stretch and provide freedom of movement, but they also have good handle and easily transmit vapor from the body **[2].**Knitted fabrics are also noted for their freedom of body movement in form fitting garments (due to inherent stretch), ease of care, resilience, soft draping qualities, good air porosity and Relatively low cost of simple fabrics. Various types of knitted garments are produced in Bangladesh such as polo pique, single lacoste, double lacoste, rib and interlock fabrics.

In Wikipedia Efficiency is used with the specific purpose of relaying the capability of a specific application of effort to produce a specific outcome effectively with a minimum amount or quantity of waste, expense, or unnecessary effort **[3].** If outcome is greater than the input materials in this case machine is considered highly efficient. The efficiency of a machine depends on many factors such as machine speed, input materials quality, Routine maintenance, skilled machine’s operator, auto spacing and oiling, power failure etc.

The introduction of stitching motion and related mechanisms driven by electronic system in these knitting machines has given much rise in their freedom to create versatile fabric structures, and in their productivity. For example, garment-length fabrics have become applicable to seamless women’s innerwear, which can be produced by making an active use of the freedom in changing the stitch density and the number of stitch during operation **[4]**

In the book of Iyer, Mammel, Schach “Circular Knitting”, second edition, 1995. Knitted fabric can be classified into two categories, namely weft knitted fabric and warp knitted fabric. In weft knitting a yarn presented horizontally is kinked into a row of loops. To achieve these needles can be moved simultaneously and the loops formed one after the other or at the same time or the needles are moved successively to form the loops **[5].**

In a journal of Md.Solaiman, Elias Khalil ;Mostafizur Rahman; Joy Sarkar they identify the causes from single , Rib Machine randomly and calculate production randomly and find the basic causes of efficiency loss **[6].**

Chapter 03 Theoretical Background

3.0 Fabric

Textile fabrics can be produced directly from webs of fibers by bonding, fusing or interlocking to make non-woven fabrics and felts, but their physical properties tend to restrict their potential end-usage. The mechanical manipulation of yarn into fabric is the most versatile method of manufacturing textile fabrics for a wide range of end-uses .

There are three principal methods of mechanically manipulating yarn into textile fabrics: interweaving, intertwining and inter looping. All three methods have evolved from hand manipulated techniques through their application on primitive frames into sophisticated manufacturing operations on automated machinery.

Interweaving or Weaving : Interweaving or Weaving is the intersection of two sets of straight threads, warp and weft, which cross and interweave at right angles to each other. Weaving is by far the oldest and most common method of producing continuous lengths of straight-edged fabric.

Intertwining and twisting : Intertwining and twisting includes a number of techniques, such as braiding and knotting, where threads are caused to intertwine with each other at right angles or some other angle. These techniques tend to produce special constructions whose uses are limited to very specific purposes.

Inter-looping or Knitting : Inter-looping or Knitting consists of forming yarn(s) into loops, each of which is typically only released after a succeeding loop has been formed and inter-meshed with it so that a secure ground loop structure is achieved. The loops are also held together by the yarn passing from one to the next. (In the implied illustration this effect is not illustrated.)

Fabrics are produced mostly from yarns. Few fabrics are directly produced from fibers. Fabrics are made from yarns and are constructed mostly either by weaving or knitting. Weaving Major portion of the fabrics are produced by weaving. Among the other fabric constructions, lace making is worth mentioning. Felts are fabrics made directly from fibers without making yarns.

A wide variety of woven fabrics are available in today's market. An average consumer is unaware of many fabrics and their suitability for a specific end use. Clothing refers to the various articles used to cover the body. Apparel may be divided into two classes. First one the desire for warmth and for protection against elements, Secondly the desire for satisfaction we receive from wearing clothing that makes us appear to advantage.

Baby's cloths need not be full of frills or elaborate, since the baby's comfort should be the main criterion. Their clothes are meant to protect them from colds and chills, while allowing enough freedom of movement for the limbs. Clothes should not be tight as they will hamper the circulation and breathing.

The appearance of a garment is greatly influenced by the fabric used for construction, not all fabrics are suitable for all garments. To choose a suitable fabric for a specific end use calls for basic knowledge in fabric construction and types of fabrics available in the market.

3.1 Introduction of knitted Fabric

Knitting is the second most frequently used method of fabric construction. The term "Knitting" describes the technique of constructing textile structures by forming a continuous length of yarn into columns of vertically intermeshed loops. Knitted fabrics have been gaining popularity during the past two decades, thanks to the increased versatility of techniques and adaptability of the many new manmade fibers. Knitted fabrics are now widely used in the applications where woven fabrics formerly predominated. Today, the usage of knitted fabrics ranges from hosiery, underwear, sweaters, slacks, to rugs and other home furnishings.

From the beginning the art of knitting was an occupation for women. Traditional hand knitting, using knitting needles or pins, has been practiced for thousands of years. The earliest example of true knitting is a pair of knitting socks found in Egypt, dating back to 1100 A.D

just over 9 centuries ago! Socks and stockings were knitted because they had to be shaped to the foot or leg. By the 16th century knitting had advanced into a craft, the first real evidence of a production knitting machine was the stocking frame, invented by the Reverend William Lee in 1589. The invention laid the foundation for the development of knitting technology. Lee's invention enabled the knitting of loops at 10 times the speed of traditional hand pin knitting.

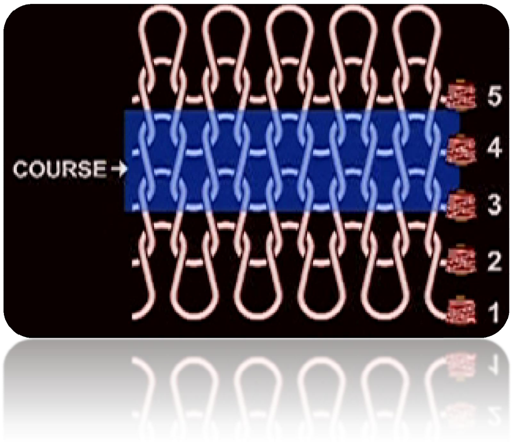
3.2 Course and Wales

There are 2 things making the knit fabric. They are course and Wales. Wales is the vertical yarn.

Course is the horizontal yarn.

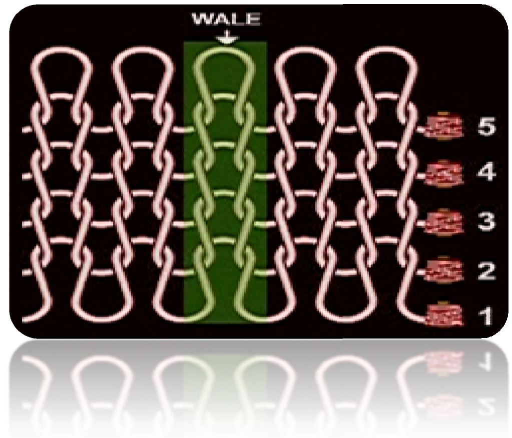
Wales lines are fixed by the machine gauge. This cannot be changed. Coarse lines can be

altered by adjusting in the machine. This is called Texture.



Course per inch:

Measured by placing an inch glass called counting



glass on the fabric and counting the number of courses are contained within the area. This values very if the fabric is distorted.

Wales per inch:

Wales per inch are measured by placing an inch glass called counting glass on the fabric and counting the number of Wales, which are contained within the area. This values very if the fabric is distorted.

3.3 Why knits are popular?

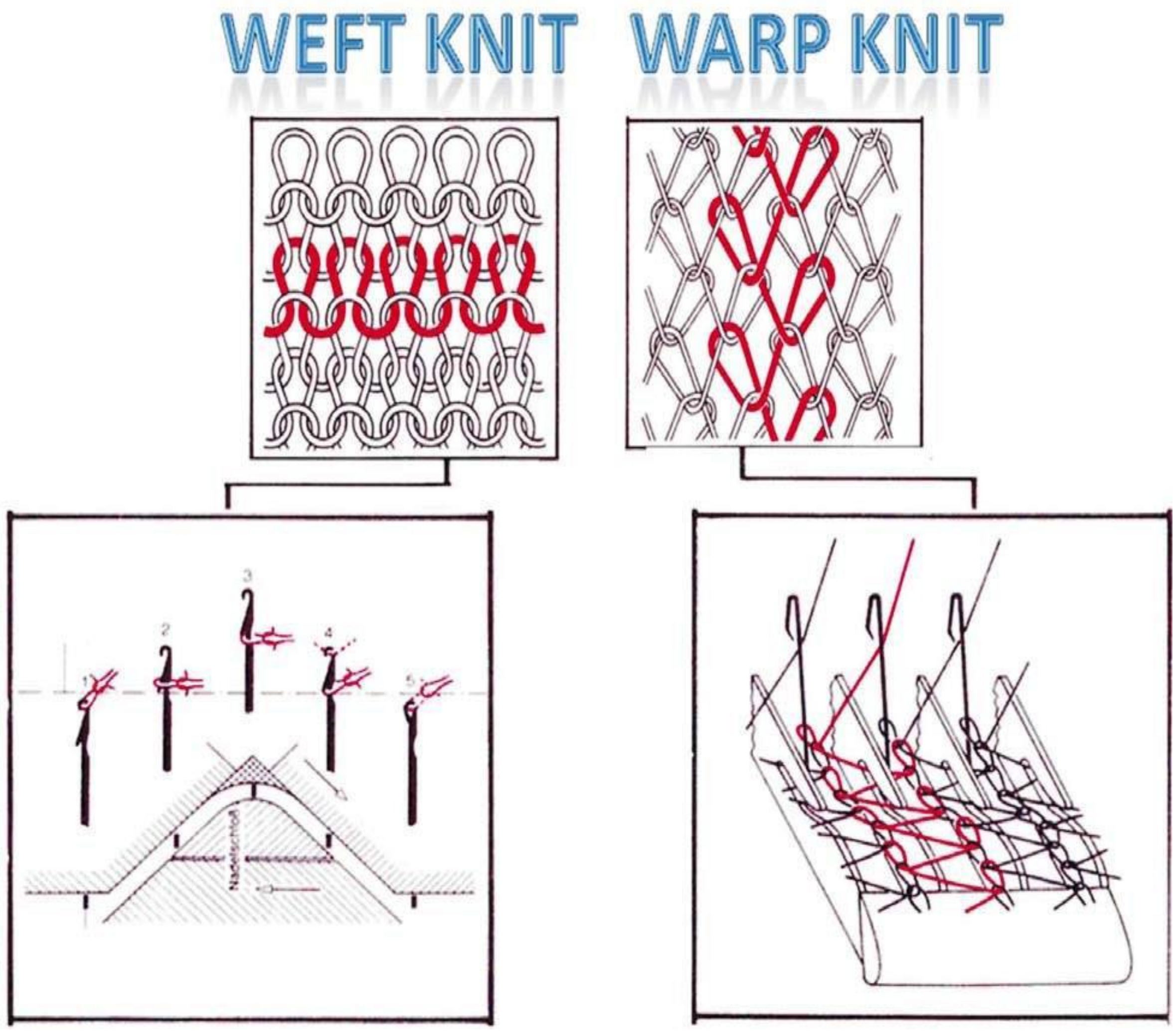
Knitted fabrics are popular today because:

- It is usually soft and drapes well.
- It molds and moves easily with body movement .
- It has good stretch ability .
- It resists wrinkles .
- Most importantly, knits relate well to contemporary life-styles .
- Good absorbency.
- Good air porosity and Relatively low cost of simple fabrics.

3.4 Classification of knitted fabrics

The knitting industry is divided into two distinct sectors :

- Weft Knitting
- Warp knitting



3.4.1 Weft knitting

In weft knitting, the loops are formed across the width of the fabric, and each weft thread is fed more or less at a right angle to the direction in which the fabric is produced. It is possible to knit with only one thread or cone of yarn, though production demands have resulted in circular weft knitting machines being manufactured with up to 192 threads.

3.4.2 Warp knitting

Warp Knitting is a method of producing a fabric by using needles similar to those used in weft knitting, but with the knitted loops made from each warp thread being formed down the length of the fabric; the loops are formed vertically down the length of the fabric from one thread as opposed to across the width of the fabric, as in case of weft knitting.

Types of warp knitting

Two common types of warp knits are Tricot and Raschel.

1) Tricot

Tricot knits are made almost exclusively from filament yarns because uniform diameter and high quality are essential yarn characteristics for use with the very high speed tricot knitting machines. Fabrics constructed by the tricot knitting machine are usually plain or have a simple geometric design. The front surface of the fabric has clearly defined vertical wales and the back surface has crosswise courses.

General characteristics of tricot knits include softness, good drapability, crease resistance, non-reveling and elasticity. The wide range of textile products made from tricot knits include lingerie, sleepwear, robes, men's shirts, blouses, dresses, waitresses and nurses uniforms, backing for bonded fabrics, and automobile upholstery. Tricot knits are made predominantly from nylon, acetate and polyester fiber.

2) Raschel

Raschel knits are produced from spun or filament yarns of different weights and types. Most raschel knits can be identified by their intricate, the open-space look of crochet or lace, and an almost three-dimentional surface effet design. Raschel knits are used for a diverse group of products, including lace and lace trim, sweaters, thermal underwear, swimsuits, blankets amdtennis nets.

3.5 Circular knitting machine (weft knitting)

There are mainly two types of knitting machine i.e. circular knitting machine an flat bed knitting machine .circular knitting machine is one of them .some parts of circular knitting machine are given below :

- **Creel:** creel is called the holder of cone .cone is placed in a creel for feeding the yarn to the feeder.
- **Feeder:** yarn is feed through the feeder .no of feeder is depends on the design of the fabric.
- **VDQ pulley** : G.S.M of the knit fabric is collected by VDQ pulley.VDQ pulley is used for controlling the stitch length of the fabric.
- **Guide :** Guide is called the supporting element .Guide is use to guide the yarn.
- **Sensor** : sensor is an automatic controlling system. When a yarn pass through this sensor then if any yarn break down pr any problem occur then it automatically stop by this sensoring system.
- **Cylinder** : cylinder is the main parts of a knitting machine. Adjustment of a cylinder is important. Cylinder carries needle ,sinker ,cam and many more .
- **Spreader** : spreader is used to spread the knitted fabric before take up roller. knit fabric may be tube or open type. Spreader is adjusted as need.

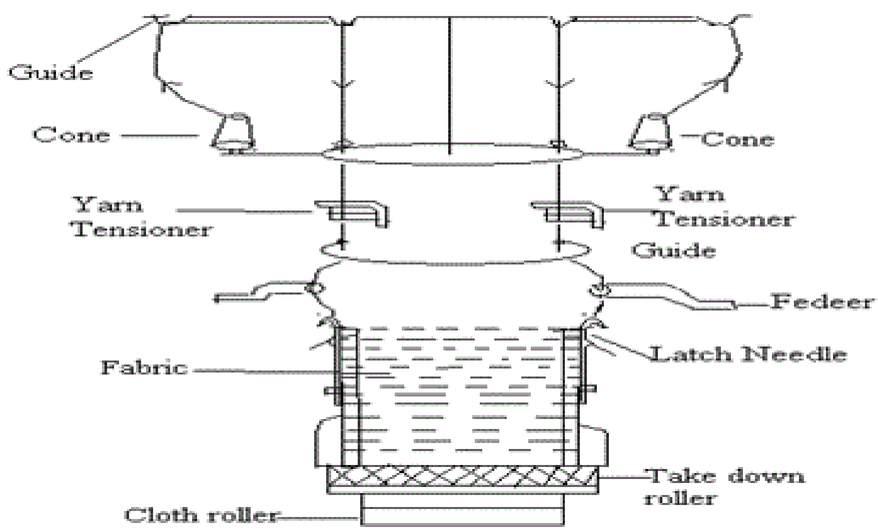


Fig 1 : circular knitting machine parts

3.6 Type of knit Fabric:

1. single jersey
2. Single lacoste
3. Double lacoste
4. Polo pique
5. Plain interlock
6. 1×1 Rib
7. 2×1 Rib
8. 2×2 Rib
9. Flat back rib
10. Two Thread Fleece
11. Three Thread fleece
12. Polar Fleece

3.7 Basic Knitting Element

There are 3 Basic Knitting elements. They are:

1. Needle
2. Sinker
3. Cam

Needle:

Function of Needle: Needle is raised to clear the old loop from the hook & to receive the new loop above it on the needle stem.

Types of Needle: In general there are 3 types of needles. They are

1. Latch needle
2. Breaded needle
3. Compound needle

According to the butt position latch needles are 4 types:

1. One butt latch needle
2. Two butt latch needle
3. Three butt latch needle
4. Four butt latch needle

CAM:

Cams are the device that convert the rotary drive into a suitable reciprocating action for the needles or other elements.

Types of cam: There are 2 types of cam. They are:

· Engineering cam
· Knitting cam

1. Knit cam
2. Tuck cam
3. Miss cam

Fig 1:cam

<u>Function of cam:</u> The function of cam is given below

1. Produce motion of needles
2. Drive the needle
3. Formation of loop

Sinker:

The sinker is the second primary knitting element. It is a thin metal plate with an individual or a collective action operating approximately at right angles from the hook side of the needle bed, between adjacent needles.

Sinkers capable of producing loop fabric are well known in the knitting industry. In such machines the sinkers generally include a blade having an upper edge which defines a lower knitting level and a nib having an upper edge which is at an upper knitting level. Long loops are formed at the upper knitting level of the sinkers with a loop yarn and a base yarn is knitted over the blade. The sinkers may be formed and their movement controlled to cause either the loop yarn to appear on one side of a fabric and the base yarn on the other or the loop yarn to appear on both sides.

In the past it has not been possible to producing loop cloth of ideal quality since loops would twist or coil making it difficult to finish a loop fabric into satisfactory velor. Furthermore loops which were supposed to appear on the front of a fabric would sometimes appear on the other side. The back of loop cloth was therefore apt to have objectionable loose protruding loops and double tuck stitches.

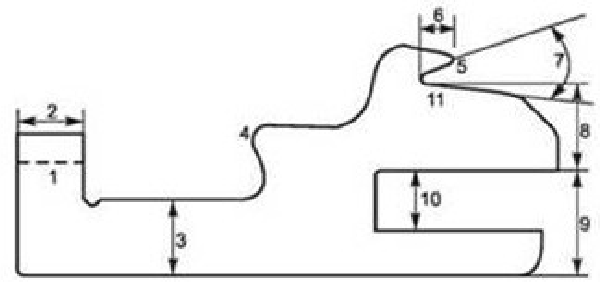


Fig 2 : shinker

1=Butt,

2=Butt breadth,

3=Height of shank,

4=Buldge,

5=Neb,

6=Length of neb,

7=Throat angle,

8=Sinker platform height,

9=Breadth of lower shank,

10=Clearance,

11=Throat

Sinkers Operation

The held loop is positioned in the throat of the sinker when the sinker moves forward and the needle moves upward for clearing. The held loop is held by the throat and hence its movement along the needle is restricted.

The sinker remains at its forward position when the needle attains its clearing position.

The sinker retracts when the needle comes down after feeding. At this stage, due to sinkers retraction, fabric or held loop is eased out. Also the sinker belly supported the fabric or held loop and hence its movements along the needle is prevented.

Sinker remains in backward position and the needle descends to its lowest position drawing the new loop through the old one.

Before the needle ascends, the sinker moves forward to push the knitted fabric a little and to hold the old loop away from the head of the needle and to be in a position to control the fabric.

Fig 3: sinker

3.8Needle gauge

In knitting, the word gauge is used both in hand knitting and machine knitting; the latter, technical abbreviation GG refers to "Knitting Machines" fineness size. In both cases, the term refers to the number of Needles contained in one inch of the needle bed in knitting machine. A needle gauge makes it possible to determine the size of a knitting needle.Total number of needles can be determined by the help of needle gauge. The formula is following.

Number of Needles = Machine Diameter x Needle Gauge x ∏ (3.1416)

3.9 Machine Gauge:

Knitting machine gauge is used to express the number of needles in a unit length of the needle bed. This needle bed may flat or circular. In circular double knit machine it used for cylinder as well as dial. Knitting machine gauge is denoted by alphabet “E”. The formula is

Machine Gauge = Number of needle/inch

4.0 Guidelines for Checking of GSM

The following are the further guidelines for checking the GSM:

- Actual GSM of fabric (as explained above) should be measured at the start of new article
- fabric roll should be cut as per counter meter reading on the machine. In this practice, weight of each roll will be same. This is the easiest way to check the GSM of each roll

4.1 Stitch Length of Fabric Sample

Stitch Length should be checked whenever starting the new order or problem arises. The use of round meter for setting the stitch length is better. However, if it is not available then, it may be checked manually. But in any case, it must be checked when starting the new article or in case of any problem.

4.2 Calibration of Round Meter

Round meter is sometimes used for the setting of stitch length. It is advised that round meter must be checked and calibrated for the correct setting. Check the stitch length manually and compare the results with the round meter reading.

4.3 Measuring Actual Stitch Length

To find the actual stitch length, take a sample of fabric and mark 100 needles and then take out at least three yarns each and measure the stitch length. Compare this value with the round meter value.

5.0 Machine Maintenance

5.1 Machine Maintenance Schedule

Maintenance of knitting machine is very important that affect the machine efficiency, machine life and fabric quality. The management should prepare a maintenance schedule and it should be followed strictly. The main parts of the knitting machine should be checked with extreme care and responsibility. If the knitting machine is too old, then maintenance became more important to avoid any major breakdown. The following are the guidelines for machine maintenance(Daily, Weekly, Monthly, Bi- Annually and Annually).

5.1.1 Daily Maintenance

The check points for daily maintenance are as follows:

Yarn feeding device and related parts:

- Check yarn feeding device (MPF,IRO), Slipped-off, Loose or broken MPF drive belt
- Malfunction of clutch, IRO tape flipper, etc
- Check MPF teeth
- Clean fluff from MPF area
- Remove fluff from tension washers
- QAP (Quality Pulley): diameter, loose lock nut

Lubricators:

- Oil level of mist lubricator
- Check oil drop rate (should be 100-120 drops/ min)
- Supply amount of compressed air
- Check lubrication points for disconnection, leakage etc.
- Check compressed air pressure

Abnormal Noise:

- Knitting elements (cam holders, sinker cap and dial cap)
- Yarn feeding units and related parts (QAP, change gear box, drive tape, etc)
- Frame (machine bed, take-up unit, motor drive, etc.)

Oil leakage:

- Lubricator main body
- Part underneath the bed
- Oil amount in the oil sump bottle
- Connection between oil mist pipes and nozzles
- Part underneath the gear ring

5.1.2 Weekly Maintenance

The check points for weekly maintenance are mentioned here under:

- Piping for lubrication oil and compressed air
- Oil amount in the bed & gear box and make up if required
- Check oil sump mist lubricator
- Draining of water from the air compressor
- Clean the lint fan

5.1.3 Monthly Maintenance

The check points for monthly maintenance are as follows:

- Lint accumulation (Check for lint and clean.):
- Lint in the control panel
- Lint around lint fans and other areas
- Lint in the motor cover

Belt tension:

- Check main drive motor belt tension
- Check drive belt tension for yarn feeding device

5.1.4 Bi-Annual Maintenance

The check points for bi annual maintenance are mentioned here under:

- Change the oil in gear box
- Change the oil in needle bed
- Remove the MPF pulleys and clean with kerosene oil
- Machine cleaning should be checked very carefully for all parts

5.1.5 Annual Maintenance

The check points for annual maintenance are mentioned here under:

- Change grease in fabric roll winder
- Change grease in gear box of yarn feeding system

5.1.6 Machine Overhauling

Each knitting machine should be overhauled once a month. It is a guide line for overhauling which is followed worldwide.

6.0 Basic knitting design :

There are four basic knitting structure :

1) Single jersey
2) Rib
3) Interlock
4) Purl

6.1 The Knitting Actions:

The basic action of a needle are shown in below. Except for the manner in which the hook is closed (in this case by pressing the beard), the knitting action is similar for all needles. The arrows indicate the relative movement of the loops along the needles. (Whether the needle moves through the loops or the loops are moved over the needle by some other elements depends upon the machine design.)

1. The needle is in the (so-called) rest position, with the previously formed loop (a) held on its stem and covered by the hook.

2. The loop is cleared from the needle hook to a lower position on the needle stem.

3. The new yarn (b) is fed to the needle hook at a higher position on the needle stem than the position of the previous ('old') loop.

4. The yarn is formed into a 'new' loop.

5. The hook is closed, enclosing the new loop and excluding and landing the old loop onto the outside of the closed hook.

6. The new loop (b) is drawn through the head of the old loop (a). Simultaneously the old loop slides off the closed hook of the needle and is cast-off or knocked-over.

7. The old loop now hangs from the feet of the fully formed new loop and the knitting cycle starts again.

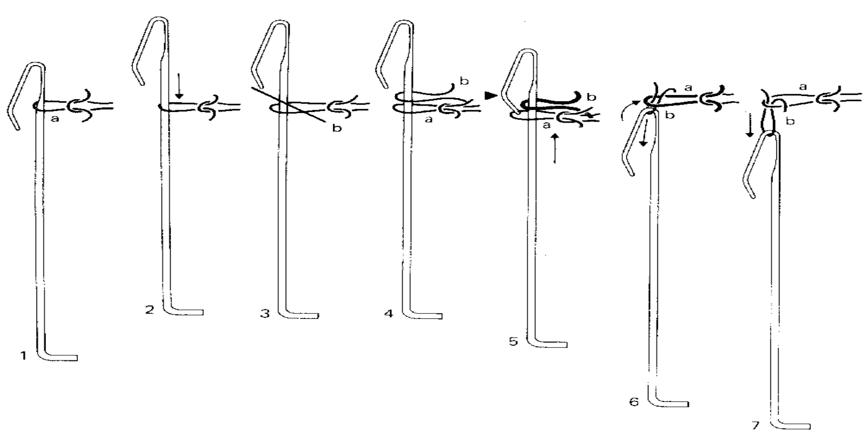


Fig. Basic knitting action of a needle.

7.0 Example of production calculation for single jersey Machine

Production/ hour = (No of Needle ×No of Feeder ×Stitch Length(mm) ×RPM ×60 X efficiency) / (100x10×2.54×36×840 ×Count ×2.2046)

= (π×D×G× No of Feeder ×Stitch Length(mm) ×RPM ×60) / (10×2.54 ×36×840 ×Count ×2.2046)

7.1 Example of production calculation for Rib Machine

Production/ hour = (No of Needle ×No of Feeder ×Stitch Length(mm) ×RPM ×60) / (no of feeder/course x 10×2.54×36×840 ×Count ×2.2046)

= (π×D×G × No of Feeder ×Stitch Length(mm) ×RPM ×60) / (2 ×10×2.54 ×36×840 ×Count ×2.2046)

7.2 Example of production calculation for Fleece Machine

Production calculation of three thread fleece

1) Production of base yarn

$$= \frac{rpm x no\ of\ needle(\pi dg)x(no\ of\ feeder)/\mathbf{3}x\ stitchlength(mm)xtimexshift}{1000x0.9x840xcountx2.2046} \text{ kg/shift}$$

= x kg/shift

2) Production of binding yarn

$$= \frac{rpm x no\ of\ needle(\pi dg)x(no\ of\ feeder)/\mathbf{3}x\ stitchlength(mm)xtimexshift}{1000x0.9x840xcountx2.2046} \text{ kg/shift}$$

=Y kg/shift

3) Production of loop yarn

$$= \frac{rpm x no\ of\ needle(\pi dg)x(no\ of\ feeder)/\mathbf{3}x\ stitchlength(mm)x\ timexshift}{1000x0.9x840xcountx2.2046} \text{ kg/shift}$$

=Z kg /shift

Total production of three thread fleece fabric=(x+y+z) kg/shift

7.3 Example of production calculation for Interlock Machine

Production/ hour = (No of Needle ×No of Feeder ×Stitch Length(mm) ×RPM ×60) / (no of feeder/course x 10×2.54×36×840 ×Count ×2.2046)

= (π×D×G × No of Feeder ×Stitch Length(mm) ×RPM ×60) / (2 ×10×2.54 ×36×840 ×Count ×2.2046)

8.0 Efficiency

It is the percentage equation expression the ratio between actual production and calculated production.

$$\text{Efficiency} = \frac{Actual\ \ Production}{Calculated\ Production} \text{ x } 100$$

8.1 Type of Efficiency:

1. **Running efficiency** : It is related to time. Efficiency at a certain time is knows as running efficiency. Actual production of machine is always low due to interruption , minor causes of interruption are included during calculation of running efficiency.
2. **Attained efficiency** : The actual which is obtained is obtained from the machine is called attained efficiency.
3. **Overall efficiency**: machine stopped for various reasons in the industry included major causes & minor causes for which production is called overall efficiency .It is calculated for the year round.
4. **Individual machine efficiency**
5. **Group efficiency**
6. **Mill efficiency**

8.2 Production Calculation (on 8 Hours basis):

Production for 100% Efficiency:

= Machine R.P.M × 8 hours × 60 minutes x (5)
= (Fabric Weight in Grams)
= (Fabric Weight in Grams) / 1000
= (Fabric Weight in Kilo Grams) ……. (8)

This will be the weight of fabric produced at 100% efficiency at that particular machine in 08 hrs. Similarly, the 100% production in 12 hrs or 24 hrs can be found.

Production For 85% Efficiency:

In order to set the production target for the knitting machine, multiply the 100% production value with the desirable efficiency (in our case we took it 85 %)

= (8) x 0.85
= Kg……… (9)

This (9) will be the production target based on the actual conditions.

8.3 Knitting Machines Daily Efficiency:

For calculating the actual efficiency of machines and operators (shift wise & on daily basis), a counter status check method is suggested. This counter status check is used to determine the actual production shift wise. The following example illustrates the method to calculate the actual efficiency:

For example:

I. M/C No = 1
II. Work Order No = 1685
III. RPM (Round Per Minute) = 20
IV. Total No. of Hours of One Shift = 8
V. Counters Required to Knit One Roll = 1900
VI. No. of Rolls Produced in One Shift = 3
VII. Total No. of Kilograms Produced in One Shift = 105
VIII. Counters Received from the Previous Shift = 1100
IX. Counters Forwarded to the Next Shift = 1000

So, the Total actual rounds (counters) in the shift will be:
= (VI × V) + IX – VIII
= (3 × 1900) + 1000 – 1100 = 5600 Rounds

But as per the speed (rpm) 100% rounds should have been

= IV ×60 × 20 = 9600 Rounds

The Machine Efficiency can be found as follows:
= 100 x Actual Rounds /100% Rounds
= 100 × 5600 / 9600 = **58.33%**

8.4 Causes of Efficiency Loss and Machine Stoppage Time

Many causes are responsible for losses of machine efficiency. The following causes were the main reasons for reducing the productivity of the machine. Average time of machine stoppage and causes of machine stoppage are given following table.

Serial No	Reasons for Stoppage	Mean Time of machine stoppage
1	Needle breakage	7 minutes/day
2	Program change	2 hours(two times in a month)
3	Star mark	7 minutes/day
4	Hole mark	5 minutes/day
5	Sinker mark	5 minute/day
6	Needle mark	6 minutes/day
7	Maintenance(three person)	1.5 hours per month
8	Hole mark	5 minutes/day
9	RPM,Oil & Belt check	6 minutes/day
10	Power failure	12 minutes/day
11	Yarn Breakage	7 minutes/day
12	Fabric Handling	15 minutes/day

Fig : Basic causes and Time Required to repair

8.5 The Factors that affecting Efficiency:

Many causes are responsible for losses of efficiency.The factors affect the efficiency of knitting production are given below :

1) Model to Model
2) Machine to Machine
3) Different model of same manufacture
4) Skill of operator
5) Faulty yarn

9.0 Productivity:

It is the percentage equation expression the ratio between output and input .

$$\text{Efficiency} = \frac{output}{Input} \text{ x } 100$$

9.1 Production Control

9.1.1 Production Targets for Feeders Machine

Daily production targets should be defined on the basis of production capacity of the machine. There is a 20 round method to measure the actual production capacity of the knitting machines. In this method, the weight of the fabric produced for 20 rounds is taken and the production is calculated in a kilogram which is based at 100 percent efficiency by using the calculations explained below.On the basis of this value, the actual efficiency of the machine and corresponding production target may be defined. The following is the procedure of the experiment that needs to be conducted on the knitting machine:

- Run the machine for 20 rounds and produce the fabric
- Cut the 20 round fabric from the roll. If possible, a colored yarn can be used to identify the fabric produced in 20 rounds
- When cutting this fabric from the roll, handle it carefully
- Now immediately place this fabric on the table in relaxed state and measure the length and width of the fabric
- Weigh the fabric

Using this data, calculates the production target as follows:

Fabric Width = (cm) = /100 (m) ……. (1)
Fabric Double Width = 1× 2 (cm) = /100 (m) ……. (2)
Length of Fabric produced in the 20 rounds =/100(m)………..(3)

Weight of Fabric produced in 20 rounds = (gm) ………… (4)

Weight of One Round Length

(4) / No. of rounds = ……... (5)
Meter Weight (4) / (3) (gram / meter) = ...(6)
GSM (6) / (2) = gram / meter ^{2} ....(7)

9.1.2 Type's of productivity :

1. Productivity of machine
2. Productivity of worker
3. Productivity of material
4. Productivity of time

9.1.3 causes of production interruption:

- Yarn breakage
- Loose feeding of yarn
- Quality check during production
- Doffing
- Counter stoppage
- Cleaning
- Cone change
- Electric supply off
- Needle break
- Load shedding
- Maintenance
- Natural calamities
- Political unrest

Chapter 04 Material and Methods

4.0 Materials and Methods:

4.1 Materials

Single jersey, Double jersey, Interlock, fleece knitting machine were selected. For calculate machine stoppage time a stop watch is used. For calculate the calculated production stitch length, machine R.P.M, number of feeders, number of needles, machine gauge (needles per inch) and yarn count were identified. From ANON TEX GROUP we take all data .

Fig: Circular Knitted machine

Machine Used to take Data

For single jersey

1) Machine No: 08
Brand & Origin: Korea
Dia X Gauge: 34 X 24G
Feeders: 102
RPM: 25
Fabric type: Single Jersey
Stitch Length: 2.75
Yarn count: 28Ne
GSM: 160

2) Machine No: 17
Brand & Origin: Korea
Dia X Gauge: 30 X 24G
Feeders: 90
RPM:25
Fabric type: Single Jersey
Stitch Length: 2.95
Yarn count: 22Ne
GSM: 190

For Rib

3) Machine No: 20
Brand & Origin: Korea
Dia X Gauge: 38 X 18G
Feeders: 76
RPM: 20
Fabric type: Rib
Stitch Length: 1.50
Yarn count: 42Ne(CD)
GSM: 220

4) Machine No: 20
Brand & Origin: Korea
Dia X Gauge: 38 X 18G
Feeders: 76
RPM: 22
Fabric type: Rib
Stitch Length: 1.50
Yarn count: 42Ne(CD)
GSM: 220

For Fleece

5) Machine No: 24
Brand & Origin: Korea
Dia X Gauge: 36 X 18G
Feeders: 108
RPM: 20
Fabric type: Fleece
Stitch Length: Knit-3.9;
Tuck-3.8; Loop-1.53
Yarn count: 30cvc(80/20);
Knit+Tuck; 20(CD) Loop.
GSM: 280

6) Machine No: 43
Brand & Origin: Korea
Dia X Gauge: 36 X 18G
Feeders: 108
RPM: 20

Fabric type: Fleece
Stitch Length: Knit-3.8;
Tuck-3.7; Loop-1.50

Yarn count: 34cvc(75/25);
Knit+Tuck; 22(CD) Loop.
GSM: 290

For Interlock

7) Machine No: 14
Brand & Origin: Korea
Dia X Gauge: 34 X 18G
Feeders: 68
RPM: 22
Fabric type: Interlock
Stitch Length: 1.45
Yarn count: 42Ne(CD)
GSM: 220

8) Machine No: 32
Brand & Origin: Korea
Dia X Gauge: 36 X 18G
Feeders: 72
RPM: 22
Fabric type: Interlock
Stitch Length: 1.52
Yarn count: 40Ne(CD)
GSM: 180

4.2Methods:

4.2.1. Stitch Length Measurement Process

In industry stitch length was measured manually. At first a stitch was identified and it was marked by red color. Considering its and it was marked by red color. Considering its base stitch, count hundred stitch and last stitch is marked by red color. Then the course was unloving from the fabric and its length was measured by a measuring scale. Finally the length was divided by hundred and this dividing result indicate the stitch length.

4.2.2. Number of Needles Calculation

For identifying number of needles at first identifying machine diameter by a measuring scales. Count the number of needles per inch. After multiplying Pi (π), no of needles and machine gauge, we found the number of needles.

4.2.3. Yarn Count Determination

Yarn count is determined by the Begley's balance. At first a one lea that means one twenty yards yarn was taken by Beasley's balance. Then by electric balance the weight of the sample was taken. Then by the following formula, yarn count is determined. Ne= L x w/l x L here, Ne= English count, w= Unit weight of the sample in pound, l= unit length of the sample in yard, L= Length of the sample in yard W=Weight of the sample in pound.

4.2.4. Time Determination Method

A stop watch was used for determine the time. When a problem was occurred on that time stop watch was on until the problem was recovered. This will determine stoppage time of machine and repairing time of the problem.

4.2.5. No. of Feeder Calculation

Actual Number of feeders was calculated by counting the number of feeders in the machine. In theoretically numbers of feeders are calculated by multiplying machine diameter by

Chapter 05 Results and Discussions

5.0 Data of Single Jersey Machine(SL 01)

The observation was carried out for 8 hours on single jersey knitting machine (SL 01).Consumed time for each machine stoppage due to various causes was tabulated and the summary of the report is given below.

Table -1: Causes of stoppage of single jersey knitting machine in 8 hours

Serial No	Yarn breakage	Loose feeding	Quality check	Unload fabric	Counter stoppage	Cleaning	Cone change
01	30.5sec	10.30sec	20.50sec	4min 30sec	05.11sec	6min20sec	1min05sec
02	50.11sec	08.12sec	20.00sec	3min 10sec	02.55sec	4min10sec	1min55sec
03	20.03sec	05.50sec	18.50sec	3min 05sec	05.05sec	5min50sec	2min
04	40.50sec	11.40sec	21.05sec	4min 50sec	05.10sec	4min30sec	1min40sec
05	40.12sec	09.55sec	19.05sec	2min 55sec	05.50sec	5min10sec	1min35sec
06	20.50sec	0.34sec	18.00sec	3min 02sec	04.10sec	4min25sec	1min22sec
07	30.33sec		20.10sec	4min 10sec	04.30sec	3min50sec	1min15sec
08	25.50sec		19.10sec	3min 40sec	08.50sec	5min40sec	1min55sec
09	30.40sec				07.33sec		
10	40.10sec				02.00sec		
11	32.22sec						
12	29.50sec						
13	31.12sec						
14	33.10sec						
15	28.22sec						
16	40.10sec						
17	35.20sec						
18	37.30sec						
19	28.50sec						
20	40.30sec						
21	38.30sec						
22	41.20sec						
Total	**13min**	**0.68min**	**3 min**	**30min**	**0.82min**	**39min**	**12.18min**

Table : 1 (Machine No 17 s/j)

5.1 Production & Efficiency Calculation of Serial No 1(S/J) :

Calculated production time required: 8x60=480 min

On the basis of Table no :1

Total time loss for those causes : 98.68 min

Actual production time : (480-9.68) min =381.32 min

Time Efficiency = $\frac{Actual\ time}{Calculated\ time}$ x 100

= $\frac{381.32}{480}$ x 100

= 79.46%

Example of production loss :

Production/ hour = (No of Needle ×No of Feeder ×Stitch Length(mm) ×RPM ×60) / (10×2.54×36×840 ×Count ×2.2046)

= (π×D×G× No of Feeder ×Stitch Length(mm) ×RPM ×60) / (10×2.54 ×36×840 ×Count ×2.2046)

= (3.1416×30×24×90×2.95 ×25 ×60) / (10×2.54×36 ×840 ×26 ×2.2046)

=900822384 / 44026955.48

= 20.46kg/hr

In 8 hours the production is = 20.46x 8 = 163.68 kg/shift

So in 480 min the production is = 163.68kg

In 385 min the = 6.41hr.

So , in 385 min the production is = 131.14 kg

The production loss for machine stoppage is = (Calculated production - Actual production)

= 163.68-131.14

= 32.54 kg/shift

So , Total production loss for machine stoppage is 32.54 kg /shift

5.2 Total effect on efficiency in percentage (%) for specific causes (single jersey-01) :

Total effect on efficiency in percentage (%) for the causes of yarn break = 2.70%

Total effect on efficiency in percentage (%) for the causes of Loose feeding = 0.15%

Total effect on efficiency in percentage (%) for the causes of Quality check =0.62%

Total effect on efficiency in percentage (%) for the causes of Unload fabric = 6.25%

Total effect on efficiency in percentage (%) for the causes of Counter stoppage= 0.17%

Total effect on efficiency in percentage (%) for the causes of Cleaning = 8.12%

Total effect on efficiency in percentage (%) for the causes of Cone change = 2.53%

Total effect on efficiency in percentage (%) = 20.54%

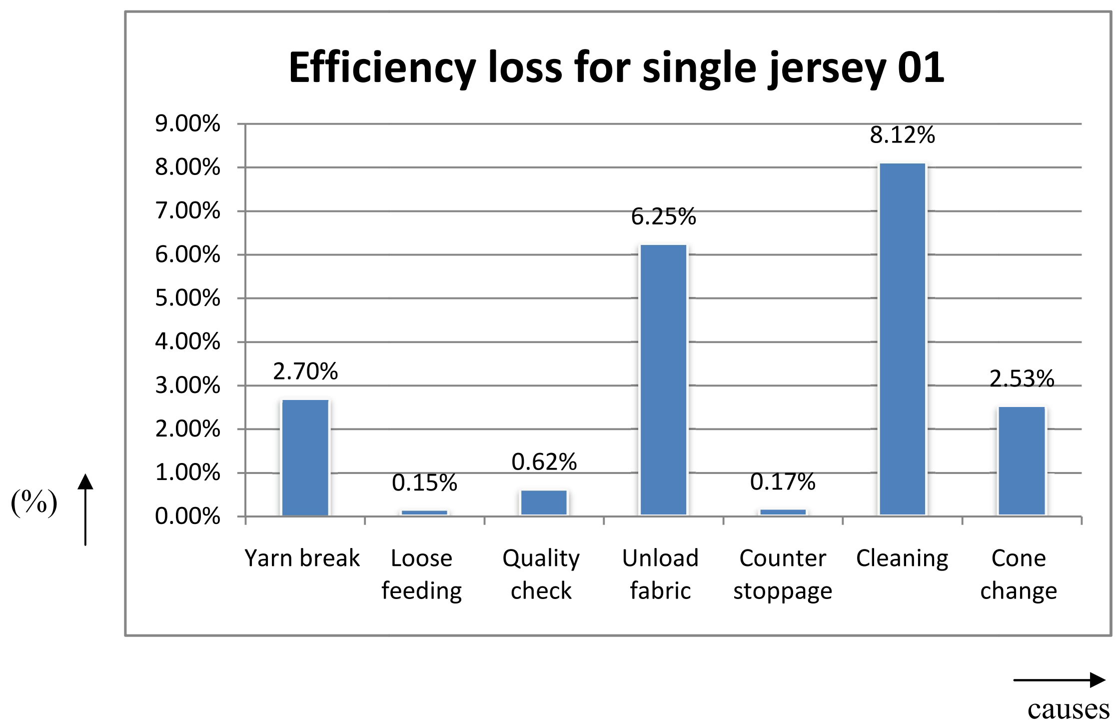


Fig: 1 Efficiency loss for single jersey 01

The above illustrated analysis 5.2 and figure 1 clearly indicate that the efficiency loss % of single jersey machine is maximum for cleaning about 8%.That means the knitting machine is stopped more time for cleaning and unloading. From knitting faults view maximum efficiency loss is found for yarn break.

6.0 Data of Single Jersey Machine(SL-2)

This observation was carried out for 8 hours on single jersey knitting machine (SL02).Consumed time for each machine stoppage due to various causes was tabulated and the summary of the report is given below.

Table -2: Causes of stoppage of single jersey knitting machine in 8 hours

Serial No	Yarn breakage	Loose feeding	Quality check	Unload fabric	Counter stoppage	Cleaning	Cone change
01	20.50sec	10.30sec	20.30sec	4min20sec	08.10sec	3min50sec	1min55sec
02	30.33sec	07.12sec	19.00sec	3min15sec	05.55sec	5min11sec	1min45sec
03	25.50sec	05.50sec	18.33sec	4min30sec	05.55sec	4min50sec	1min12sec
04	30.40sec	10.40sec	21.01sec	3min51sec	08.10sec	3min30sec	3min40sec
05	40.10sec	09.55sec	18.05sec	2min53sec	05.50sec	5min18sec	1min34sec
06	32.22sec	05.30sec	16.00sec	3min05sec	05.10sec	3min55sec	1min40sec
07	29.50sec	09.12sec	20.17sec	4min15sec	07.55sec	4min45sec	1min33sec
08	30.5sec	05.50sec	15.50sec	4min51sec	05.50sec	5min19sec	2min12sec
09	50.11sec	07.40sec			04.05sec		
10	20.03sec	09.05sec					
11	40.50sec						
12	40.12sec						
13	20.50sec						
14	35.20sec						
15	37.30sec						
16	28.50sec						
17	40.30sec						
18	38.30sec						
19	41.20sec						
Total	10. 51 min	1. 32 min	2.47min	31min	0.91 min	36.63min	16.87min

Table 2: (Machine No: 8 S/J)

6.1 Production & Efficiency Calculation of serial No : 2(S/J)

Calculated production time required: 8x60=480 min

On the basis of Table no :2

Total time loss for those causes : 99.71 min

Actual production time : (480-99.71) min =380.29min

$$\text{Time Efficiency} = \frac{Actual\ time}{Calculated\ time} \times 100$$

$$= \frac{380.29}{480} \times 100$$

$$= 79.22\ \%$$

6.2Total effect on efficiency in percentage (%) for specific causes (single jersey 02):

Total effect on efficiency in percentage (%) for the causes of yarn break = 2.18%

Total effect on efficiency in percentage (%) for the causes of Loose feeding = 0.27%

Total effect on efficiency in percentage (%) for the causes of Quality check =0.51%

Total effect on efficiency in percentage (%) for the causes of Unload fabric = 6.45%

Total effect on efficiency in percentage (%) for the causes of Counter stoppage= 0.19%

Total effect on efficiency in percentage (%) for the causes of Cleaning = 7.63%

Total effect on efficiency in percentage (%) for the causes of Cone change = 3.51%

Total effect on efficiency in percentage (%) = 20.74%

Efficiency loss for single jersey 02

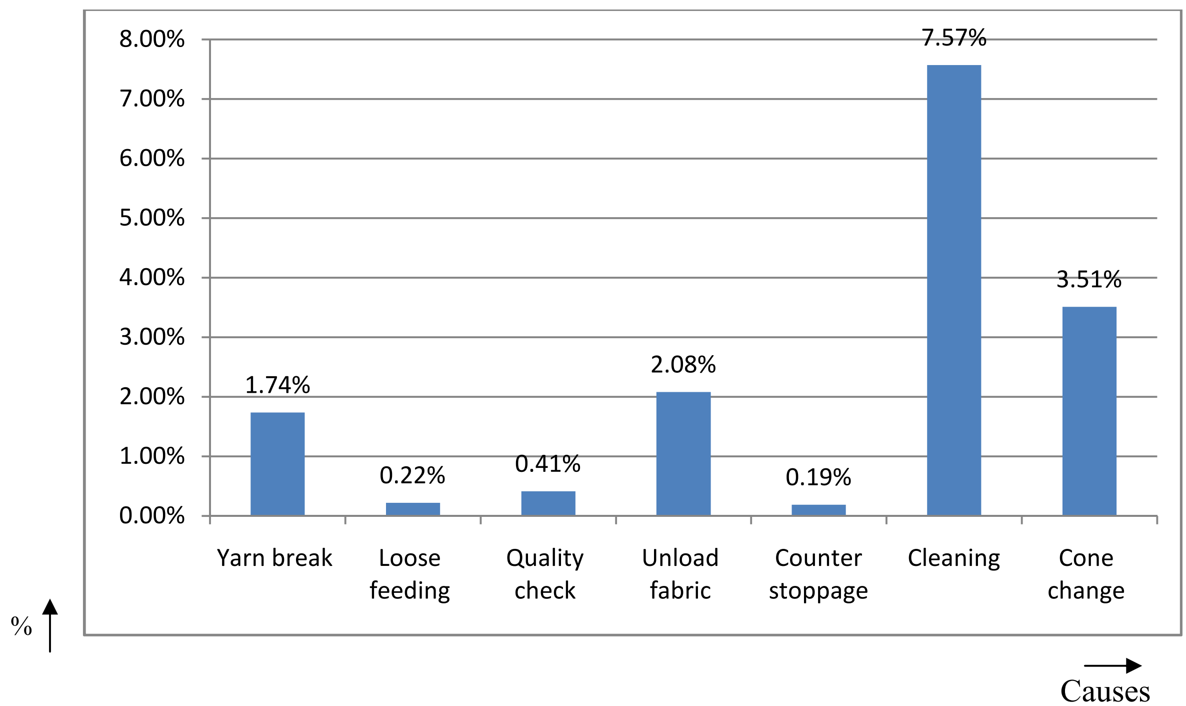


Fig: 2 Efficiency loss for single jersey

In the above illustrated analysis 6.2 and figure 2 clearly indicate that the efficiency loss % of single jersey machine is maximum for cleaning about 7%.That means the knitting machine is stopped more time for cleaning and unloading. From knitting faults view maximum efficiency loss is found for yarn break. The minimum efficiency loss is for counter stoppage.

7.0 Data of Rib(SL 3)

Observation was carried out for 8 hours on Rib knitting machine (SL 03).Consumed time for each machine stoppage due to various causes was tabulated and the summary of the report is given below.

Table -3: Causes of stoppage of Double jersey(Rib) knitting machine in 8 hours

Serial No	Yarn breakage	Feeding slippage for dust	Quality check	Unload fabric	Counter stoppage	Cleaning	Cone change
01	11.55sec	09.30sec	12.50sec	4min 30sec	03.18sec	4min20sec	1min44sec
02	23.15sec	08.12sec	15.00sec	3min 10sec	03.55sec	5min10sec	2min12sec
03	18.53sec	05.50sec	18.50sec	4min 05sec	02.05sec	5min50sec	1min55sec
04	24.50sec	11.40sec	12.05sec		04.10sec	5min30sec	2min44sec
05	34.12sec	09.55sec	18.05sec		03.50sec	3min10sec	1min35sec
06	24.50sec	10.40sec	15.00sec		02.10sec	4min50sec	2min10sec
07	31.35sec	09.30sec	17.10sec		04.30sec	3min51sec	
08	20.50sec		13.10sec		03.50sec	4min40sec	
09	26.45sec				04.00sec		
10	36.15sec						
11	32.25sec						
12	30.51sec						
13	31.15sec						
14	21.17sec						
15	25.25sec						
16	30.18sec						
17	19.20sec						
18	29.35sec						
19	20.54sec						
20	31.30sec						
21	33.45sec						
22	29.44sec						
Total	**8.77min**	**1.05min**	**2.02min**	**11.45min**	**0.52min**	**37.35min**	**10.16min**

Table :3 (machine no: 35 ; Rib)

7.1 Production & Efficiency Calculation of Serial No :3 (Rib)

Calculated production time: 8x60= 480 min

Actual production time : 480-71.32 = 408.68min

$$\text{Efficiency} = \frac{acual\ production}{calculated\ production} \times 100\%$$

$$\text{Now, Efficiency} = \frac{408.68}{480} \times 100\% = 85.14\%$$

7.2Total effect on efficiency in percentage (%) for specific causes (Rib 03):

Total effect on efficiency in percentage (%) for the causes of yarn break =1.82 %

Total effect on efficiency in percentage (%) for the causes of Loose feeding =0.21%

Total effect on efficiency in percentage (%) for the causes of Quality check =0.42 %

Total effect on efficiency in percentage (%) for the causes of Unload fabric = 2.38%

Total effect on efficiency in percentage (%) for the causes of Counter stoppage= 0.16%

Total effect on efficiency in percentage (%) for the causes of Cleaning =7.78%

Total effect on efficiency in percentage (%) for the causes of Cone change = 2.12%

Total effect on efficiency in percentage (%) = 14.89%

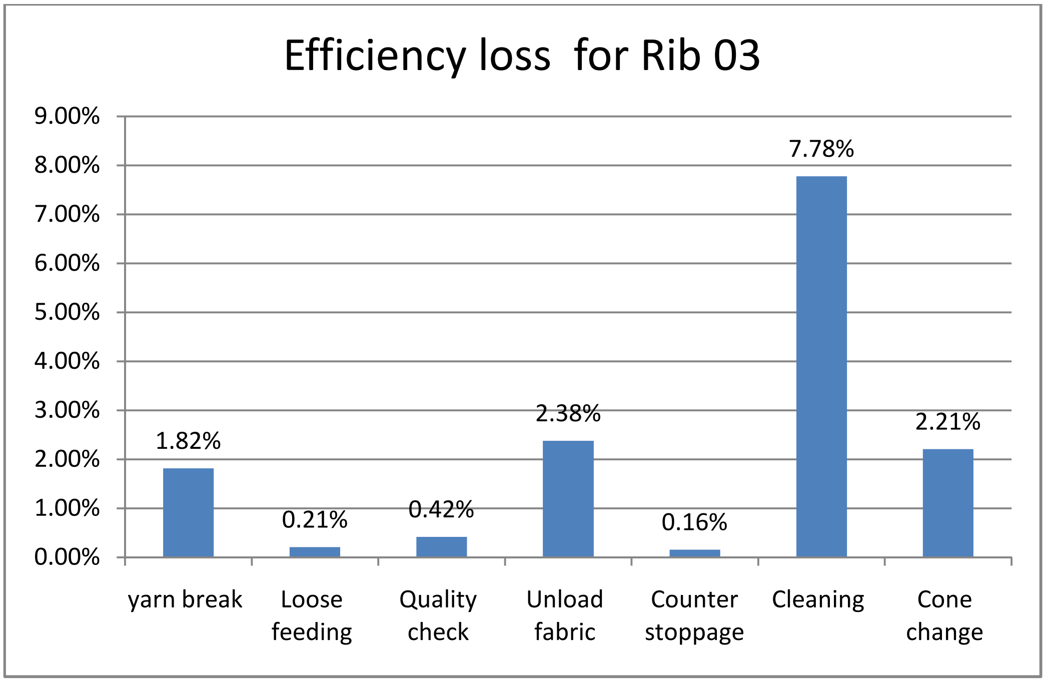


Fig : 3 Efficiency loss for Rib 03

From the above analysis 7.2 and figure 3 it is found that the efficiency loss % of Rib machine is maximum for cleaning about 7%.That means the knitting machine is stopped more time for cleaning and unloading. From knitting faults view maximum efficiency loss is found for yarn break. Here cone change efficiency loss is above 3% and same effect is for Unload fabric.

8.0 Data of Rib(SL 4)

This observation was carried out for 8 hours on Rib knitting machine (SL 04).Consumed time for each machine stoppage due to various causes was tabulated and the summary of the report is given below.

Table -4: Causes of stoppage of Double jersey (Rib) knitting machine in 8 hours

Serial No	Yarn breakage	Feeding slippage for dust	Quality check	Unload fabric	Counter stoppage	Cleaning	Cone change
01	11.55sec	09.30sec	12.50sec	4min 30sec	03.18sec	4min20sec	1min05sec
02	23.15sec	08.12sec	15.00sec	3min 10sec	03.55sec	5min10sec	1min55sec
03	18.53sec	05.50sec	18.50sec		02.05sec	5min50sec	2min12sec
04	24.50sec	11.40sec	12.05sec		04.10sec	5min30sec	1min40sec
05	34.12sec	09.55sec	18.05sec		03.50sec	3min10sec	1min35sec
06	24.50sec	10.40sec	15.00sec		02.10sec	4min50sec	1min22sec
07	31.35sec	09.30sec	17.10sec		04.30sec	3min51sec	
08	20.50sec		13.10sec		03.50sec	4min40sec	
09	26.45sec		13.10sec		04.00sec		
10	36.15sec						
11	32.25sec						
12	30.51sec						
13	31.15sec						
14	21.17sec						
15	25.25sec						
16	30.18sec						
17	19.20sec						
18	29.35sec						
19	20.54sec						
20	31.30sec						
Total	**7.73min**	**1.05min**	**2.23min**	**7.40 min**	**0.52min**	**37.35min**	**9.81 min**

Table: 4 (machine no: Rib)

8.1 Production & Efficiency Calculation of serial No : 4 (Rib)

Calculated production time: 8x60= 480 min

Actual production time : 480-66.09 =413.91min

Efficiency = $\frac{acual\ production}{calculated\ production}$ x 100%

Now, Efficiency= $\frac{413.91}{480}$ x 100% = 86.23%

8.2Total effect on efficiency in percentage (%) for specific causes (Rib-04):

Total effect on efficiency in percentage (%) for the causes of yarn break =1.62 %

Total effect on efficiency in percentage (%) for the causes of Loose feeding =0.21%

Total effect on efficiency in percentage (%) for the causes of Quality check =0.46 %

Total effect on efficiency in percentage (%) for the causes of Unload fabric = 1.54%

Total effect on efficiency in percentage (%) for the causes of Counter stoppage= 0.16%

Total effect on efficiency in percentage (%) for the causes of Cleaning =7.78%

Total effect on efficiency in percentage (%) for the causes of Cone change = 2.04%

Total effect on efficiency in percentage (%) =13.81 %

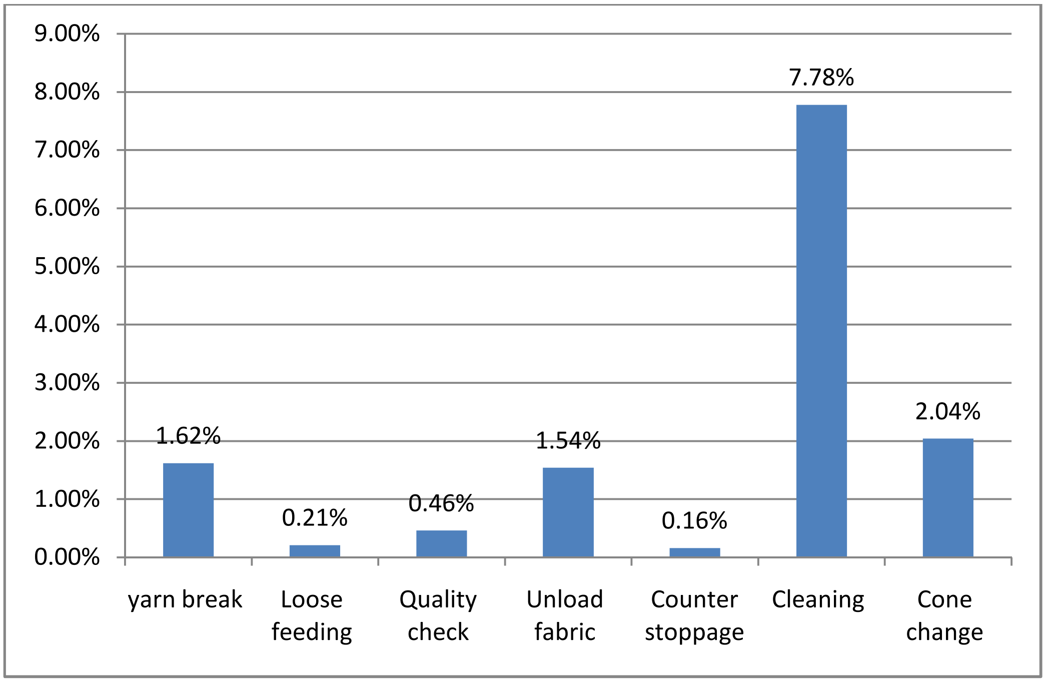


Fig : 4 Efficiency loss for Rib 04

The above illustrated analysis 8.2 and figure 4 clearly indicate that the efficiency loss % of Rib machine is maximum for cleaning about 7%.That means the knitting machine is stopped more time for cleaning and unloading. From knitting faults view maximum efficiency loss is found for yarn break. It shows the minimum cause % is for loose feed.

9.0 Data of Fleece Machine(SL 5)

The observation was carried out for 8 hours on Fleece knitting machine (SL 05).Consumed time for each machine stoppage due to various causes was tabulated and the summary of the report is given below.

Table -5: Causes of stoppage of Fleece knitting machine in 8 hours

Serial No	Yarn breakage	Loose Feeding	Quality check	Unload fabric	Counter stoppage	Cleaning	Cone change
01	15.25sec	10.33sec	05.51sec	4min 30sec	05.11sec	4min25sec	1min55se c
02	22.15sec	09.15sec	10.00sec	3min 15sec	04.50sec	5min11sec	1min45se

							c
03	19.33sec	07.55sec	12.53sec	3min 05sec	03.40sec	5min51sec	1min35se c
04	29.50sec	12.41sec	10.05sec	4min 51sec	05.11sec	5min29sec	1min43se c
05	30.12sec	10.50sec	15.17sec	3min 53sec	04.50sec	3min55sec	1min36se c
06	23.51sec	11.41sec	11.00sec	5min 02sec	03.10sec	4min56sec	1min56se c
07	31.33sec	10.32sec	16.10sec	4min 11sec	05.30sec	3min51sec	1min53se c
08	20.53sec	11.55sec	13.15sec	3min 43sec	03.50sec	5min56sec	2min10se c
09	24.40sec	10.44sec			05.00sec		
10	35.10sec	11.12sec					
11	32.23sec						
12	29.51sec						
13	31.33sec						
14	22.15sec						
15	25.22sec						
16	30.15sec						
17	19.25sec						
18	30.32sec						
19	21.55sec						
20	32.30sec						
21	33.30sec						
22	29.55sec						
23	31.33sec						
24	20.53sec						
25	29.50sec						
26	31.34sec						
27	30.11sec						
28	23.52sec						
29	26.55sec						
30	29.45sec						
31	30.34sec						
Total	**14.01min**	**1.75min**	**1.56min**	**32.50min**	**0.66min**	**39.57min**	**14.55min**

Table : 5 (machine no:24 fleece)

9.1Production & Efficiency Calculation of serial No :5 (Fleece)

Calculated production time: 8x60= 480 min

Actual production time : 480-104.60 =375.40min

Efficiency = $\frac{acual\ production\ time}{calculated\ production\ time}$ x 100%

Now, Efficiency= $\frac{375.40}{480}$ x 100% = 78.21%

9.2Total effect on efficiency in percentage (%) for specific causes (Fleece -05):

Total effect on efficiency in percentage (%) for the causes of yarn break =2.91 %

Total effect on efficiency in percentage (%) for the causes of Loose feeding =0.36 %

Total effect on efficiency in percentage (%) for the causes of Quality check =0.35%

Total effect on efficiency in percentage (%) for the causes of Unload fabric = 6.77%

Total effect on efficiency in percentage (%) for the causes of Counter stoppage= 0.14%

Total effect on efficiency in percentage (%) for the causes of Cleaning =8.24 %

Total effect on efficiency in percentage (%) for the causes of Cone change = 3.03%

Total effect on efficiency in percentage (%) = 21.79%

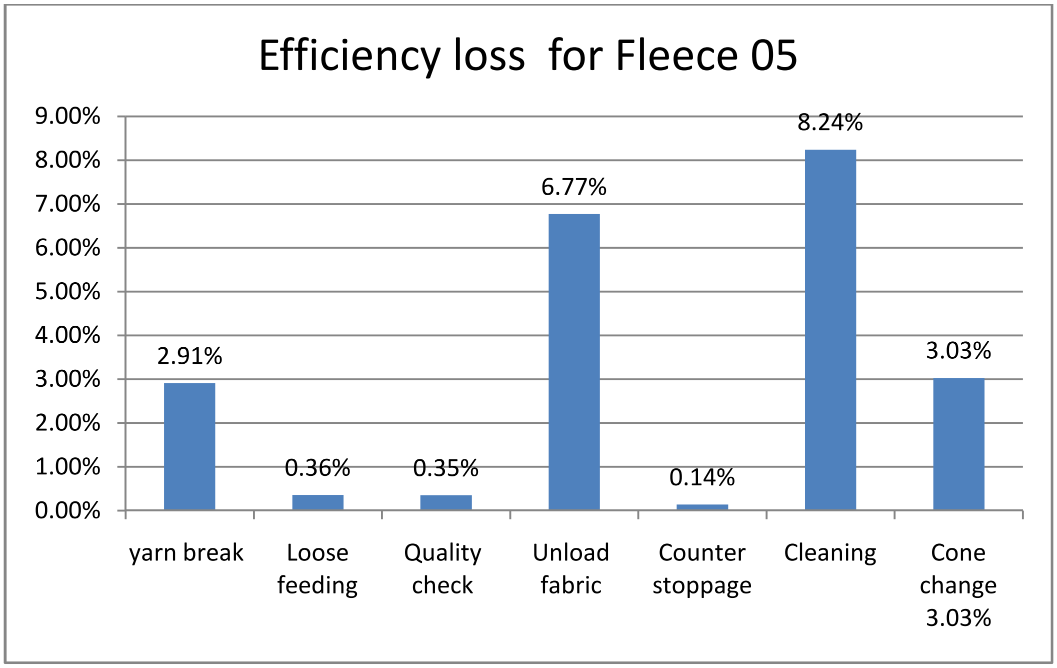


Fig : 5 Efficiency loss for Fleece 05

The above illustrated analysis 9.2 and figure 5 it is observed that the efficiency loss % of Fleece machine is maximum for cleaning about 8%.That means the knitting machine is stopped more time for cleaning and unloading. From knitting faults view maximum efficiency loss is found for yarn break.

10.0 Data of Fleece(SL 6)

The observation was carried out for 8 hours on Fleece knitting machine (SL 06).Consumed time for each machine stoppage due to various causes was tabulated and the summary of the report is given below.

Table -6: Causes of stoppage of Fleece knitting machine in 8 hours

Serial No	Yarn breakage	Loose Feeding	Quality check	Unload fabric	Counter stoppage	Cleaning	Cone change
01	16.55sec	15.00sec	10.54sec	5min 25sec	06.25sec	5min29sec	1min05sec
02	25.51sec	10.11sec	09.00sec	4min 15sec	05.45sec	4min55sec	1min55sec
03	20.33sec	08.45sec	13.52sec	3min 12sec	06.41sec	5min45sec	2min12sec
04	30.55sec	10.41sec	11.25sec	5min 10sec	04.10sec	5min35sec	1min40sec

05	25.12sec	11.55sec	10.17sec		05.55sec	4min55sec	1min35sec
06	23.51sec	12.42sec	10.50sec		04.16sec	4min45sec	1min22sec
07	31.33sec	11.43sec	15.40sec		06.11sec	4min31sec	1min15sec
08	25.53sec	13.50sec	14.25sec		05.54sec	5min10sec	1min55sec
09	28.40sec	11.44sec			06.00sec		3min
10	35.10sec	12.12sec					
11	32.23sec	10.45sec					
12	28.55sec	11.23sec					
13	31.55sec	09.45sec					
14	25.25sec						
15	25.22sec						
16	32.10sec						
17	25.35sec						
18	31.32sec						
19	28.55sec						
20	34.31sec						
21	31.35sec						
22	28.55sec						
23	34.32sec						
24	27.54sec						
25	28.55sec						
26	37.35sec						
27	35.10sec						
28	33.51sec						
29	28.56sec						
30	30.55sec						
31	33.34sec						
32	34.54sec						
33	40.55sec						
34	41.40sec						
Total	**18.60min**	**2.46min**	**1.58min**	**18.03min**	**0.82min**	**41.08min**	**15.98min**

Table : 6 (machine no: 43 ; fleece)

10.1 Production & Efficiency Calculation of serial No :6 (Fleece)

Calculated production time: 8x60= 480 min

Actual production time : 480-98.55=381.45min

Efficiency = $\frac{acual\ production}{calculated\ production}$ x 100%

Now, Efficiency= $\frac{381.45}{480}$ x 100% = 79.46 %

10.2 Total effect on efficiency in percentage (%) for specific causes(Fleece-06) :

Total effect on efficiency in percentage (%) for the causes of yarn break =3.87%

Total effect on efficiency in percentage (%) for the causes of Loose feeding =0.51%

Total effect on efficiency in percentage (%) for the causes of Quality check =0.33%

Total effect on efficiency in percentage (%) for the causes of Unload fabric = 3.75%

Total effect on efficiency in percentage (%) for the causes of Counter stoppage= 0.19%

Total effect on efficiency in percentage (%) for the causes of Cleaning =8.55%

Total effect on efficiency in percentage (%) for the causes of Cone change = 3.33%

Total effect on efficiency in percentage (%) =20.53%

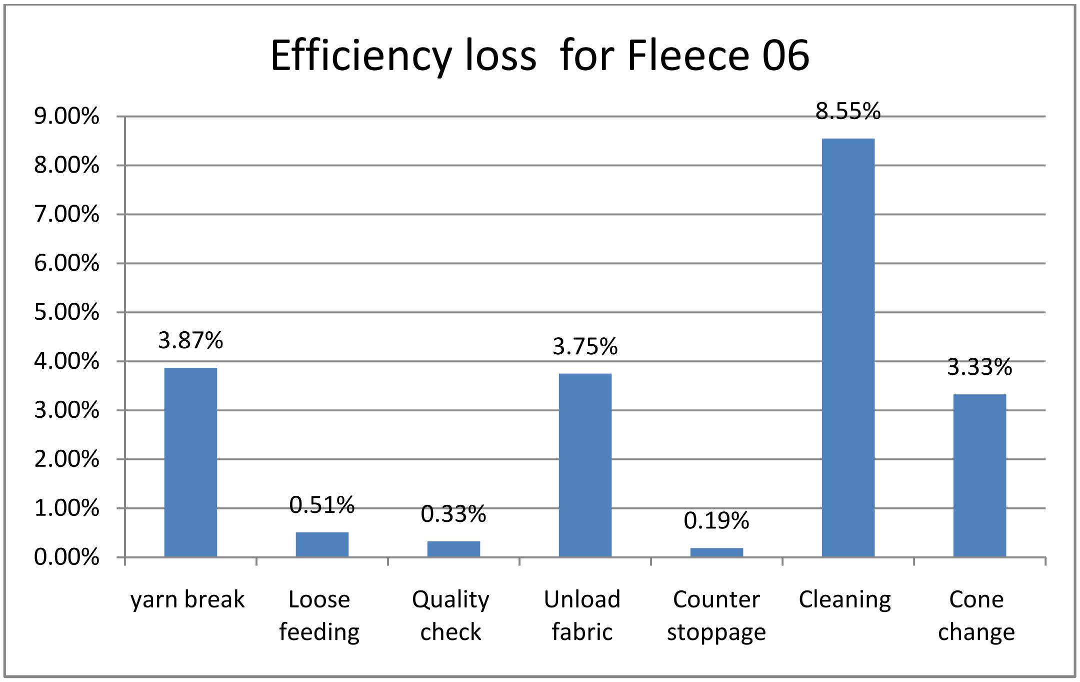


Fig :6 Efficiency loss for Fleece 06

The above illustrated analysis 10.2 and figure 6 clearly indicate that the efficiency loss % of Fleece machine is maximum for cleaning about 8.55%.That means the knitting machine is stopped more time for cleaning and yarn break. Minimum efficiency loss % is found in Quality check and counter stoppage.

11.0 Data of Interlock Machine(SL 7)

Observation was carried out for 8 hours on Interlock knitting machine (SL 07).Consumed time for each machine stoppage due to various causes was tabulated and the summary of the report is given below.

Table -7: Causes of stoppage of Interlock knitting machine in 8 hours

Serial No	Yarn breakage	Feeding slippage for dust	Quality check	Unload fabric	Counter stoppage	Cleaning	Cone change
01	10.5sec	10.30sec	10.50sec	4min	04.11sec	5min20sec	1min10sec
02	20.11sec	08.12sec	15.00sec	3min	03.55sec	4min10sec	1min50sec
03	18.03sec	05.50sec	18.50sec	3min	02.05sec	5min50sec	2min02sec

04	22.50sec	11.40sec	12.05sec		04.10sec	5min30sec	1min55sec
05	30.12sec	09.55sec	18.05sec		03.50sec	4min10sec	1min30sec
06	20.50sec	10.40sec	15.00sec		02.10sec	3min50sec	1min10sec
07	30.33sec	09.30sec	17.10sec		04.30sec	2min51sec	
08	19.50sec		13.10sec		03.50sec	4min40sec	
09	25.40sec				04.00sec		
10	35.10sec						
11	32.22sec						
12	29.50sec						
13	31.12sec						
14	21.10sec						
15	25.22sec						
16	30.10sec						
17	19.20sec						
18	29.30sec						
19	20.50sec						
20	30.30sec						
Total =	**8.34min**	**1.07min**	**1.99min**	**10min**	**0.52min**	**36.35min**	**9min**

Table 7: (Machine SL No: 7 , interlock)

11.1 Production & Efficiency Calculation of serial No :7 (interlock)

Calculated production time: 8x60= 480 min

Actual production time : 480-67.27= 412.7 min

Efficiency = $\frac{acual\ production\ time}{calculated\ production\ time}$ x 100%

Now, Efficiency= $\frac{412.7}{480}$ x 100% = 86.29%

11.2Total effect on efficiency in percentage (%) for specific causes (Interlock-07):

Total effect on efficiency in percentage (%) for the causes of yarn break = 1.737%

Total effect on efficiency in percentage (%) for the causes of Loose feeding = 0.222%

Total effect on efficiency in percentage (%) for the causes of Quality check =0.414%

Total effect on efficiency in percentage (%) for the causes of Unload fabric = 2.083%

Total effect on efficiency in percentage (%) for the causes of Counter stoppage= 0.108%

Total effect on efficiency in percentage (%) for the causes of Cleaning = 7.572%

Total effect on efficiency in percentage (%) for the causes of Cone change = 1.87%

Total effect on efficiency in percentage (%) = 13.71%

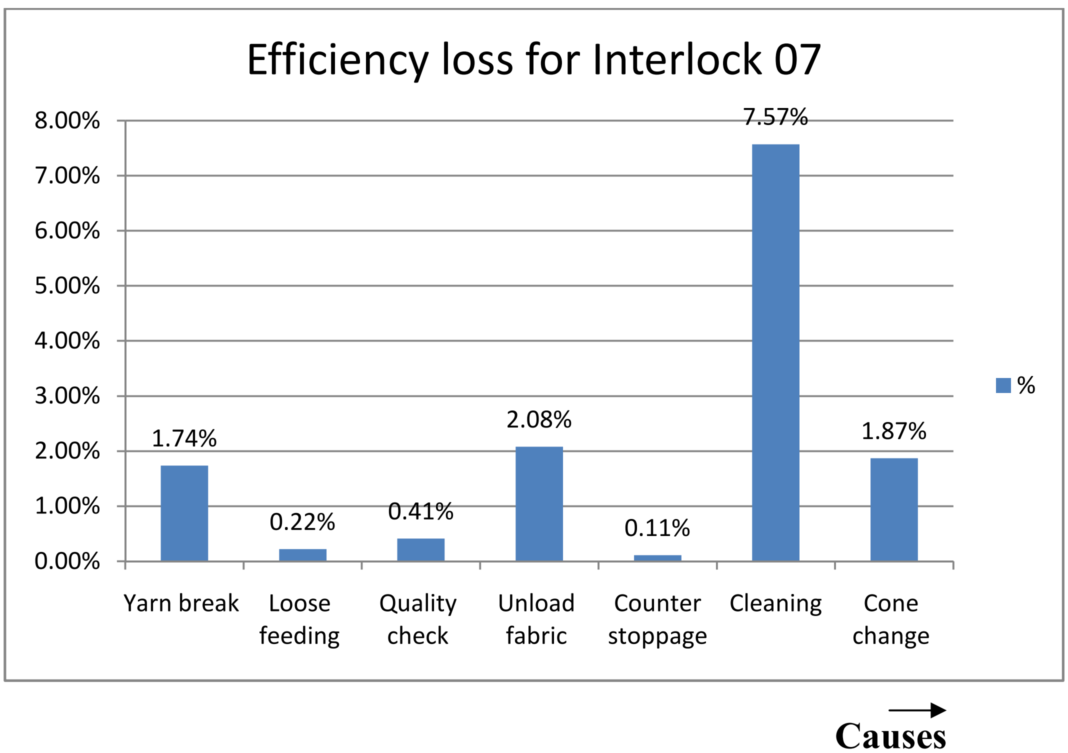


Fig : 3 Efficiency loss for Interlock 07

The above illustrated analysis 11.2 and figure 7 clearly indicate that the efficiency loss % of single jersey machine is maximum for cleaning about 7%.That means the knitting machine is stopped more time for cleaning and unloading. From knitting faults view maximum efficiency loss is found for yarn break. Minimum efficiency loss is found on counter stoppage and loose feeding.

12.0 Data of Interlock Machine (SL 8)

The observation was carried out for 8 hours on Interlock knitting machine (SL 08).Consumed time for each machine stoppage due to various causes was tabulated and the summary of the report is given below.

Table -8: Causes of stoppage of Interlock knitting machine in 8 hours

Serial No	Yarn breakage	Feeding slippage for dust	Quality check	Unload fabric	Counter stoppage	Cleaning	Cone change
01	11.51sec	11.33sec	10.52sec	5min	03.15sec	4min22sec	1min54sec
02	21.10sec	10.00sec	12.00sec	2min	02.55sec	5min15sec	2min08sec
03	19.11sec	06.44sec	15.50sec	2min	02.45sec	4min52sec	1min56sec
04	21.50sec	11.45sec	13.44sec	1min	04.12sec	5min35sec	
05	31.11sec	09.50sec	14.05sec		04.01sec	5min18sec	
06	19.50sec	11.46sec	13.00sec		03.10sec	2min52sec	
07	32.33sec	10.55sec	16.12sec		04.35sec	3min55sec	
08	20.50sec	12.33sec	14.11sec		04.50sec	5min48sec	
09	25.40sec	09.50sec			03.00sec		
10	34.10sec						
11	33.22sec						
12	29.55sec						
13	31.15sec						
14	21.50sec						
15	25.40sec						
16	30.50sec						
17	20.50sec						
18	30.35sec						
19	20.50sec						
20	30.30sec						
21	31.55sec						
22	29.30sec						
23	25.44sec						
24	32.50sec						

25	31.20sec						
26	35.55sec						
Total	**11.58min**	**1.54min**	**1.81min**	**10 min**	**0.53min**	**37.95min**	**5.96min**

Table : 8 (machine no:14 ; interlock)

12.1 Production & Efficiency Calculation of serial No :8 (Interlock)

Calculated production time: 8 x 60= 480 min

Total time loss for those causes : 69.37

Actual production time : 480- 69.37 = 410.63 min

$$\text{Time Efficiency} = \frac{acual\ Production\ time}{calculatedproduction\ \ time} \text{ x } 100\%$$

$$= \frac{410.63}{480} \text{ x } 100\% = 85.54\%$$

12.2Total effect on efficiency in percentage (%) for specific causes (Interlock -08):

Total effect on efficiency in percentage (%) for the causes of yarn break = 2.41%

Total effect on efficiency in percentage (%) for the causes of Loose feeding = 0.32%

Total effect on efficiency in percentage (%) for the causes of Quality check =0.37%

Total effect on efficiency in percentage (%) for the causes of Unload fabric = 2.08%

Total effect on efficiency in percentage (%) for the causes of Counter stoppage= 0.11%

Total effect on efficiency in percentage (%) for the causes of Cleaning =7.90 %

Total effect on efficiency in percentage (%) for the causes of Cone change =1.24 %

Total effect on efficiency in percentage (%) =14.43 %

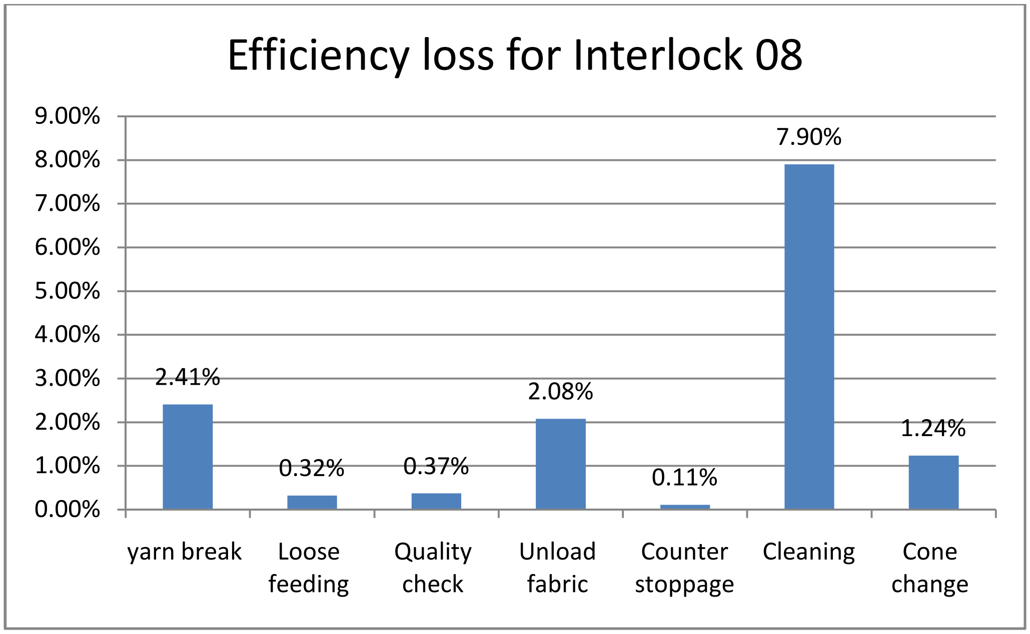


Fig:8 Efficiency loss for Interlock 08

The above illustrated analysis 12.2 and figure 8 clearly indicate that the efficiency loss % of single jersey machine is maximum for cleaning about 7.9%.That means the knitting machine is stopped more time for cleaning and cone change.

13.0 Particular causes % for S/J ;Interlock ;Fleece ; Rib Machine :

Yarn Break percentage (%) :

Table 9: Comparison of loss of efficiency of different types knitting machines due to yarn breakages.

Sl .No	Name of machine	Efficiency %	
		Machine 1	Machine 2
01	S/J	2.70%	2.18%
02	Rib	1.82%	1.62%
03	Fleece	2.91%	3.87%
04	Interlock	1.74%	2.41%

Fig-9

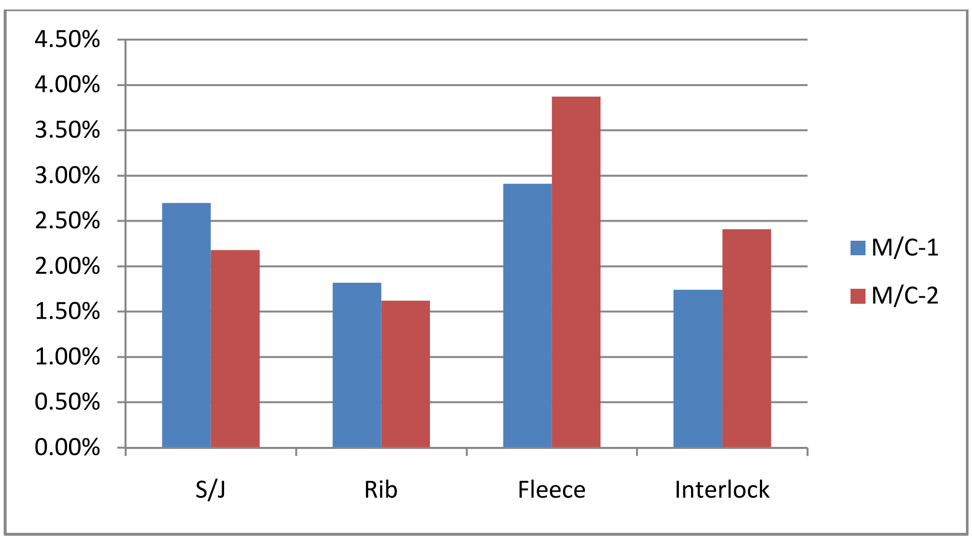


Fig : 9

From above illustrated analysis and figure 9 it is observed that the yarn breakage percentage is maximum for fleece machine in compare with the other. The cause behind it may be more number of feeder and used three thread yarn for one course. In Single Jersey machine the yarn breakage rate of second one is high than first one. Because of higher feeders and Dia & gauge .In Rib machine the yarn break percentage is not so much difference between two machines. Because of faulty yarn it may break more in first machine than second machine. In first rib machine the break percentage is 1.82% and the second one is 1.62%. In fleece it is observed that the second machine yarn breakage is more than first one. In interlock it is observed that between two interlock machines second one breaks more yarn than first one and the percentage is 1.74% and 2.41%. It may occur for faulty yarn.

Table 10: Comparison of loss of efficiency of different types knitting machines due to loose Feeding.

Sl .No	Name of machine	Efficiency %	
		Machine 1	Machine 2
01	S/J	0.15%	0.27%
02	Rib	0.21%	0.21 %
03	Fleece	0.36%	0.51%
04	Interlock	0.22%	0.32%

Table-10

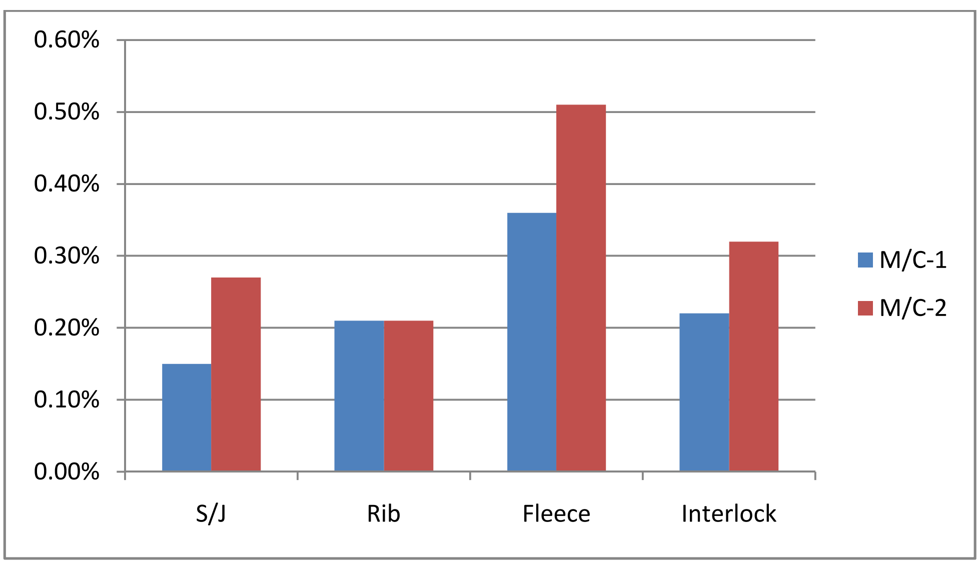


Fig :10

From upper fig. no 10 it is found that the maximum efficiency loss due to loss feeding is held in fllece machine as compared with the other. In single jersey the second machine give more loss percentage of loose feeding than the first one. In rib the percentage between two machines is same .In fleece and interlock the second machine give more loss percentage of loose feeding than the first one. Loose feeding is occurring due to the dust. The dust block the sensor so that the sensor are not detected correctly then the machine is stopped.

Table 11: Comparison of loss of efficiency of different types knitting machines due to Quality check.

Sl .No	Name of machine	Efficiency %	
		Machine 1	Machine 2
01	S/J	0.61%	0.51%
02	Rib	0.42%	0.46%
03	Fleece	0.35%	0.33%
04	Interlock	0.41%	0.46%

Table-11

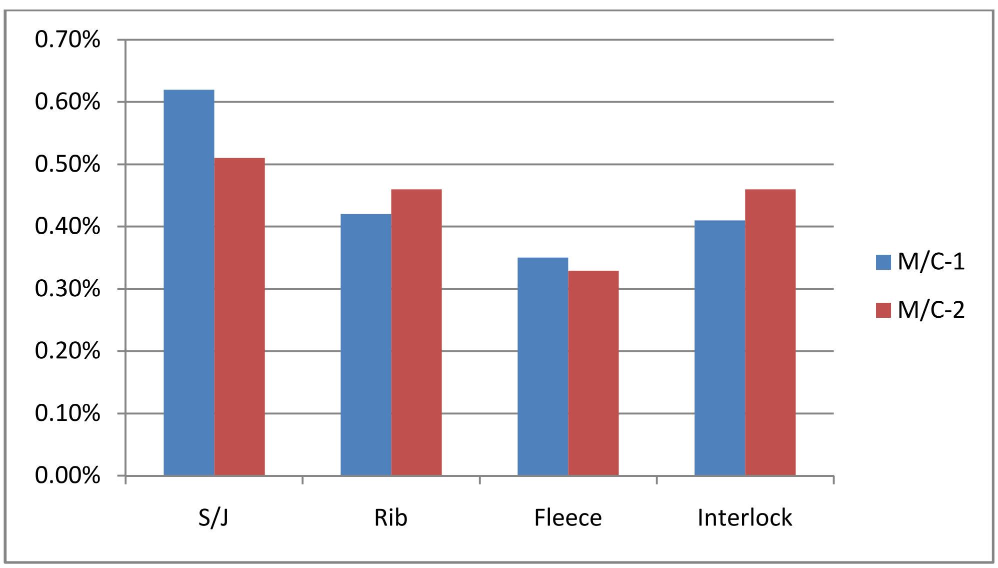


Fig :11

In above illustrated table 11 and fig. no 11 clearly indicate that due to quality check the efficiency loss percentage is maximum for single jersey machine. One of the reason of it may be higher rpm and higher machine gauge. So the possibility of needle breakage is more in single jersey. It is also observed that in rib and interlock the second machine give more efficiency loss percentage due to quality check than the first one. Quality check is a regular work when the machine is on production .It helps to produce fault free fabric. The loss of efficiency depends on worker and the type of fault.

Table 12: Comparison of loss of efficiency of different types knitting machines due to unload fabric.

Sl .No	Name of machine	Efficiency %	
		Machine 1	Machine 2
01	S/J	6.25%	6.45%
02	Rib	2.38%	1.54%
03	Fleece	3.75%	3.75%
04	Interlock	2.08%	2.08%

Table-12

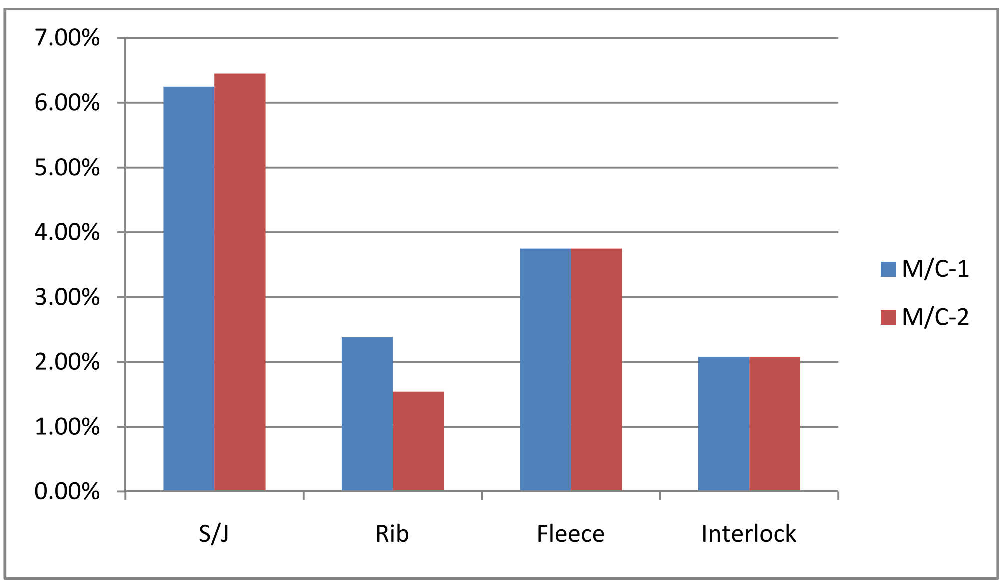


Fig :12

From table12 and fig. no 12 it is observed that more time is required for unloading in single jersey machine than the others. Because the production capacity is high in single jersey machine. So efficiency loss % is more in single jersey machine due to unloading. In rib machine, because of low amount of fabric unload the loss percentage is much lower than single jersey. In fleece and interlock machine the loss percentages are same between specific two fleece and interlock machines.

Table 13: Comparison of loss of efficiency of different types knitting machines due to counter stoppages.

Sl .No	Name of machine	Efficiency %	
		Machine 1	Machine 2
01	S/J	0.17%	0.19%
02	Rib	0.16%	0.16%
03	Fleece	0.14%	0.15%
04	Interlock	0.11%	0.11%

Table-13

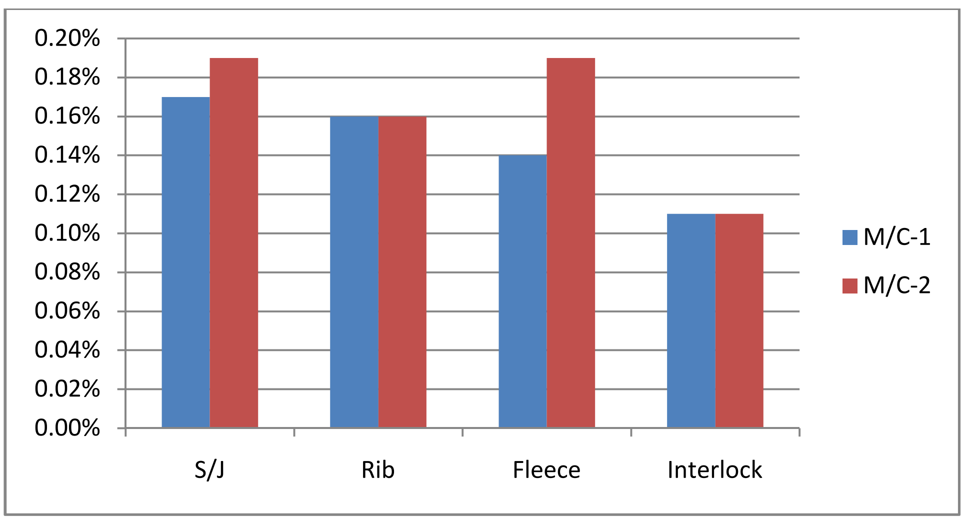


Fig :13

From table 13 and fig. no 13 it is observed that the efficient loss % is maximum in single jersey machine due to counter stoppage than the others. The counter is set by operator and when the countdown is over then the machine is automatically stopped. One of the reason of it is that the rpm of the single jersey machine is higher than the others. In rib and interlock it is observed that the percentage is same for two particulate rib machine and interlock machine..

Table 14: Comparison of loss of efficiency of different types knitting machines due to cleaning.

Sl .No	Name of machine	Efficiency %	
		Machine 1	Machine 2
01	S/J	8.12%	7.63%
02	Rib	7.78%	7.78%
03	Fleece	8.24%	8.55%
04	Interlock	7.57%	7.90%

Table-14

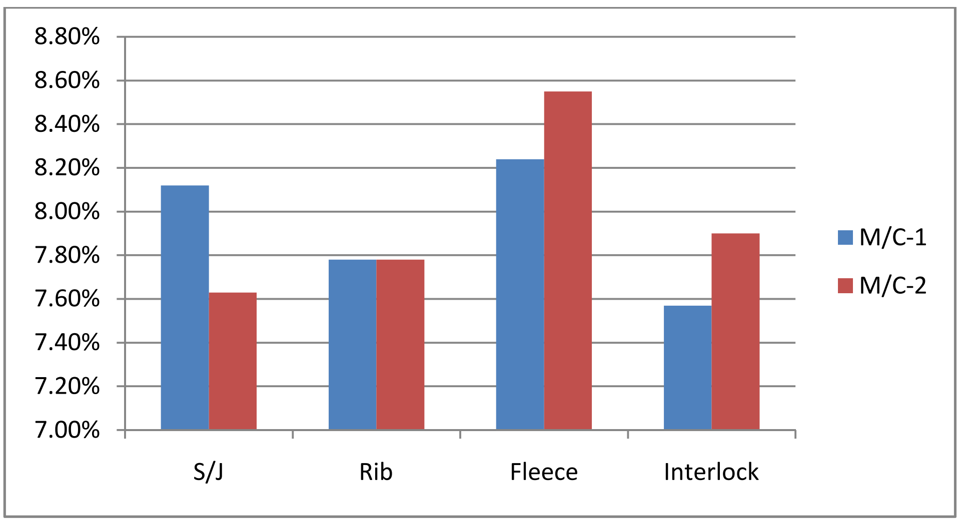


Fig :14

In above table 14 and fig. no 14 It is found that the efficiency loss percentage due to cleaning is maximum in Fleece machine that the others. This is because lower count used in fleece machine. So the possibility of dust formation is higher in that machine. Cleaning is a regular activity when the machine is on production. It depends on worker skill and amount of dust.

Table 15: Comparison of loss of efficiency of different types knitting machines due to cone change.

Sl .No	Name of machine	Efficiency %	
		Machine 1	Machine 2
01	S/J	2.54%	3.51%
02	Rib	2.11%	2.04%
03	Fleece	3.03%	3.32%
04	Interlock	1.87%	1.24%

Fig :15

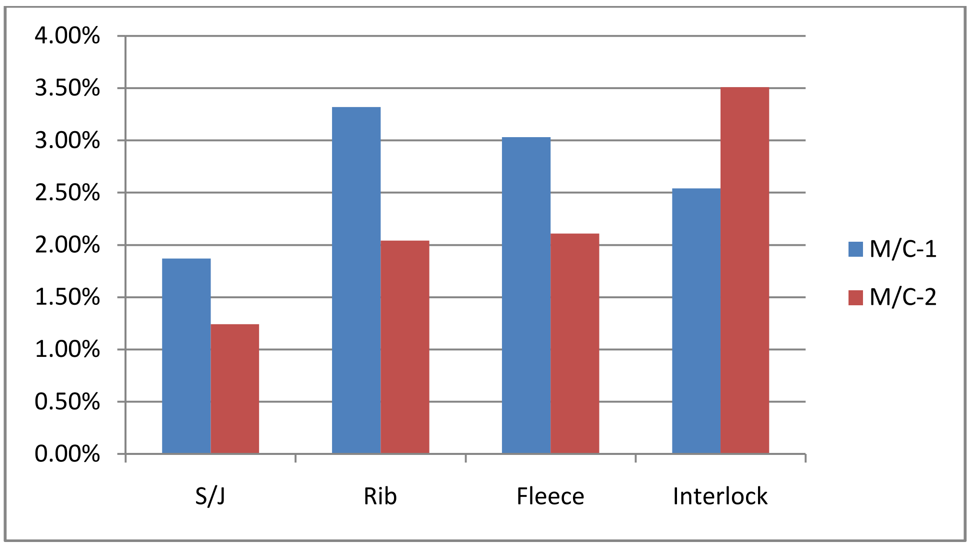


Table -15

In above table 15 and fig. no 15 it is observed that the efficiency loss% due to cone change is maximum for single jersey and fleece machine. One of the reason behind it is the higher number of feeder in single jersey and fleece machine Cone change depends on number of feeder in machine, size of cone and also amount of fault presence in cone.

14.0 Percentages (%) of total efficiency loss for S/J; Interlock; Fleece and Rib Machine:

Sl .No	**Name of machine**	**Total Efficiency loss %**	
		Machine 1	**Machine 2**
01	S/J	20.54%	20.74%
02	Rib	14.89%	13.81%

03	Fleece	21.79%	20.53%
04	Interlock	13.71%	14.43%

Table-16

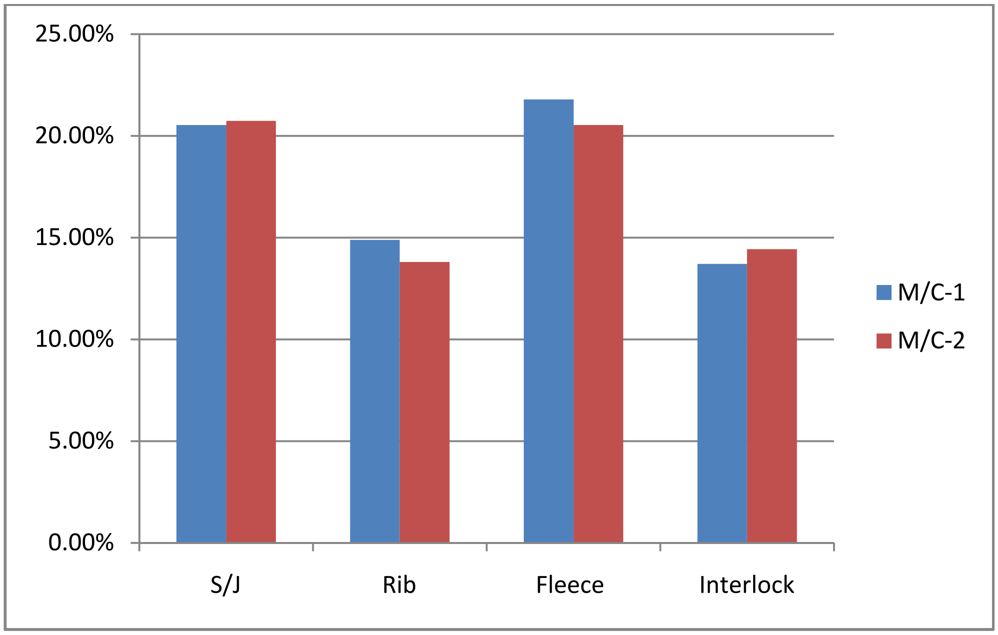


Fig :16

In above table 16 and fig. no 16 it is observed that efficiency loss is maximum for fleece machine as compared with the other ones. The cause behind it may be the higher number feeder required for three thread fleece and more cleaning time. It is also found that the efficiency loss for single jersey is also higher than rib and interlock machine but lower than fleece machine. The variation of efficiency loss is because of those causes that are observed from particular machine. E.g. yarn break, cleaning etc.

6.0 CONCLUTION:

From the above analysis and calculation it is found that 11 hours per shift (1shift=8hours) are wastage due to machine stoppage. If we calculate the production in kg, this is about 66 kg⁄shift for single jersey fabric and 20 kg⁄shift for double jersey fabric. In economic point of view this is a huge loss for an industry. By increasing m/c speed, improving operator skill, developing suctioning system, production can be increased to overcome the loss but it has to make sure that excess tension is not imposed on yarn. Production is also related to the number of feeders and machine gauge .If the number of feeders and machine gauges are increased then production can be increased. Excess machine stoppage can be eliminate by applying yarn supply through plastic tube that eliminates the possibilities of damage, using yarn feed control device and using auto lints removal.

Reference :

1. D. J. Spencer, "Knitting Technology", third edition, Woodhead Publishing Ltd., April 2001.

2. Iyer, Mammel, Schach "Circular Knitting", second edition, 1995.

3. http://en.wikipedia.org/wiki/Efficiency.

4. H. Hashi, J Text Machinery Soc, 52 (1999) 459

5. Iyer, Mammel, Schach "Circular Knitting", second edition, 1995.

6. Efficiency Losses Calculation and Identify Causes of Losses of Circular Knitting Machine during Knit Fabric Production
   Md.Solaiman, Elias Khalil ;Mostafizur Rahman; Joy Sarkar