

A STUDY ON WASTE CONTROL AND MANAGEMENT BY USING LEAN AT ANNA COOPERATIVE SPINNING MILLS LTD

Submitted in partial fulfillment of the requirements for the award of

Master of Business Administration

by

MANOJKUMAR S

Register No. 39410107



SCHOOL OF BUSINESS ADMINISTRATION

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
Jeppiaar Nagar, RAJIV GANDHI SALAI, CHENNAI - 600 119**

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Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai – 600 119
www.sathyabama.ac.in**

SCHOOL OF BUSINESS ADMINISTRATION

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **MANOJKUMAR S (39410107)** who have done the project entitled **"A STUDY ON WASTE CONTROL AND MANAGEMENT BY USING LEAN AT ANNA COOPERATIVE SPINNING MILLS LTD"** under my supervision from **December 2020 to March 2021.**

MS.KAVITHA RAJAYOGAN
Internal Guide

Mr. P. RAJA
External Guide

Dr. BHUVANESWARI G.
Dean - School of Business Administration

Submitted for Viva Voce Examination held on _____

Internal Examiner

External Examiner



ANNA COOPERATIVE SPINNING MILLS LTD

ANDIPATTI - 625 512. THENI DISTRICT, TAMILNADU.

G. THIRULOGASUNDAR, D.C.E.,
President

S. SHENTHILKUMAR, B.Tech, D.H.T, D.H.C.M.,
Deputy Director/Managing Director

☎ F.M :9385983821

✉ annaco_op@yahoo.co.in

☎ A.O :9385983820

☎ Factory :9385983822

✉ annamill1984@gmail.com

☎ Office :9385983818

GSTIN:33AAAAA1388A1ZG

Rc.No.ACSM/Gen35/2020-21/B1

Date: 29.01.2021

CERTIFICATE

This is to certify that **Selvan.S.MANOJKUMAR**,
Reg.No.39410107, second year M.B.A student of Sathyabama
Institute of Science and Technology, Chennai has undergone
"Project Internship" in Anna Co-operative Spinning Mills Ltd.,
Andipatti, from 21.12.2020 to 05.01.2021, as a part of his
educational curriculum.

During the period of training his inclination to learning and
attendance were good.

F.C

Managing Director

29.01.2021

8-16
29/01/2021

DECLARATION

I **S MANOJKUMAR (39410107)** hereby declare that the Project Report entitled **A STUDY ON WASTE CONTROL AND MANAGEMENT BY USING LEAN** done by me under the guidance of **MS. KAVITHA RAJAYOGAN** at **ANNA COOPERATIVE SPINNING MILLS LTD , ANDIPATTI THENI** is submitted in partial fulfillment of the requirements for the award of Master of Business Administration degree.

DATE:

PLACE:

S MANOJKUMAR

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ABSTRACT

Organizations today have started incorporating methodologies for reduction or elimination of wastages in various forms thereby focusing on waste management and controlling them in the effective way. one of the powerful methodologies through the implementation of Lean management within the production process. Through the various types of lean tools like 5s, kaizen, Root cause analysis, organization can eliminate the various forms of waste. Generally there is a different form of waste in the company. They are in different forms like over production, waiting, transport, movement, process, stocks, defects, non-utilized talent, by eliminating the waste by implementing the lean manufacturing process. The main objective of the study is to control and manage the waste in the Anna cooperative spinning mills ltd. waste management is the impact full and essential process, which leads to promoting the productively and reduces the environmental impacts. by using the waste management principles along with lean management to control waste and management in an effective way to increase the company revenue and improve the overall company development through continuous improvement. To analyze the overall production process by using the lean tool to identify the waste and root cause of the waste generation. waste which is generated in the company, it may be the raw material for the other product in the same market. by analyzing the waste to reuse in a way, to promote productivity, reduce the manufacturing cost. Through the lean tool implementation, company can improve the working environment, reduce waste, increase productivity, improve employee safety, and finally the company can be continuously improved.

Key word : Anna cooperative spinning mills, waste control and management , lean management, continuous improvement.

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LIST OF ABBREVIATIONS

ABBREVIATION	EXPLANATION
5s	Sort, Shine, Standardize, Set in order, Sustain
OEE	Overall Equipment Efficiency
PDCA	Plan - Do - Check - Act
ACSML	Anna Cooperative Spinning Mills Ltd

CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION ABOUT THE STUDY

Waste management is the impact full and essential process, which leads to promoting the productively and reduces the environmental impacts. Using the waste management principles along with lean management to control waste and management in an effective way to increase the company revenue and improve the overall company development through continuous improvement. The lean manufacturing process or management which helps the organization to improve the overall production process by reducing the waste. Using the lean manufacturing and management concepts in the process happen within the company to reduce the waste generation , improve the overall efficiency, promote the revenue percentage, improve the product quality, and improve the culture within the company.

To analyze the overall production process by using the lean tool to identify the waste and root cause of the waste generation. waste which is generated in the company, it may be the raw material for the other product in the same market. by analyzing the waste to reuse in a way, to promote productivity, reduce the manufacturing cost. Generally there is a different form of waste happening in the company. They are in different forms like over production, waiting, transport, movement, process, stocks, defects, non-utilized talent. The 5 R'S in the waste management REFUSE, REDUCE, REUSE, REPURPOSE, RECYCLE. These are the impactful processes which enhance the business process and environment.

1.1.1 LEAN MANAGEMENT

Lean management is generally derived from the Toyota production system. However , Fredrick Taylor and Henry Ford documented their observations relating to this topic, and Shigeo Shingo and Taiichi Ohno applied their enhanced thoughts on the subjects at Toyota in the 1930s. this lean manufacturing process which helps to promote continuous improvement in the overall process. Through the lean we are able to improve the productivity, efficiency of the production process by eliminating the

different forms of wastes in different points of the production process. by implementing the just-in-time inventory management which results in less warehouse space, fewer forklifts, reduces the unnecessary space etc. once the flow of work can be interruption free, free of materials sitting, standing and redo-loops, waste eliminated. Lean is the elimination of different types of waste, to continuous improvement processes. The essence of lean is continuous improvement by allowing the team to think, experiment and learn from the data. the management continuously encourages, challenges and leans from the mistake. It is about management gathering the facts, encourages experimentation and spreads best practices. the learn is the process of learning and improvement

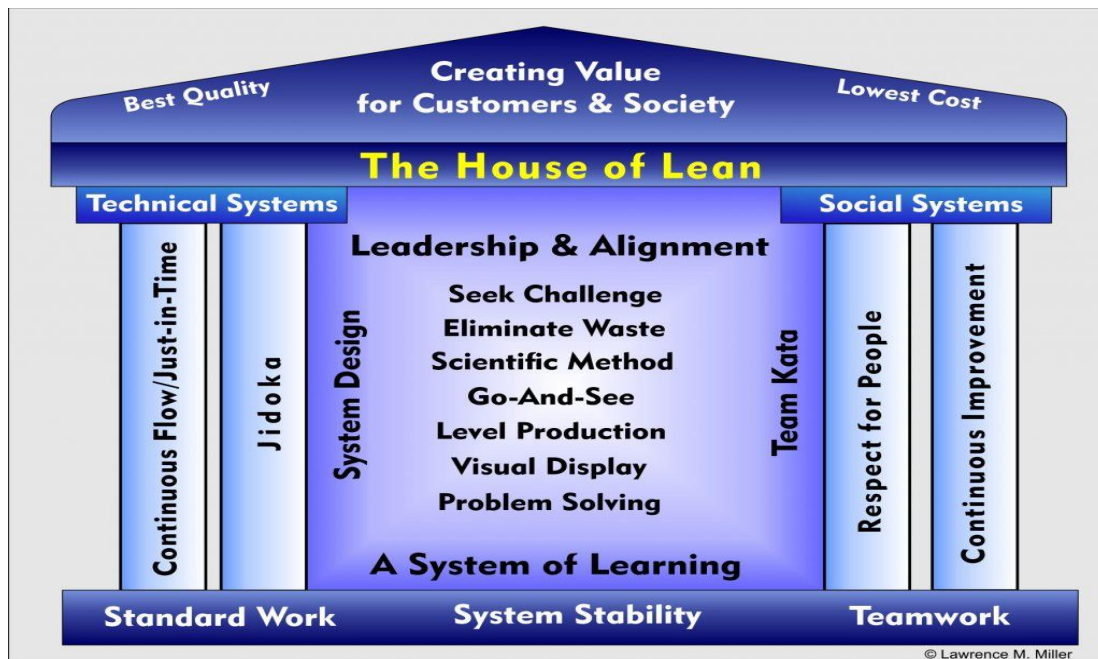


Fig 1.1 LEAN HOUSE

- Lean is a culture of continuous improvement practices at every level of the organization and by every team
- Lean is the application of the scientific method of experiment and study of work processes and systems to find improvements.
- Lean is the elimination of waste in all its form. it is able to distinguish between the work that actually adds value to your work that does not. by eliminating

waste, we free resources to develop to value-adding activity that serves the business process.

- Lean increase the safety in the working environment, improve the team culture, improve the work process, improve the flow, eliminate waste

1.1.2 TYPES OF LEAN WASTES

- ***DEFECTS***

Efforts caused by rework, scarp and incorrect information during the production process. defects impact time, money, resources, working condition, which is caused by poor quality control at the production level, poor machine repair, lack of process standards.

- ***OVERPRODUCTION***

When products are produced more than the actual schedule or demand waste .This waste is caused by unreliable production processes, unstable production schedules, inaccurate forecast and demand information.

- ***OVER PROCESSING***

Excess processing is a sign of a poorly designed process. waste related to more work or higher quality than is required. this could be related to management or administrative issues such as lack of communication, duplication of data, human error etc

- ***WAITING***

Waiting can include people, material equipment or idle equipment. waste from time spent waiting for the next process step to occur. which is caused by unplanned downtime or idle equipment, long or delayed set-up times, lack of process control, idle equipment.

- ***INVENTORY***

Maintaining a high inventory level is considered as a form of waste because of related holding costs. It includes raw materials, work in process, finished goods. It is caused by overproduction, poor forecasting and planning.

- **TRANSPORTATION**

Poor plant layout design, network design which causes transportation waste. unnecessary movements in transportation of products and materials, waiting time, fuel waste.

- **MOTION**

Motion costs money. This not only includes raw materials but also peoples and equipment. unnecessary motion of raw materials, equipment, people results in non-value added time and increased cost. poor work station layout, poor production process, poor process design, lack of production standards.

- **NON-UTILIZED TALENT**

Wastes due to underutilization of people's talent, skills. the only waste that is not manufacturing-process specific. when the management fails to ensure that all their potential employee talent is being utilized. poor management, lack of team training, lack of or inappropriate policies, failure to involve people in workplace design and development.

1.1.3 LEAN PRINCIPLES

- **DEFINE VALUE**

Define and understand the Specify value of the product from the standpoint of the customer

- **MAP VALUE STREAM**

identify all the steps in the value stream for each product , eliminating whenever possible those steps that do not create value.

- **CREATE FLOW**

Make the value-creating steps occur in tight sequences so the process will flow in a smooth and effective way.

- **ESTABLISH PULL**

As flow is introduced pull value from the next upstream activity.

- **PURSUIT PERFECTION**

As value is specified, value stream are identified, wasted steps are removed, and flow and pull are introduced, begin the process again and continue it until a state of perfection is reached in which perfect value is created with no waste

1.1.4 LEAN TOOLS

- **5S METHODOLOGY**

It help to eliminate waste that results from a poorly organized working area within the organization

- SORT - eliminate that which is not need and interrupt the process flow
- SET IN ORDER- organize the tools and equipment in order
- SHINE- clean and inspect work area
- STANDARDIZE - write standard for above
- SUSTAIN - regularly update and implement the standards for all the processes.

- **ANDON**

Visual feedback system for the plant floor that indicates production status, alerts when assistance is needed and empower the operation to stop the production process. it acts as a real-time production communication tool for the plant that brings immediate attention to problem as they occur, so they can be instantly addressed

- **BOTTLE NECK ANALYSIS**

It identifies which part of the manufacturing process limits the overall throughput and improves the performance of that part of the process. by help to identify and improve the weakest link in the manufacturing process.

- **CONTINUOUS FLOW**

To enhance the smooth flow in the work space by eliminating many forms of waste happens in inventory, waiting time, transport. manufacturing where work-in-process smoothly flows through production with minimal or no buffers between steps of the manufacturing process.

- **GEMBA**

To remain us to get out of our offices and spend time on the plant floor to know about the real time problems. Promotes a deep and through

understanding of real-world manufacturing issues by first hand observation and by talking with plant floor employees.

- ***HEIJUNKA***

A form of production scheduling that purposely manufactures in much smaller batches by sequencing product variants within the same process. it reduce the lead time and inventory size

- ***HOSHIN KANRI***

Align the goals of the company strategy, tactics and action. to ensure the process towards strategic goals is consistent and through- eliminating the waste that comes from poor communication and inconsistent direction

- ***JIDOKA***

Design and implement the equipment to partially or fully automate the process, to reduce the defects percentage, reduce labor cost, improve quality and productivity

- ***JUST-IN-TIME***

Pull parts through production based on the market and customer demand, not by projected demand. This one helps to reduce the inventory levels, improves cash flow and reduces space requirements.

- ***KAIZEN***

A strategy where both management and employees work together proactively to achieve regular , continuous improvement in the manufacturing process, by continuously eliminating waste from the manufacturing process.

- ***KABAN***

A method of regulating the flow of goods both within the factory and with outside suppliers and customers. eliminates waste from the inventory and overproduction by eliminating physical inventory in to the automatic replenishment system.

- ***KEY PERFORMANCE INDICATORS***

Metrics designed to track and identify the key performance indicator to achieve the critical organization goals. KPIs are aligned with top-level- strategic goals to achieve goals, effectively exposing and quantifying the waste to implement the continuous growth.

- **MUDA**

The elimination of waste is the primary focus of lean manufacturing. anything in the manufacturing process that does not add value for both company, customer.

- **OVERALL EQUIPMENT EFFECTIVENESS**

Framework for measuring productivity loss for the given manufacturing process, by analysis the AVAILABILITY, PERFORMANCE, QUALITY. it provides a baseline to track progress in eliminating waste from the manufacturing process. 100% OEE means perfect production like manufacturing only good parts, as fast as possible, with no down time.

- **PLAN, DO, CHECK, ACT**

An iterative methodology for implementing improvement

- Plan - establish plan and expected results
- Do - implementing plan
- Check - verify expected results achieved
- Act - review and assess, do it again

- **POKA-YOKE**

Design error detection and prevention into the production process with the goal of achieving zero defects. by continuously analyzing the defects causing area in the production process to implement the error proofing solution to the problem.

- **ROOT CAUSE ANALYSIS**

A problem solving methodology that focuses on resolving the root cause of the problem, instead of applying quick fixes to the problem. it helps to ensure that a problem is truly eliminated and solved by the corrective action to the root cause of the problem.

- **SIX BIG LOSSES**

It provide a framework for attacking the most common causes of waste in manufacturing

- Breakdowns
- Setup
- Small stops
- Reduced speed

- Startup rejects
- Production rejects
- **SMART Goals**

It helps to ensure the goals are effective, goals are

 - Specifics
 - Measurable
 - Attainable
 - Relevant
 - Time-specific
- **STANDARDIZED WORK**

Eliminates waste by consistently applying best practices. It introduces the baseline for the future improvement activities. The documentation procedure for the manufacturing process helps to analyze and standardized the overall process.
- **TAKT TIME**

The pace of production that aligns production time with customer demand . to calculate as $\text{planned production time} / \text{customer demand}$. it provides a simple and consistent method of pacing production to provide an efficient goal for the plant floor.
- **TOTAL PRODUCTIVE MAINTENANCE**

To focus on proactive and preventative maintenance to maximize the operational time of the equipment. It creates a shared responsibility for equipment to increase productivity . increasing uptime, reducing cycle time, eliminating defects.
- **VALUE STREAM MAPPING**

A tool used to visually map the flow of the production process to analyze the current and future state of the processes to create the opportunities for improvement. to expose the defects and waste in the process flow and provide a roadmap to improve in the future state.
- **VISUAL FACTORY**

By implementing the visual indicator, displays and controls used throughout manufacturing plants to improve the communication . It makes the state and

condition of the manufacturing process easily accessible and very clear to everyone.

1.2 INDUSTRY PROFILE

The Indian textile industry is one of the largest in the world with a large unmatched raw material base and manufacturing strength across the value chain. It is the 2nd largest manufacturer and exporter in the world, after China. The share of textile and clothing in India's total exports stands at a significant 12 % (2018-19). India has a share of 5 % of the global trade in textiles and apparel. The uniqueness of the industry lies in its strength both in the hand-woven sector as well as in the capital intensive mill sector. The mill sector is the second largest in the world. Traditional sectors like handloom, handicrafts and small scale power-loom units are the biggest source of employment for millions of people in rural and semi urban areas and also contribute to more than 75% of total textiles production in the country. The Indian textile Industry has inherent linkage with agriculture and with the culture and traditions of the country making for its versatile spread of products appropriate for both domestic and the export markets. The textile industry contributes to 7% of industry output in value terms, 2% of India's GDP and to 12% of the country's export earnings. The textile industry is one of the largest sources of employment generation in the country with over 45 million people employed directly, and another 6 crore people in allied sectors, including a large number of women and rural population. The sector has perfect alignment with Government's key initiatives of Make in India, Skill India, Women Empowerment and Rural Youth Employment. In keeping with the goal of making India's development inclusive and participative, the Government's central focus has been on increasing textile manufacturing by building the best-in-class manufacturing infrastructure, up gradation of technology fostering innovation, enhancing skills and traditional strengths in the textile sector.

1.2.1 TAMIL NADU IN THE TEXTILE SECTOR

Some of the textile products from Tamil Nadu which are universally recognized for the excellent craftsmanship and their uniqueness are Kancheepuram Silk Sarees, Bhavani Carpet (Jamukalam), Madurai Sungudi Sarees, Coimbatore Kora Sarees,

Paramakudi Sarees, Salem Silk Dhoties, Erode and Karur Home Textiles, Tirupur Knitwear Garments, etc. Tamil Nadu acts as the hub of textile exports from the country viz., Tiruppur for Knitwear Garments, Coimbatore for Yarn, Karur for Home Textiles and Chennai for Woven Garment exports. The State accounts for 19% of the Nation's Textile output with a robust network of all the sub-sectors of the Textile industry. The State Textile industry is the largest economic activity after Agriculture. Tamil Nadu is the leading State in the Country in Textile sector and having major stakeholders with 46% of Spinning capacity, 60% of yarn export, 20% of Power loom capacity, 12% of Handloom capacity, 70% of Cotton Fabric Knitting capacity, 20% TUFs investments, direct employment to around 31 lakh people, more than Rs. 50,000 crore exports and 1/3 of textile business in the country.

1.2.2 TAMIL NADU IN THE SPINNING SECTOR

The Spinning sector is the cornerstone of Tamil Nadu industrial development and has been able to keep pace with technological trends. Tamil Nadu enjoys the premier position in the country, both in terms of spindle age and 6 Tamil Nadu New Integrated Textile Policy 2019 production of yarn. Out of 3376 spinning mills in India, 2013 are located in Tamil Nadu providing employment to 2.80 lakhs workforce. Of the 53.05 million spindles in India, 24.10 million spindles are installed in our State. As against the 5659.58 million kgs. of cotton, blended and non-cotton spun yarn produced in India, 2003.20 million kgs. of spun yarn are produced in Tamil Nadu during the year 2016-17. Tamil Nadu is the number one producer of cotton yarn and leading State in the Country in export of cotton yarn. Tamil Nadu is also one of the major producers of synthetic yarn in the Country.

Nevertheless, the State Spinning Sector possesses 60% of Spinning Mills in the Country and holds the number one position till date. Still, many of the Spinning Mills in the State are functioning with obsolete machinery and are not equipped with State-of-the-art technology. This is evident from the fact that the Spindle capacity of the State is only 46% and similarly, 35% of yarn is produced as against 60% of Spinning Mills in our State. The cotton based Spinning Sector of the State is also now shifting attention to Man Made / Synthetic Filament Yarn.

To retain the premier position of Tamil Nadu, the Spinning mills in the State need to be modernized with the latest technologies, so as to increase their productivity and production at reasonable cost. The financial assistance provided by the Government of India for Technology Up gradation in the Spinning sector under TUFS has been withdrawn, since the launch of Amended Technological Up gradation Fund Scheme (ATUFS) in January, 2016.

There are 6 Co-operative Spinning Mills and 7 National Textile Corporation Mills functioning in the State. The Co-operative Spinning Mills in the State are set up by the Government of Tamil Nadu with the objective of providing uninterrupted supply of hank yarn at fair prices to handloom weavers in the State and also to provide sustainable employment to the members of weavers' families, repatriates and Adi-dravidars in rural areas. In order to cope up with the latest technological trends and to increase the productivity by strengthening the capacity, the Co-operative Spinning Mills have been modernized at the total cost of Rs.175.24 crore. These Mills are functioning with 1,18,368 spindle capacity and produce yarn to the value of Rs.320 crores per annum, catering to the yarn requirement of Weavers Co-operative Societies and for Government Schemes.

1.3 COMPANY PROFILE

ANNA CO-OPERATIVE SPINNING MILLS LIMITED (ACSML)

The cooperative spinning mills are the industrial cooperative established by primary weavers co-operatives societies with the state government support in all aspects to fulfill their hunk yarn requirement for their continuous production economically weaker section of weaving community. At present 6 Co-operative spinning mills are functioning. These five co-operative spinning mills produce the yarn required for free distribution of sarees and dhoties scheme, Free uniform scheme school children's and for the weavers co-operative societies to produce market varieties.

Anna cooperative spinning mills limited as an industrial cooperative institution is established as the sixth planning commission by the government of Tamil Nadu with a total cost of Rs 72.48 lakhs allotted in the sixth plan expense in 1982. its located in Andipatti of Theni Districts by the initiation of Tamil Nadu government to fulfill the yarn requirement of primary and industrial handloom weavers cooperative societies

and handloom clusters of Madurai, Theni, Virudhunagar, Dindigul, Ramanathapuram and tiruchirapalli Districts. There is also a private channel of distribution of yarn to the needs of textile based MSMEs in these districts. The management of ACSML is done by the elected board of directors and government officials under the control department of handloom and textiles, Government of Tamil Nadu, the major policies and strategies of ACSML are framed by the state government.

1.3.1 PRODUCTION OVERHEAD OF THE COMPANY

Table 1.1 PRODUCTION OVERHEAD OF THE COMPANY

Clean cotton cost	57%
Wages	11%
Power	13%
Packing material	1%
Stores	2.5%
Depreciation	3%
Interest	5.5%
Overheads	5%
Manufacturing cost	41%
Profits	2%

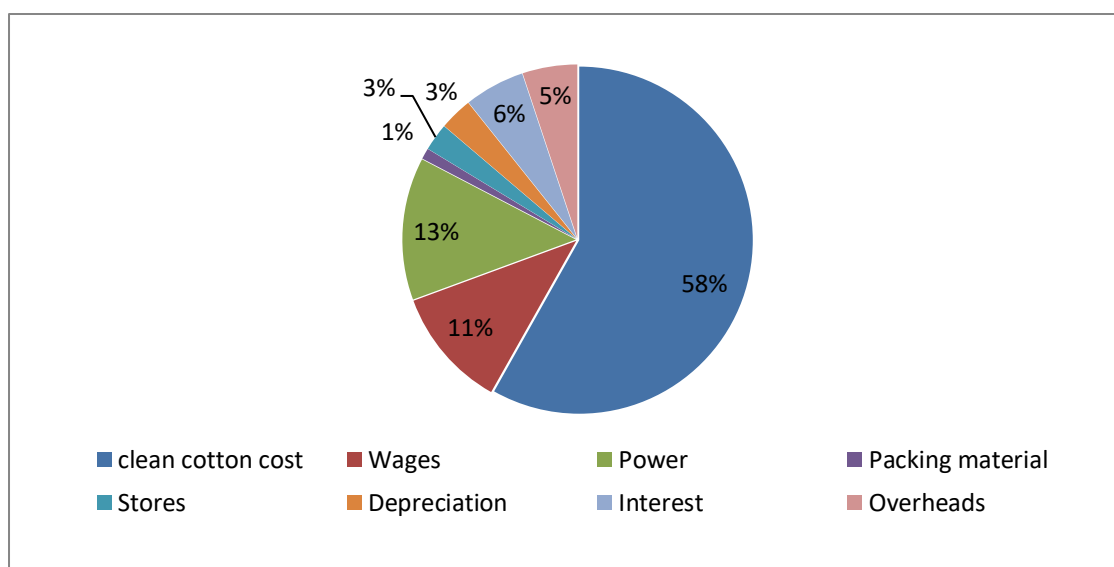


Chart 1.1 MANUFACTURING COST

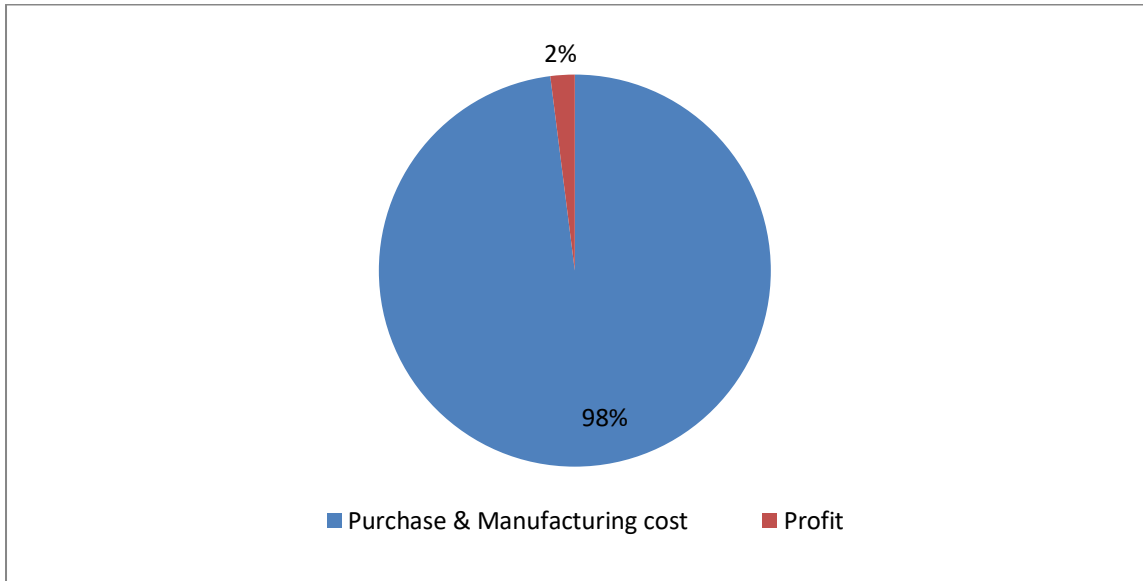


Chart 1.2 MANUFACTURING AND PROFIT PERCENTAGE

1.3.2 PROCUREMENT OF RAW MATERIALS

- Maharashtra
- Gujarat
- Bangalore
- Bombay
- Tamil Nadu

1.3.3 MARKETING AREAS

- Coimbatore
- Karur
- Rajapalayam
- Chennimalai

1.3.4 MACHINERIES DETAILS

In ACSML manufacturing process are designed with various semi automatic and manual machineries. they implement various automated system into the system to increase the efficiency and reduce the production waste.

Table 1.2 LIST OF MACHINERIES IN THE COMPANY

S no	Machineries	No
1	Circular bale pluckier	2
2	Chute feed blow room line • Metal dector • c/p pre cleaner • MPM 6 multi mixer • SPH separomat • FDT Feed Trunk • cleanomate • I- Scanner	1
3	Carding	9
4	Drawing	2+3
5	Simplex	6
6	Spinning	24
7	Conner	5
8	Auto Conner	3+1
9	TFO	2
10	Automatic waste evacuation system	1

1.3.5 STANDARD PRODUCTION AND WASTE PERCENTAGE**Table 1.3 COMPANY STANDARD PRODUCTION AND WASTE PERCENTAGE**

S no	Production efficiency / waste	Product	Percentage
1	Spinning production efficiency	20s,30s,40s	86.17% - 87.03%
2		60c	69.98%
3	Salable waste	20s,30s,40s	10.34% -12.00%
4		60c	9.62%
5	Invisible waste	20s,30s,40s	0.78% - 0.97%
6		60c	0.90%

1.3.6 THE CRITERIA IN CENTRAL LABORATORY FOR QUALITY TEST

- Mean mic-4.5%
- Maturity-0.88%
- Span length-30.5%
- Uniformity ratio-46.5%
- Short fiber index-5.7%
- Breaking tenacity-26%
- Elongation-6.8%
- Color -74.7/8.6
- Lint-97.8%
- Trash-1.5%
- Cage loss-0.7%
- Moisture-7.2%

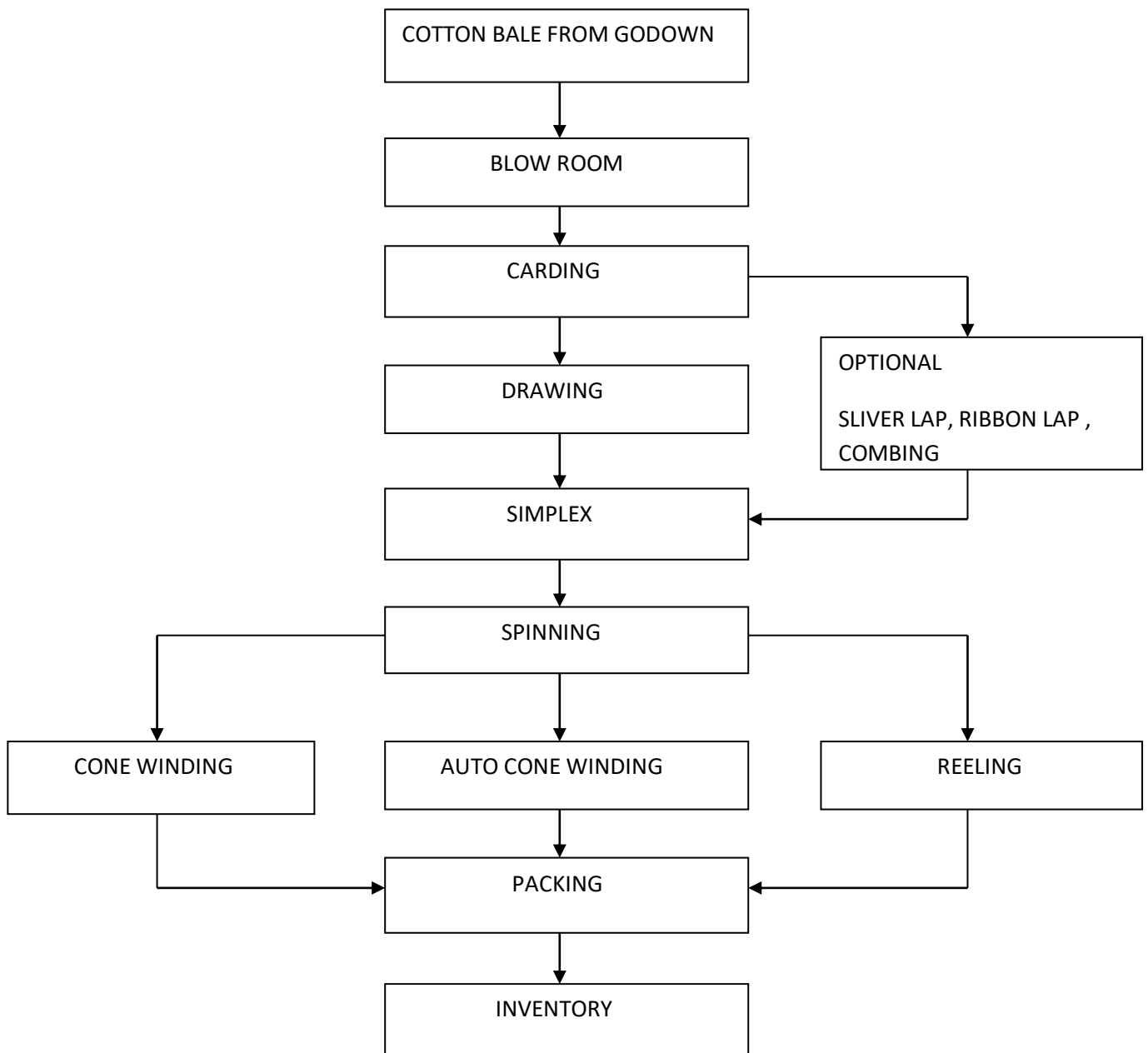
QUALITY CONTROL PARAMETERS-COTTON:

- Span length (Length of fiber)
- Strength
- Uniformity ratio (14-15%)
- MIC (3.5-4.5%)
- Waste percentage-less than 3 percent
- Moisture (8%)
- Color grade (CG)

QUALITY CONTROL PARAMETERS-POLYESTER:

- Cut length
- Denier
- Spin finish
- Tenacity

1.3.7 PROCESS SEQUENCE IN ANNA COOPERATIVE SPINNING MILLS LTD.



In Anna cooperative spinning mills ,they manufacture yarn in various counts according to the order. spinning is the process of converting the natural fibers like cotton into yarn. according to the cotton quality, different types of yarn counts are manufactured. the various products from this ACSML are

- Cone winding - 20s, 30s, 40s, 60s

- comber - 60c
- Doubling - 2/17s, 2/40s, 2/60s
- Reeling - 20s, 30s, 40s, 60s
- TFO - 2/40s

According to the order various other counts of yarn products are manufactured.



Fig 1.2 SPINNING YARN PRODUCT

1.4 INTRODUCTION TO WASTE MANAGEMENT IN THE SPINNING MILLS

In the production economics of a spinning mill, yarn realization plays an important role. To illustrate, in the prevailing cost and yarn selling price, even an 1% improvement in the yarn realization and waste reduction lead to save some huge amount of money in the production process. In the yarn manufacturing process, generally various measures necessary to improve yarn realization and control waste. Besides controlling process wastes such as blow room and card droppings, flats stripes, comber noil, sweep waste and yarn waste, equal important should also be laid on the control of reusable waste (soft waste) such as lap bits, sliver bits, roving

ends , pneumafil and roller waste. This is because, apart from loss in production, reprocessing of soft wastes involves extra handling and deteriorates yarn quality. Spinning mills should pay attention to waste management in order to improve the productivity and profit of the mills

1.4.1 DEFINITION AND CONCEPT OF THE WASTE

Waste is a type of material which is not in use, discarded some waste is useful or not useful. waste which is usable are used for the coarse count yarn, open end spinning etc. those waste are not reusable are sold out to the market at low prices these waste are seeds , coots, leafy matter etc, are used as fertilizers in a farm.

1.4.2 TYPE OF WASTE

In spinning mill there are two type of waste generated

- Soft type of waste
- Hard type of waste



Fig 1.3 VARIOUS TYPE OF SPINNING WASTE

Soft waste - The waste which is in fibers form is called as the soft waste. The soft waste is generated from carding to the speed frame(Including all types of slivers bits, lap pits, roving ends, pneumafil and roller waste. These soft waste are reusable

for producing a low quality of yarn. Example - Coarser count or open end spinning yarn.

Hard waste - The waste which is not reusable is called hard waste. These waste are produced in the ring frame and the winding department.

1.4.2.1 AUTOMATIC WASTE EVACUATION SYSTEM (AWES)

Presently , many mills are implementing this Automatic waste evacuation system in blow room, carding, comber, which remove waste from these machines either continuously or intermittently. This system not only reduces the manpower required to collect and transport waste but also helps to control the fly and fluff generation in these departments and improve yarn quality, particularly short thick faults. This system collects the waste from the following lines and segregates the waste according to the quality.

Type of waste in AWES

- Flat waste
- Licker-in waste
- Micro dust waste

1.4.2.2 BLOW ROOM

Amount of waste extracted in the blow room is mostly determined by the trash level in the cotton. The quality of the cotton plays an important role in the production of the quality yarn products. In the modern blow room lines, greater importance is attached to the opening of cotton cleaning. Hence, cleaning efficiency of about 60% in cotton with high trash content and 50% in cotton with low trash level can be considered to be quite satisfactory in these lines. For good cleaning efficiency, the waste extracted in the blow room should be about the same as the trash in mixing. it may affect the further production process. if however, the cleaning efficiency achieved is less than 50%, 60% then the total waste extracted is low, but trash content in the mixture is high.

Type of waste in blow room

- Dropping

- Seeds, cotes
- Dust, Dirt
- Floor sweep

1.4.2.3 CARDING

Waste extracted in cards is usually in the range of 4% to 7% depending upon the type of card and mixing. according to the counts and quality of the cotton the waste percentage varies. Between the same type of cards and mixing, the waste % should not vary more than 0.5% from the average. The card waste is also governed by the cleaning efficiency achieved in the blow room. Thus, while assessing the waste, combined waste extracted in the blow room and cards should be taken into account. The combined cleaning efficiency will be generally in the range of 90% to 98% with modern cards. to illustrate, for 4% trash in cotton and 0.12% trash in sliver, the combined cleaning efficiency is 97%.

Type of waste in carding

- Flat strips
- Licker-in waste
- Sliver cut
- Filter waste
- Floor sweep
- Dropping

1.4.2.4 COMBERS

Generally, higher level percentage of waste should be extracted only in such cottons where combing performance is satisfactory or where the end use requires yarns of very high quality. under good working conditions, for every 1% increase in comber waste, yarn strength will increase by 1% and evenness is expected to improve by 0.15 U%. variation in noil % between combers must be maintained within 0.5% and between heads it must be within 1.5%.

Type of waste in comber

- Nolis
- Slivers waste

- Lap waste
- Sweep waste

1.4.2.5 DRAW FRAME

It is also called a Breaker draw frame. Feed materials are card slivers. During this process 6-8 carded slivers are fed to this machine to produce more parallelized breaker slivers. the waste generated during this process should be within 0.5%.

Type of waste in Draw frame

- Slivers waste

1.4.2.6 LAP FORMER

It is also called Finisher draw frame. Feed material is breaker draw frame drawn sliver.

During this process 6-8 breaker slivers are fed to this machine to produce more parallelized and uniformed finisher sliver. The waste percentage in this process is 0.5%.

Type of waste in Lap former

- Lap waste
- Slivers waste

1.4.2.7 SIMPLEX

In the simplex process, the main function of a simplex machine is the attenuation of the drawn sliver and inserting a small amount of twist to give required strength of roving. the waste percentage is 0.5%.

Type of waste in simplex

- Rowing waste
- Sliver waste

1.4.2.8 SPINNING

In the Ring frame machine, it produces the required count of yarn from the supplied roving by drafting. the machine in which the final draft is given to the roving and converted to yarn . winding the yarn on to a ring cop. the waste % of the spinning process should be within 2-3%.

Type of waste in spinning

- Pneumafil
- Hard waste
- Roller lapping
- Sweeping
- Vacuum waste.

1.4.2.9 WINDING

The winding is the process of rewind the yarn from the ring cops(small quantity) to cone(large packages). The yarn winding is processed in both manual cone winding machines within 1% of waste and auto cone winding within 0.75% of waste. if yarn undergoes additional processes in post spinning such as reeling, doubling, TFO twisting, the waste would be somewhat higher.

Type of waste in winding

- Hard waste

1.4.2.10 SWEEP WASTE

Sweep waste in all the departments of a spinning mill together should be within 1%. A high percentage of sweep waste arises invariably due to operatives throwing away the waste like roller waste, lap bits, sliver bits, roving ends etc.

1.4.2.11 INVISIBLE WASTE

Invisible loss in a spinning mill occurs due to a number of factors such as short fibers (fluff) escaping from the departments, improper accounting of waste produced, weighting error in cotton purchased and waste sold etc. to maintain the invisible loss

within 1%. mill should also ensure the moisture content in the processing and storing areas. by maintaining the proper Relative humidity in the mill.

1.4.2.12 PROCESS AND PACKAGING WASTE

In the spinning mill, waste like cotton, sliver, roving, yarn waste. various other processing and packaging waste are also happening, they are cotton bale covers, packing straps, cones etc. manage this type of waste in the spinning mills, it also provides the safe and good working condition.



Fig 1.4 CONE AND PACKING WASTE

1.5 NEED FOR THE STUDY

Waste control and management will help us to improve the overall performance in the manufacturing sector. Further this study will help us to understand the nature and needs of the industry and the type of work carried out in recording the various aspects of the waste control and management within the organization. Hence it is undertaken to study the various performance of the operation and analyze the various types of waste generated during the manufacturing process. implementation of the Lean thinking and manufacturing process which help the organization to reduce the different type of waste and take into continuous improvement. The information gathered would help the organization to enrich their performance.

1.6 SCOPE OF THE STUDY

The scope of the project is mainly concentrated on the study of different techniques and tools used for waste control and management. Every organization needs to control and manage their waste in an efficient way, it actually leads the organization into the continuous development path. waste management which helps to reduce the manufacturing cost.

This study is confined to the waste control and management of the ANNA COOPERATIVE SPINNING MILLS LTD.

- This study aims at analyzing with help of various lean tools to control the various forms of waste which happen in the company , the various lean tools are
 - 5S Tool
 - Overall equipment effectiveness (OEE)
 - Root cause analysis
 - Kaizen (continuous improvement)
 - Lean Layout
 - Muda

1.7 OBJECTIVES OF THE STUDY

1.7.1 PRIMARY OBJECTIVE

- The major objective is to study waste control and management in the spinning industry through lean tools analysis.

1.7.2 SECONDARY OBJECTIVES

- To study the manufacturing process to know the various types of waste in the process.
- To understand and measure Overall equipment efficiency (OEE) of the spinning machine.
- To analyze the waste control and management by using lean tools like 5s, Root cause analysis, Lean Layout, Muda.

- To manage the waste in the proper way to improve the employee's safety and working condition by using the Kaizen (continuous improvement).
- To evaluate the waste control and management of Anna cooperative spinning mills ltd, and offer suitable suggestions for the improvement of waste control and management.

1.8 LIMITATIONS OF STUDY

- Lack of availability of data and information, because most of the information and data has been kept confidential
- The study has been limited i.e. (Dec 2019- Jan 2020).
- Opinions of the manager of the organization were taken into consideration.
- Every study will be bound with certain limitations

CHAPTER- 2

2. REVIEW OF LITERATURE

- **Marko Milosevic Etal (2013)** This paper explains the methods and techniques of lean concept which is uses to increase the efficiency of all processes in the company. Also show the result of the level of implementation of this method in international and domestic production companies. It can conclude the large companies pay much attention to lean concepts, they attain the productivity and satisfaction of their employees.
- **George L. Hodge et al(2011)** conducted a research to identify lean tool for textile industries to eliminate waste and non-value added activities in US to enhance the customer satisfaction, Author identified the following barriers for implementing lean manufacturing they are resistance to change both shop floor employees and management; shop floor employees are reluctant to offer suggestions for improvements; disconnect among marketing, sales, product and development; shop floor personnel are not native English speakers; so training needs to be multilingual.
- **Neha Verma et al(2015)** conducted a study to identify waste related problems like cause of equipment failure, bottleneck problems and rectify them in lean manufacturing implementation in small scale industries. Process was analyzed in concern with rejection control, inventory control,waiting time, set time and eliminating non value added time / activities. In this study no new machines were purchased nor were operators expected to work faster or harder; only procedures and layouts were changed to allow the product to flow more smoothly through the manufacturing process.
- **Dave et al(2015)** study deals with Lean Construction along with information and communication systems. Study reveals that by adopting techniques such as process modelling, lean principles and process

analysis techniques, the manufacturing industry maintains a well performing process.- process standardization across the industry will be highly effective and efficient.

- **Mohammad Said Obeidat et al (2014)** research identifies five types of waste that are identified and analyzed in the sewing line with the aid of VSM: defects, inventory, overproduction, transportation, and waiting time. Applied lean manufacturing techniques include line balancing, layout redesign, and quality at the source. Impacts of implemented lean techniques on production are analyzed, and an improved future-state value stream map is developed. Results show approximately 96% reduction in production wastes in addition to 43% reduction in lead time. Here process measures must be defined and the cost of processing must be quantified. Line productivity is based on the number of line workers and product cycle time. To increase workers' productivity, calculates Line target, workstation target and work efficiency will be done separately. using this cost per hour calculates. Line balancing concept is tested for each line, redesign of the layout will be done. LP without high investment in machining, technology, or human training.
- **Roba Salem et al, (2015)** studied the level of recognition of lean concepts, principles, tools, and techniques in different industrial sectors in Qatar, to assess lean awareness and to know the perception about lean benefits and lean challenges. Data were collected from 333 organizations from various sectors like oil and gas, academic institutions and service sectors through an on-line survey. Results showed that industries in Qatar need to give more credit to lean thinking in order to strategically advance current efficiencies as well as cope with competition at global level. Research also reveals that there are differences on the levels of awareness, recognition and appreciation of lean concepts in different industrial sectors.
- **Pratik Chikhalikar (2015)** study focused on the implementation of the lean in the engine manufacturing unit in India. Research identified the

important lean tools and time horizon to implement the same. Study revealed that following factors effects on lean implementation they are 7 Types of waste, Lack of information transmission, Improper inventory management, Bottleneck operation, Material flow and transportation problem, JIT, Kanban, Kaizen, TPM, 6 sigma, 5S, Single Minute Exchange of Die

- **Rakesh kumar and vikas kumar (2015)** conducted a study to establish the significance of Lean Manufacturing elements related to Indian manufacturing industry, study also list the benefits gained-, major obstacles faced- and identifies the adverse impact such as over cost cutting, exceptionally low inventories, over dependence of Lean guideline, physical and mental health, society, product quality.
- **Azharul Karim et al(2013)** conducted research to develop an effective methodology for implementing lean manufacturing strategies and leanness, following are the methodology adopted for the present study they are Production and process details, Lean team study, Performance variables. VSM and MTM together and offered a new approach to reduce lead time and to measure productivity based on Lean principle and standardized processes
- **Youssef Larteb et al (2015)** study identified that success parameters of lean implementation are top management engagement, commitment, allocation of time and resources for improvement projects, strong management's leadership, and employee's development program. Study used structured questionnaires" it includes seven parameters of lean implementation they are, personalized demarche, top management commitment, allocation of resources, strong communication, structural methodology, multifunctional teams, and continuous performance measurement.
- **Ramune Ciarniene et al 2014** research reveals the challenges and barriers to be faced and overcome while implementing lean concept. Lean

enterprise or simply "Lean", is a practice, which regards the use of resources for any work other than the creation of value for the end customer, as waste, and thus a target for elimination. Research depicts the following three types of barriers they are the people issue, The process issue, The sustainability issue. Study suggested that first use the tools and techniques instead of sufficient consideration to personally related issues. Trust issue, human motivation and commitment are the real constraints. Secondly clearly understood by top management maintained properly, thirdly, LI have to be incorporated into the company's strategy. Concluded remarks- specific value to the customer, VSM waste elimination, CI, continuous flow and pull driven system

- **Naga Vamsi Kishna Jasti et al 2014** research identifies the existing lean product development frame work that is useful in implement LMS. Researcher done validity and reliability analysis using questionnaire survey. Respondents are from Top and middle level management determined through Cronbach's alpha value. The LPD framework can be categorized under two broad areas, namely: 1. researcher/academic-based; 2. consultants/experts-based. The study has identified 40 elements from eight frameworks, which reflects these are playing an important role in the implementation of LPD frameworks.
- **Gulshan Chauhan et al(2012)** research depicts about, Elimination of waste, JIT, and CI. Driving parameters towards LM are vertical information system, integration of functions, decentralization, multifunctional teams, Pull, JIT deliveries, zero defects, CI and Elimination of waste. JIT is top priority, then CI. He follows SPSS correlation method to find the importance of implementation.
- **Rahul Sindhwani et al(2015)** study reveals that, LI will improve the manufacturer and consumer relation by meeting the latest demand of consumers. Typical seven parameters like Overproduction, Processing Waste/over processing, transportation, Waiting/delays, Inventory waste,

Motion waste, defects are used. Follows tools and technique for eliminating wastes were- Pull system/KANBAN, VSM,5s, By applying the lean and agile principles of one piece flow, pull system and value streaming the production rate of the lower frame was increased. The pull system utilized to understand that there is need to increase the production rate. VSM was done to identify the constraints and one piece flow to achieve the required cycle time.

- **Nirav Patel et al (2015)** LM can be considered as a business strategy and it has been proved to be an effective management philosophy for improving business by eliminating non value added waste and improving in process operations.VSM can be an extremely powerful tool, combining material processing steps with information flow as well as other important related data. Parameters used were Cost Rate, Material Cost, Duration (min), and Predecessors, its inter relationship between them with the money and time. Application of tools were Process activity mapping, Demand amplification mapping, quality filter, production variety funnel, value adding time profile and related parameters. VSM works in any of the sector such as hospitability, manufacturing, service industry, automobile, machining and casting, transportation etc.
- **Nordin Norani et al(2010)** research identified the, main reason for failure of implementation of Lean manufacturing is due to the letdown in managing the change process during a lean manufacturing transformation, organizational change management. Serve as the basis for further empirical research and validation. Provide practitioners with a better understanding of lean transition and unambiguous guidance, and/or tools to minimize the resistance and conflicts of implementing a lean manufacturing system. In the present research 11 critical factors were studied, and proposed framework of organizational change is intended to provide practitioners with a better understanding of the lean transition and a clear guidance to minimize the resistance and conflicts for the implementation of lean and thus improves its chance of success.

- **Sudipta Chowdhury (2015)** conducted a study to improve the productivity of the furniture manufacturing industry in India. Various lean strategies such as Single-Minute Exchange of Dies (SMED), Gemba (The real place) and Short Interval Control were implemented. Result revealed that significant improvement in both monetary terms and also in reduction of processing time of different lots. Study also reveals that Overall Equipment effectiveness increased in a higher multifactor productivity of 2.26. It was realized through this study that lean strategies can successfully be implemented in furniture manufacturing industry.
- **Chaple (2014)** investigate the enablers and barriers in implementing the Lean principles and lean diffusion in Indian manufacturing industries. Result shows that the trend in lean manufacturing for research now is focused on lean assessment. Leanness attracts focus to answer specific questions of different levels of managers responsible for lean implementation to assess the lean implementation level and to justify spending over lean implementation. He worked on multiple criterion decision-making (MCDM) for lean assessment to assess lean performance holistically & popularity of lean in India; but when it comes to success, its only start of journey. Other than automobile and electronics industry, others are having medium to low diffusion of lean in India.

CHAPTER - 3

3. RESEARCH METHODOLOGY

It is a scientific and systematic way to solve the research problem. It is understood as a science of studying how research is done scientifically. It is necessary for the researcher to know not only the research methods and techniques but also methodology. Research design is the conceptual structure within which research is conducted. The study aims to control and manage the waste in an effective way within the company. The researcher has to use information or facts already available and analyze that data and information to make critical evaluations of the waste management. The data collection is based on both primary and secondary data for analysis are taken from the company record books and reports. Tools and techniques are used for analysis. Lean tools like 5S, Overall equipment efficiency (OEE), Kaizen, Root cause analysis, Lean layout, Muda.

3.1 RESEARCH DESIGN

The research design used in this project is both analytical and descriptive research. In the Analytical research, researcher has to use the various facts and information already available and analyze these to make a critical evaluation of the efficiency and performance of the process. to measure and understand about waste control and management.

In the descriptive research design to describe the phenomenon as it exists in the organization in order to understand and describe the characteristics of the various variables and factors of the situation. it will take the description of the waste control and management techniques.

3.2 SAMPLING TECHNIQUES

1. Overall equipment effectiveness (OEE)
2. 5s audit analysis
3. Root cause analysis
4. Kaizen (continuous improvement)
5. Lean layout
6. Muda

3.2.1 OVERALL EQUIPMENT EFFECTIVENESS(OEE)

Overall equipment effectiveness is a measure of how well a manufacturing operation is utilized compared to its full potential, during the period when it is scheduled to run. it identifies the percentage of manufacturing that is truly productivity. it can be used to compare the performance of a given production of a given production asset to industry standard. As a baseline it can be used to track progress overtime in eliminating waste from a given production asset. Overall equipment effectiveness can be calculated by multiply the following three factors

- **Availability**

Availability takes into account Availability loss, which includes all events that stop planned for an appreciable length of time. Availability loss includes unplanned stops (such as equipment failures and material shortages) and planned stops (such as changeover time).

- **Performance**

Performance takes into account performance loss, which includes all factors that cause the production asset to operate at less than the maximum possible speed when running.

- **Quality**

Quality takes into account Quality loss, which factors out manufactured pieces that do not meet quality standards.

Formula for calculating Overall equipment efficiency

$$OEE = \text{Availability} \times \text{Performance} \times \text{Quality}$$

$$\text{Equipment availability} = \frac{\text{Operation time}}{\text{PLanned production time}}$$

$$\text{Performance efficiency} = \frac{\text{Actual production rate}}{\text{Standard production rate}}$$

$$\text{Quality} = \frac{\text{Good units}}{\text{Total units}}$$

3.2.2 5S METHODOLOGY

The 5s lean method is actually much more than a cleaning techniques. It help to eliminate waste that results from a poorly organized working area within the organization.



Fig 3.1 5S METHODOLOGY

- **SEIRI: SORT**
 - High use equipment used hour by hour, day by day. keep within arm's reach of point of use.
 - Medium use Equipment used once a month. keep within the work area.
 - low use Equipment used once year store in a distant location.
 - Unneeded Equipment throw it away.
- **SEITON: SET IN ORDER**
 - organize the tools and equipment in order.
 - Place for everything and everything in place.
 - Easy to get part in a short time.

- **SEISO: SHINE**
 - Cleaning is a workspace inspection process. cleaning is done with the purpose to identify and eliminate the sources of contamination. waste clean and inspect the work area.
- **SEIKETSU: STANDARDIZE**
 - Put a system in place to readily identify abnormal conditions.
 - Standardize and identify the methods to consistently apply.
 - Everything in its place by Visual maps and standards clear procedure in the work station.
 - Using standard color coding .
- **SHITSUKE: SUSTAIN**
 - Regularly update and implement the standards for all the processes.
 - Re-audit and continuously improve the system.

3.2.3 KAIZEN

Kaizen is probably the most known lean method. Kaizen is the combination of kai and zen that means "change" and "good". This is simply what we have translated as " Continuous improvement". It is principle or philosophy that is at the heart of learning.

- A strategy where employees work together proactively to achieve regular, incremental improvement in the manufacturing process.
- Combines the collective talents of a company to create an engine for continually eliminating waste from the manufacturing process.

The continuous improvement is adapted by implementing the Plan-Do-Check-act . It is a scientific method used to manage change, and is also known as the Deming Cycle. It was developed by Dr. W Edwards Deming. The PDCA cycle involves four parts

1. Plan - Establish plan and expected results
2. Do - Implementing plan

3. Check - verify expected results achieved
4. Act - Review and assess, do it again

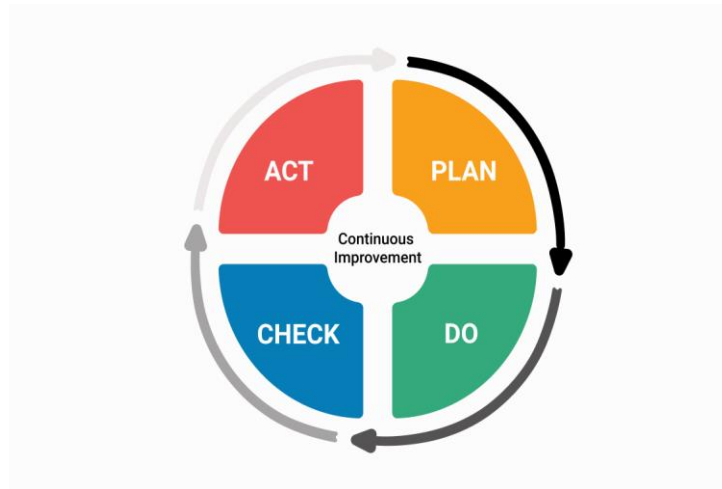


Fig 3.2 PLAN- DO - CHECK - ACT (PDCA TOOL)

3.2.4 ROOT CAUSE ANALYSIS

A problem solving methodology that focuses on resolving the underlying problem instead of applying quick fixes that only treat immediate symptoms of the problem. A common approach is to ask why five times each time moving a step closer to discovering the true underlying problem.

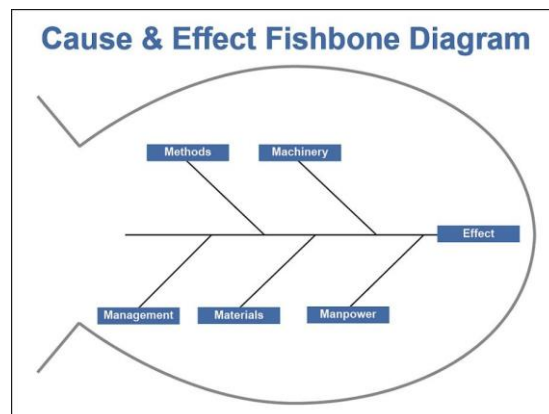


Fig 3.3 ROOT CAUSE ANALYSIS

- To allow a team to identify, explore and graphically display, in increasing detail, all of the possible cause related to a problem or condition to discover its root causes

- Enables a team to focus on the content of the problem, create a snapshot of the collective knowledge and consensus of a team around a problem.
- Focuses the team on causes, not symptoms.

3.2.5 LEAN LAYOUT

Lean manufacturing is all about adding value and avoiding waste. Facility planning (land, buildings, equipment, furnishings) provide the physical capability to add value. Facilities are expensive. This is why facility design and strategic thinking should be implemented in an efficient way. The lean facility layout is an integral part of a Lean manufacturing strategy, its help to improve the process flow, material flow.

- Product Focused cells
- Focused Plant-within-Plant Factories
- Reduced Storage & Handling space
- Kanban stock points
- Direct delivery of raw materials
- Integrated support Areas

The competitive advantage of properly designed plant layout are

- Operate at low cost
- Provide fast delivery
- reduce the unwanted material and product movement.
- Produce many varied products.

3.2.6 MUDA

The elimination of waste is the primary focus of lean manufacturing. anything in the manufacturing process that does not add value for both company, customer. The muda which means Wastefulness, uselessness and futility, which is contradicting value addition in the process.

7 Wastes (Muda)

- Defects
- Over - Production.

- Over - Processing
- Motion
- Transportation
- Waiting
- Inventories

3.3 SOURCES OF DATA COLLECTION

- Primary data - This refers to raw facts collected or generated for the given research and it is gathered originally for the first time for the specific research problem.
- Secondary data - Secondary data is the data, which has been collected by someone else for some other purpose and is used by the researcher in his research for study. various sources of secondary data are Books, Journals, Internet, company records.
- In this project, both primary and secondary collected is collected from the following sources.
- Primary data is collected from the various departments within the company.
- Secondary data is collected from the production reports which are maintained by the company. Data are collected from the websites, books, journals pertaining to this topic.

CHAPTER - 4

4. DATA ANALYSIS AND INTERPRETATION

After the data is collected from the various aspects of this study. This data is analyzed in both analytical and descriptive ways. For the representation of the data use of various charts is made. After data analysis is done, the obtained information is interpreted and various inferences are made and conclusions are drawn related to the objective, Which have been listed in the beginning of the project.

Tools used in the analysis

1. Overall equipment efficiency
2. 5s analysis
3. Root cause analysis
4. Kaizen
5. Lean Layout
6. Muda

4.1 OVERALL EQUIPMENT EFFICIENCY

Overall equipment effectiveness is a metric that measures the availability, performance efficiency and quality rate of your equipment. It is especially important to calculate OEE for your constraint operation. it is a measure of how well a manufacturing operation is utilized compared to its full potential, during the period when it is scheduled to run.

$$\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality}$$

$$\text{Equipment availability} = \frac{\text{Operation time}}{\text{PLanned production time}}$$

$$\text{Performance efficiency} = \frac{\text{Actual production rate}}{\text{Standard production rate}}$$

$$\text{Quality} = \frac{\text{Good units}}{\text{Total units}}$$

Table 4.1 SPINNING PRODUCTION DATA

S no	Date	production in kg/per day	total spindle worked out of 72576 spindle	production in per spindle in gram	spindle production point%	waste %	waste in kg	on date machinery utilization %	Up to date machinery utilization %
1	18/12/20	6755	59772	105.3	82.3	3.1	216.1	82.3	85
2	19/12/20	6462	61493	105.1	84.71	2.9	192.99	84.71	84.9
3	20/12/20	6496	61849	105.6	85.2	2.9	194.01	85.2	85
4	21/12/20	5821	55505	105	76.5	3.1	186.22	76.5	84.6
5	22/12/20	6277	59663	105.6	82.2	3.1	200.81	82.2	84.5
6	23/12/20	6691	63324	105.6	87.2	2.9	199.83	87.2	84.6
7	24/12/20	6276	59663	105.6	87.3	3	194.1	87.3	84.4
8	25/12/20	3909	37044	105.5	51	2.9	116.74	51	83.2
9	26/12/20	6413	60778	105.59	83.9	2.9	191.53	83.9	83.2
10	27/12/20	6593	62452	105.59	86	2.7	182.95	86	83.2
11	28/12/20	6428	60924	105.59	83.9	3.1	205.64	83.9	83.3
12	29/12/20	6456	61306	105.3	84.4	3.2	213.42	84.4	83.3
13	30/12/20	6533	61891	105.2	85.2	2.9	195.11	85.2	83.4
14	31/12/20	6109	58052	105.2	80	3.2	201.49	80	83.3
15	1/1/2021	5884	55929	105.3	77.1	3.2	194.51	77.1	77.1
16	2/1/2021	6515	61813	105.5	85.1	3	201.49	85.1	81.1
17	3/1/2021	6614	62655	105.5	86.3	3	204.55	86.3	82.8
18	4/1/2021	6562	62194	105.5	85.7	3	202.94	85.7	83.5
19	5/1/2021	6325	60002	105.4	82.6	3.2	209.09	82.6	83.4
20	6/1/2021	6277	59663	105.6	82.2	3.1	200.81	82.2	83.3

OEE is calculated using the following formula

OEE = Equipment availability × Performance efficiency × Quality

The calculation for determining equipment availability is as follows

$$\text{Equipment availability} = \frac{\text{Operation time}}{\text{PLanned production time}}$$

Table 4.2 EQUIPMENT AVAILABILITY CALCULATION

Equipment Availability	
Machine : Spinning machine	Time duration : 20 days
Planned production time	28800 minutes
Down time	720 minutes
Operation time	28080 minutes

$$\text{Equipment availability} = \frac{28080 \text{ minutes}}{28800 \text{ minutes}}$$

The equipment availability of the spinning machine= 0.975 or 97.5 %

The calculation for determining performance is as follows

$$\text{Performance efficiency} = \frac{\text{Actual production rate}}{\text{Standard production rate}}$$

The average production of yarn per day is 6269.8 kg, total no of spindles in 24 spinning machines is 24192. For the 3 shifts 72576 spindles. Average production per spindle in gram is 105.4 grams. By calculating the average production rate per spindle and total spindle, the average spindle worked out of 72576 spindle is 59298.6 spindle.

$$\text{Performance efficiency} = \frac{59298.6 \text{ spindle}}{72576 \text{ spindle}}$$

The performance efficiency of the spinning machine = 0.81 or 81.7%

The calculation for determining quality is as follows

$$\text{Quality} = \frac{\text{Good units}}{\text{Total units}}$$

The average production of yarn per day is 6269.8 kg and also with 3.02 % of waste in this spinning process.

$$Quality = \frac{6269.8 \text{ kg}}{6465.22 \text{ kg}}$$

The quality percentage of the spinning machine = 0.96 or 96.97%

$$OEE = 97.5\% \times 81.7\% \times 96.7\%$$

Overall Equipment efficiency of the spinning machine = 77.02 %

Table 4.3 OVERALL EQUIPMENT EFFICIENCY

OVERALL EQUIPMENT EFFICIENCY (OEE)	
Equipment availability	97.5%
Performance efficiency	81.7%
Quality	96.7%
OEE	77.02%

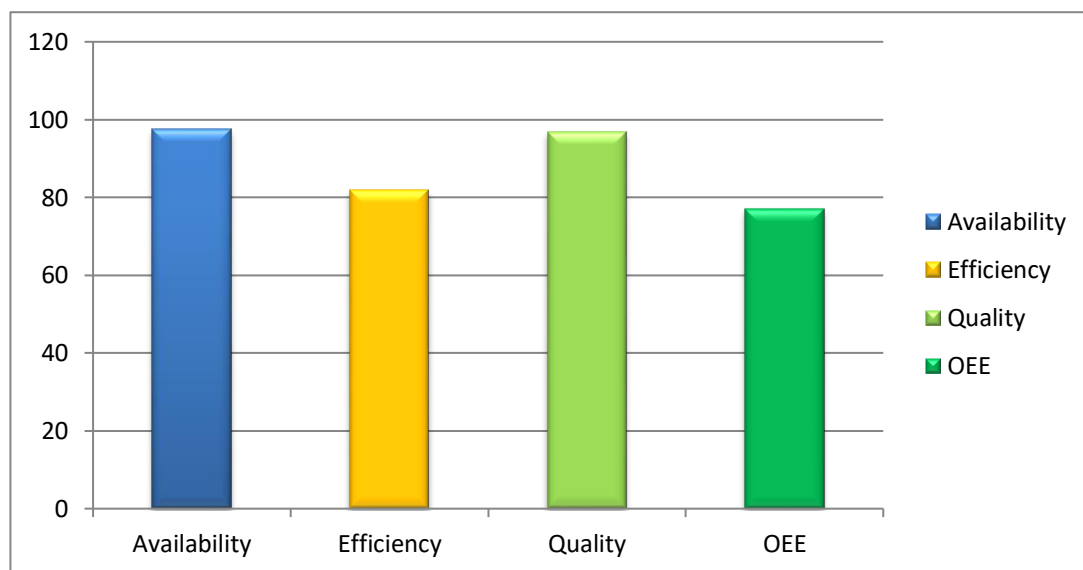


Chart 4.1 OVERALL PRODUCTION EFFICIENCY RESULT

INTERPRETATION

The above table represents the Overall equipment efficiency of the spinning machine. which is calculated by using the three factors like equipment availability, Performance efficiency , Quality of the spinning machines .

The above calculation shows the OEE of the spinning machine is 77.02%. The company needs to address the factors which affects the Performance efficiency of the machines, which actually reduce the Overall equipment efficiency.

4.2 5S METHODOLOGY

The 5s lean method is actually much more than a cleaning technique. It helps to eliminate waste that results from a poorly organized working area within the organization.

Table 4.4 5S PERFORMANCE INDICATOR

S no	5s SCORE	INDICATION
1	1 - 20	Very Poor
2	20 - 40	Poor
3	40 - 60	Fair
4	60 - 80	Good
5	80 - 100	Excellent

Table 4.5 GUIDELINES FOR 5S SCORE

SCORING GUIDELINES	
6 - Deviation	
5-6 Deviation	
3-4 Deviation	
1-2 Deviation	
No Deviation	

Table 4.6 5S AUDIT CHECKLIST

5S AUDIT CHECKLIST									
		Scores	0	1	2	3	4		
SORT 1S (SEIRI)	Distinguish between what is needed and not needed								
	1	Have all unneeded equipment, tools, items been removed?		X					
	2	Are all remaining items neatly arranged ?				X			
	3	If any unneeded inventory, supplier parts, materials are stored?			X				
	4	Are walkways and work areas clearly outlined?					X		
	5	Does a procedure exist for dispensing unneeded items?			X				
	Subtotal>>		0	1	4	3	4		
	Subtotal for Sort>>								12
SET IN ORDER 2S (SEITON)	A place for everything and everything in its place								
	1	Is there a visually marked, specified place for everything?				X			
	2	Is everything in its specified place?			X				
	3	Are standards and limits easily recognizable?				X			
	4	Is it easy to see what needs to be where?					X		
	5	Are things put away after use?				X			
	Subtotal>>		0	0	2	9	4		
	Subtotal for set in order>>								15
SHINE3S (SEISO)	Cleaning and looking for ways to keep it clean								
	1	Are work areas clean?			X				
	2	Is equipment kept clean?				X			
	3	Are cleaning materials easily accessible?				X			
	4	Are cleaning guidelines and schedules easily visible?			X				
	5	Is cleaning used as a form of inspection?				X			
	Subtotal>>		0	0	4	9	0		
Subtotal for Shine>>								13	

STANDARDIZE (SEIKETSU)	Make standards obvious and maintained					
	1	Is all necessary information visible?				X
	2	Are all standards known and visible?				X
	3	Is there a checklist for all cleaning and maintaining jobs?			X	
	4	Are the future standards being considered with a clear improvement plan for the area?				X
	5	Are the first 3Ss (sort, shine, set in order) being maintained?				X
	Subtotal>>		0	0	2	6
	Subtotal for Standardize>>					16
SUSTAIN 5S (SHUKAN)	Stick to the rules and follow up					
	1	Is everyone adequately trained in standard procedure?				X
	2	Are tools and parts being stored correctly?				X
	3	Are procedures up-to-date and regularly reviewed?			X	
	4	Are stock controls being adhered to?				X
	5	Are activity boards up-to-date and regularly reviewed?				X
	Subtotal>>		0	0	2	9
	Subtotal for Sustain>>					15
	Total>>		0	1	15	35
	Grand total 5s score>>					71

Table 4.7 5S AUDIT RESULT

5S AUDIT	
SORT	12
SET IN ORDER	15
SHINE	13
STANDERTIZE	16
SUSTAIN	15
TOTAL	71

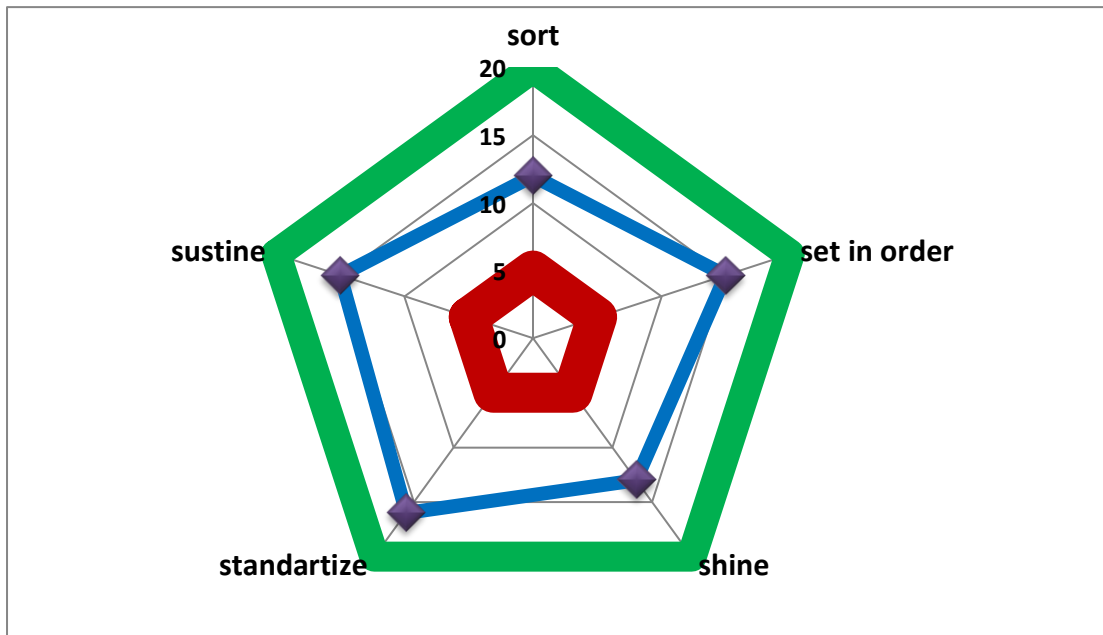


Chart 4.2 5S AUDIT RESULT

- **Sort** - some old machineries and repaired equipment are stored in the work space. waste materials like used cones, packing covers, green straps are stored
- **Set in Order** - All the Machineries and equipment are neatly arranged, walkways and work areas clearly outlined. Everything in its specified place.
- **Shine** - All the work area and equipment are kept clean, but waste cotton are near to the electric line cables. it may cause an accident.
- **Standard** - All the standards are known and visible, but checklists for cleaning and maintenance are not placed in the workplace.
- **Sustain** - All the stock controls , inventory management, and all the activities are regularly reviewed. but lack of safety measure training for employees

INTERPRETATION

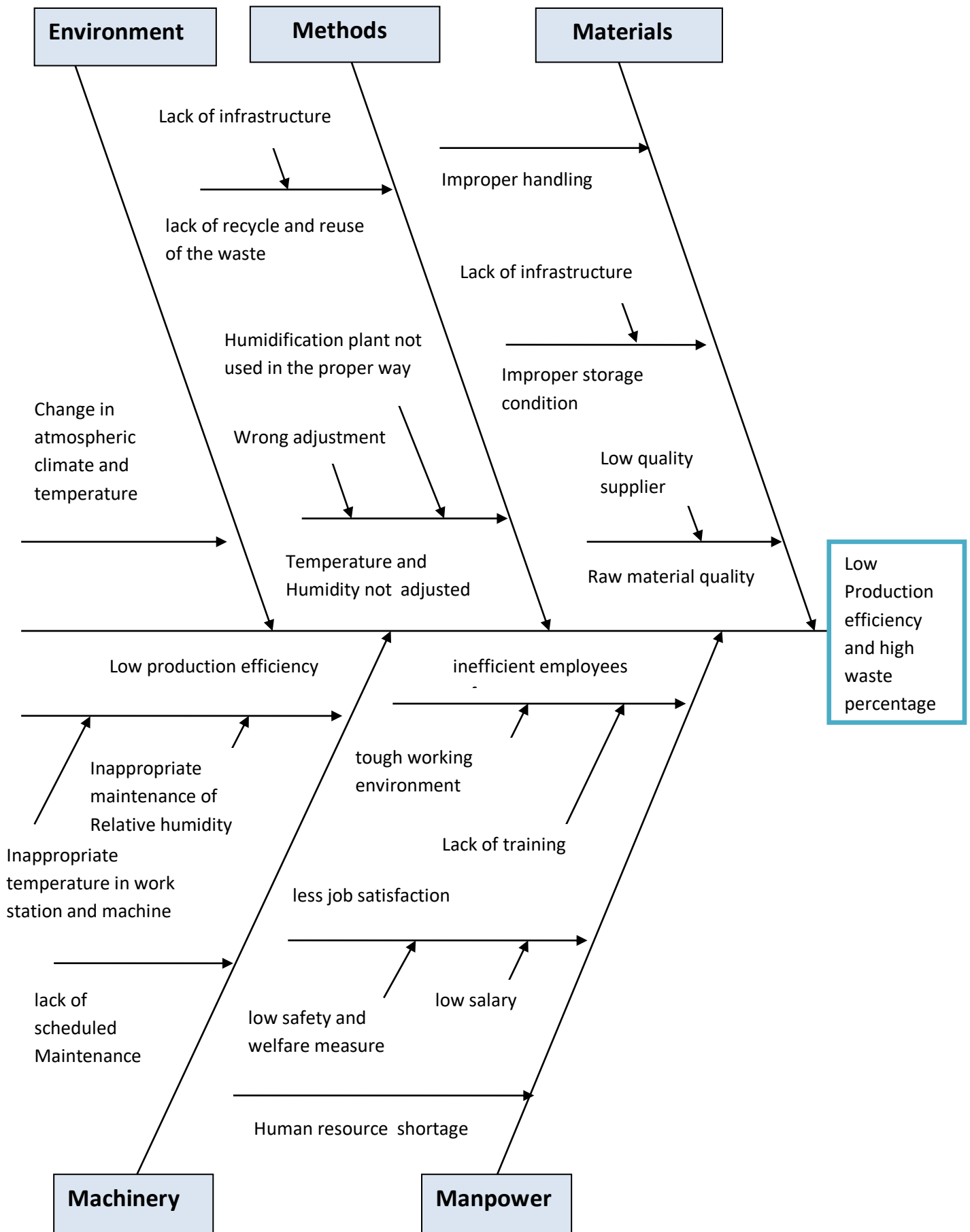
The above table represents the 5S audit checklist of the overall manufacturing unit. which helps to audit the 5s Sort, Shine, Set in order, Standardize in the organization .Through this organization is able to identify the area which they have to improve.

The above checklist shows that organization overall total for 5s is 71. They need to concentrate more on the Sort and shine in the organization to improve the efficiency .

4.3 ROOT CAUSE ANALYSIS

A problem solving methodology that focuses on resolving the underlying problem instead of applying quick fixes that only treat immediate symptoms of the problem. A common approach is to ask why five times each time moving a step closer to discovering the true underlying problem.

- **Materials** - High percentage of impurities in the raw cotton, which leads to high percentage of waste in the production process. Low quality of the raw materials, improper storage condition and improper handling of the raw material are the factors which cause low production and high waste percentage.
- **Methods** - Cotton materials and production process should be maintained in the proper humidified workstation to produce the cotton from the loss of weight and reduce invisible loss, improper use of humidification plants which cause high wastage in the process. waste cotton is not reused in the proper way.
- **Environment** - Atmospheric conditions like temperature and climate, they plays an important role in the production efficiency .
- **Manpower** - Because of the tough working conditions, lack of training , low salary for contract workers , low safety and welfare measure these major reasons which cause the employees to be more inefficient.



- **Machinery** - Inappropriate maintenance of relative humidity, lack of scheduled maintenance, Inappropriate temperature in the workstation and machineries which affect the machinery to cause breakdowns, low quality of the products.

INTERPRETATION

The above Root cause analysis diagram shows the various factors which cause the high waste percentage and low production efficiency during the production process. by identifying the root cause in five important categories like Materials, Methods, Environment, Machinery, Manpower. which help us to rectify and improve the process.

4.4 KAIZEN

A strategy where both management and employees work together proactively to achieve regular , continuous improvement in the manufacturing process, by continuously eliminating waste from the manufacturing process. The continuous improvement is adapted by using the Plan-Do-Check-Act method, it is also known as Deming cycle.

4.4.1 KAIZEN 1: occupancy of old machineries and repair parts

In the production unit, there are lots of old machineries and in the inventory there are a lot of old and repaired parts are stored.

PLAN : Analysis the condition repair parts and old machineries are stored in the inventory and work space. categories the old machineries and part according to the needs. Reuse the part if they are in good condition.

DO : Develop and implement a solution. The possible suggestion were given for the problem identified

Table 4.8 KAIZEN 1 SUGGESTION

S no	PROBLEM	IMPACT	IMPROVEMENT
1	Work space is occupied with old machineries	It reduces the material and workers movement.	Remove all unnecessary old machines from the work space.
2	Lots of old and repair parts are stored in the inventory	It reduce the storage space in inventory	Repair the part for the better usage or sort the parts from the inventory

CHECK : Once the implementation has been started, the performance of the solution is tracked over time. The problem is compared before and after implementation. check the inventory and work space , if the old machineries and repaired part clear from the particular place.

ACT : If the solution gives good improvement, the suggestions are implemented or else PDCA cycle is carried out from beginning with different solutions. By organizing the old machines and parts in the separate area. With the given suggestion , old machines and repaired parts are removed and organized in the proper way . It helps to organize the work space in an effective way.

4.4.2 KAIZEN 2 : Employees are not provided with safety gadgets

In the spinning mills, employees are highly affected by the micro dust while managing the raw materials and clean Automatic waste evacuation system. spinning machine operators are affected by the high sound from the machine. but employees are not provided with safety masks and ear buds.

PLAN: Understand the importance of the safety gadgets like face mask, ear buds while handling the waste material. provide the safety gadgets to the needed employees

DO : Develop and implement a solution. The possible suggestions were given for the problem identified.

Table 4.9 KAIZEN 2 SUGGESTION

S no	PROBLEM	IMPACT	IMPROVEMENT
1	Safety gadgets like face masks are not provided to the employees who manage the waste and clean the Automatic waste evacuation system.	Micro dust from the cotton waste which causes high level lungs and breathing problems to the employees.	Providing them with good quality face masks and safety measures to reduce the health problems.
2	Safety gadgets like ear buds are not provided to the operators in the spinning department	High frequency sound from the spinning machine, which affects the hearing sensitivity of the operators.	Providing them with suitable ear buds to the operator. implement the strict rules to wear all safety gadgets during the work time.

CHECK: Once the implementation is started, continuously monitor the employees whether they are wearing the safety gadgets during the waste handling and production process. check the quality and efficiency of the safety gadgets.

ACT : If the provided safety gadgets and measures are good enough for employers safety, the implantation is good or else we have to improve the safety measures. with the given suggestion employees are safe from the micro duct while handling the waste.

4.4.3 KAIZEN 3 : Cotton waste material are not recycled and not stored in proper way

In the yarn manufacturing process, for the 20, 30, 40 count almost 15% is generated and for the combing process 25% - 30% waste is generated. From the waste only a small percentage of the waste is mixed with the raw cotton material in the bale

breaking process. remaining waste is not reused or recycled. Various other waste like cones, packing straps, packing covers are not stored in the proper way.

PLAN: Calculate the waste% from all different departments. segregate the waste in the proper way. increase the reusability of the waste in the production process. implement the recycling process into the production process. allocate the proper place for the storage of the waste materials

DO: Develop and implement a solution, the possible suggestion were given for the problem identified

Table 4.10 KAIZEN 3 SUGGESTION

S no	PROBLEM	IMPACT	IMPROVEMENT
1	Cotton waste materials are not recycled in the efficient way	It highly impacts the efficiency of the production process. increase the manufacturing cost	Categories the waste in a proper way. implement the open end spinning machine to recycle the waste into low end yarn count products.
2	Various other waste like cones, straps, packing covers are not stored in proper place	Waste occupies the most space. it affects the cleanness of the production units.	Segregate the waste in the proper way. stored the waste in the proper place and disposed of it in regular time interval.

CHECK: Once the implementation is started, check the utilization and efficiency of the open end spinning machine and monitor the production level of the yarn from the OE spinning machine. regularly check whether the waste are segregated and stored in the proper way .Finally dispose of them in the regular interval time period.

ACT : If the solutions are good improvement, the suggestions are implemented, or else we have carried out the different PDCA cycle to improve the process. With the given suggestion, the cotton waste is segregated and recycled with the help of an Open end spinning machine to produce low count yarn counts. and various other waste are stored and disposed of in the proper way.

INTERPRETATION

The above table shows three kaizen improvement attempts were made in the production process of the spinning mills. through the PDCA cycle , suggested the solution for good improvement in the manage the work space efficiency, improve the safety measure for the employees , suggest the implement the open end spinning machine to recycle the waste cotton in to low count yarn product, and suggestion to organized the waste in effective way. This improvement helps to increase the efficiency of the production process.

4.5 LEAN LAYOUT

Lean manufacturing is all about adding value and avoiding waste. Facility planning (land, buildings, equipment, furnishings) provide the physical capability to add value. Facilities are expensive. This is why facility design and strategic thinking should be implemented in an efficient way. The lean facility layout is an integral part of a Lean manufacturing strategy, its help to improve the process flow, material flow. In Anna cooperative spinning mills ltd, it is the process or functional layout. Process layout is a design in which equipment is arranged according to the function.

Table 4.11 PROCESS FLOW COLOR CODE

S no	Color code	Process
1		Combed yarn
2		Carded yarn
3		Reeling yarn
4		Doubling yarn
5		Two for one twist yarn

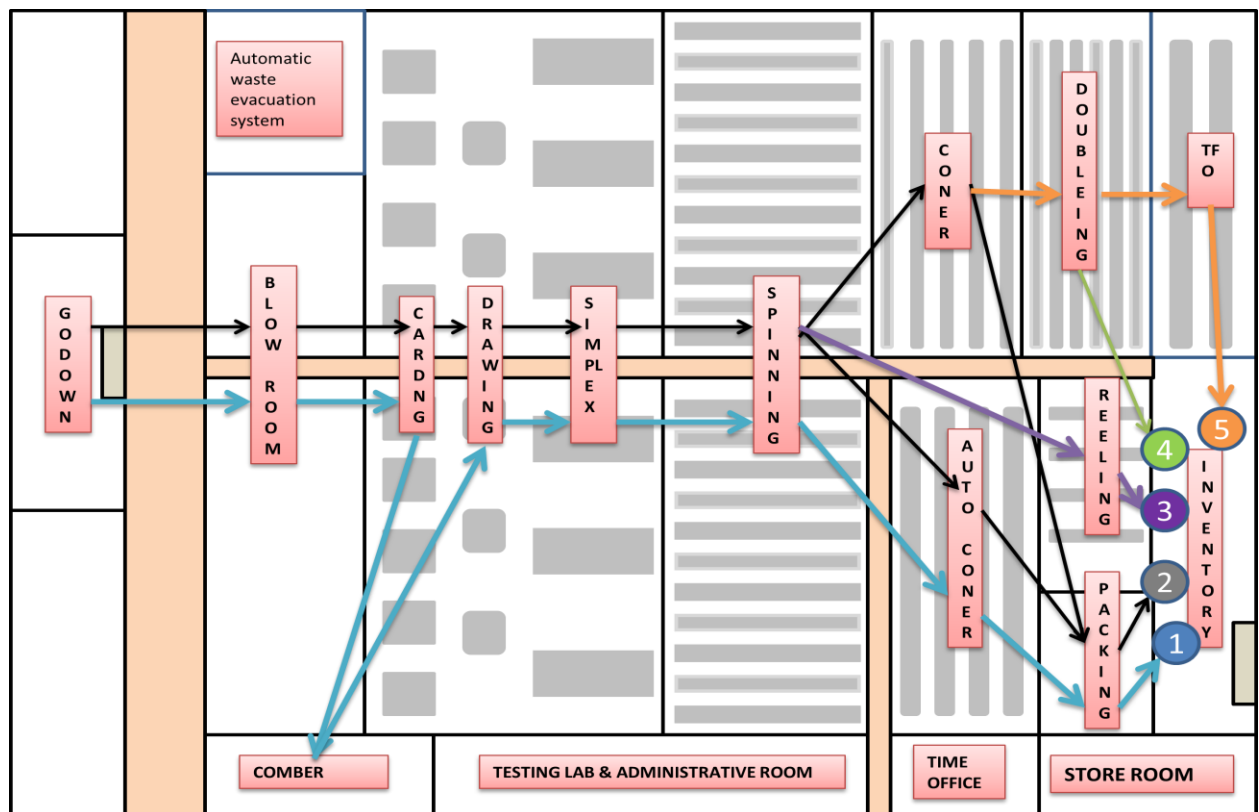


Chart 4.4 LAYOUT DESIGN AND PROCESS FLOW ANALYSIS

INTERPRETATION

The above Chart 4.4 layout design of the company shows layout design, machinery arrangement, product production process is designed and organized in an efficient way. To maintain the continuous and smooth flow in the production process. It is a process or functional layout, through which this company is able to produce different types of yarn products. Lean manufacturing facility layout analysis shows company layout structure and is organized efficiently.

4.6 MUDA

The elimination of waste is the primary focus of lean manufacturing. anything in the manufacturing process that does not add value for both company, customer.

- **Poka-Yoke** - It is the process of Error Proofing to achieve Zero defects in the production process. The various error proofing techniques used in the ACSPL are Metal detector, magnet path to remove the metal from the raw cotton, I-scanning process, Fire sensors throughout the plants to avoid fire accidents. These are various error proofing techniques used in the process to reduce waste and improve quality and efficiency of the production process.
- **Visual Factory** - In ACSML various visual indicators , displays and control panels used in the plant, Color light indication in the machineries like Red and Green , which indicate the production status and defects in the production process. Various color cans are used in the production process to differentiate the yarn counts .
 - 60 K - Green color can
 - 20's - Pink color can
 - 30's - Blue color can
 - 60c, 40's and remaining counts are identified by the physical marks in the can.
- **JIDOKA** - It means Automation. Design equipment to partially automate the manufacturing process and to automatically stop when defects are detected. in ACSML they implement various automated production and waste management systems .
 - Blow room with bale breaker, which automatically breaks the bale and cleans the cotton according to the further requirement in the carding machine.
 - Automatic waste evacuation system, which automatically collects the waste from the blow room line, carding machine, and separates the waste according to the quality and size.
 - **OHTC** - Over head traveler cleaner in simplex and spinning machine are used to collect the waste around the machine.
 - Automatic cone winding machine, which helps to improve the production efficiency by reducing the waste and high production ability.

In the above lean tool analysis (5s Methodology, Root cause analysis, kaizen , layout design and efficiency analysis, Overall equipment efficiency , poka-yoke,

Jidoka (Automation), Visual factory, company are able to control the different forms of waste like unwanted movement, waiting, in efficient inventory , overproduction, transport. To remove the defects (waste) from the spinning mills by implementing the lean management into the production process.

To reduce the waste percentage and electricity waste, which help the organization to reduce the overall manufacturing cost

Table 4. 12 WASTE PERCENTAGE ANALYSIS

Department	Salable waste %	Usable waste %
Blow room	3 - 4%	-
Carding	5 - 7 %	0.5 %
Drawing	0.5%	0.5 %
Simplex	0.5 %	0.5 %
Spinning	2 %	1 %
Cone winding	1 %	-
Auto cone winding	0.075%	-
Combing	18 - 20 %	-

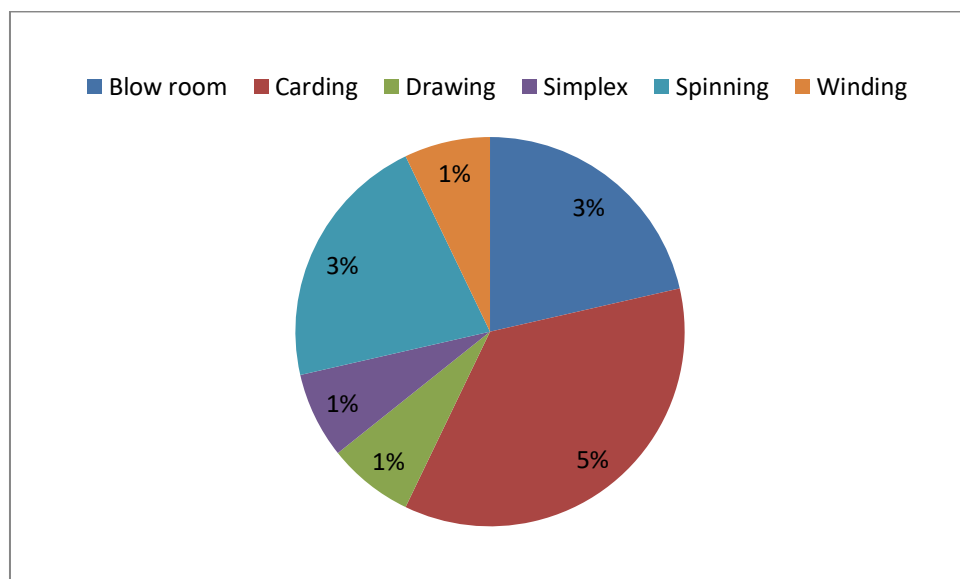


Chart 4.5 CARDED YARN WASTE PERCENTAGE

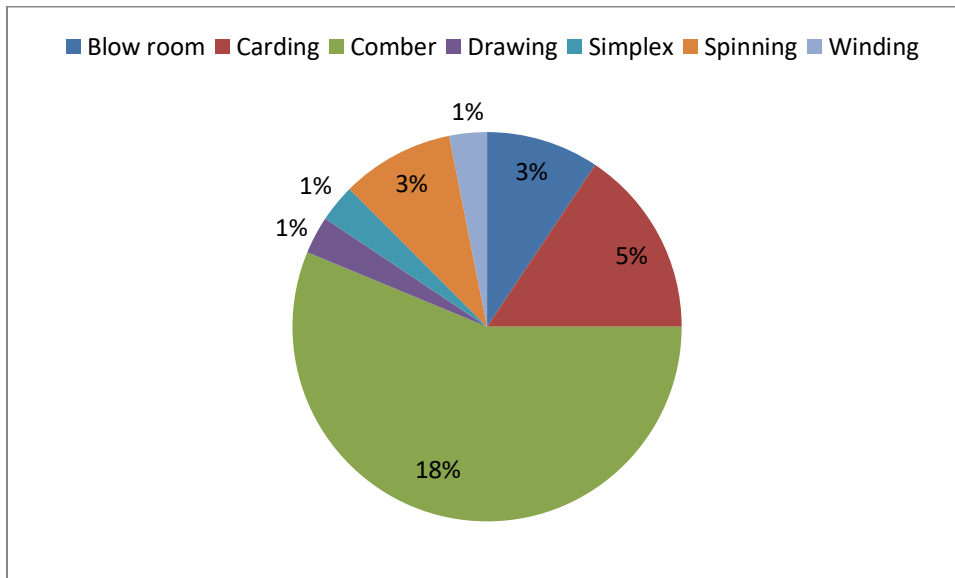


Chart 4.6 COMBED YARN WASTE PERCENTAGE

- Total waste % for carded yarn = 13.50 % - 15 %
- Total waste % for combed yarn = 28 % - 30 %

To reduce the waste percentage and improve the production efficiency of the spinning mills by

- By improving the cleaning efficiency of the blow room line to reduce waste, maintain the standard setting and beater speed according to the required yarn count.
- By improving the cleaning efficiency of the carding by 5 to 7 % to reduce the waste percentage , Higher flat with high cylinder speed can be used for better removal of seed coats and also reduce neps thick places.
- Analysis and segregate the different types of waste .Weight that waste and record that section wise person and shift wise. always compare with standards.
- Optimal utilization of humidification plant to maintain the suitable humidity in the production plant to improve product quality, maintaining product weight,

reducing machine downtime and improving employee comfort. Optimal Relative humidity for the spinning mills is 35 - 65 % RH. In this mills they maintain the RH is from 40 - 50 %, and temperature is from 35 - 40 degree Celsius

- Maintaining the product weight , upto 3.5 % increase in product yield. by reduce the invisible loss
 - Improve the yarn product quality, by reducing the breakage of the fiber.
 - .Reduce the static build-up, to reduce the machine jams and employee discomfort.
- By reducing the electricity waste in the spinning mills, which helps the management to save manufacturing cost. To reduce the electricity waste by
 - Cleaning has to be done in peak hour from (6.00 am to 9.pm) to save 20% of electricity cost
 - Frequently check the working condition of all the machines.
 - Avoid running of empty spindles in simplex and spinning machine
 - use an appropriate compressor line for cleaning purposes, not in the main compressor line.

INTERPRETATION

From the above Table 4.11 and other Lean tool analysis, In the ACSML waste percentage of the carded yarn is 13.50% - 15%, and waste percentage of combed yarn product is 28% - 30%. In the production process, they implement various Error proofing ,Visual indicators ,Automation in the system to reduce the various forms of Muda (waste) to improve production efficiency and reduce manufacturing cost.

CHAPTER - 5

5. FINDINGS,SUGGESTIONS & CONCLUSION

5.1 FINDINGS

Findings are based on data analysis & interpretation, research and tabulation.

- The Overall equipment efficiency of the spinning machine is calculated by using the three factors like equipment availability, Performance efficiency , Quality of the spinning machines . The OEE of the spinning machine is 77.02%.The company needs to address the factors which affect the Performance efficiency of the machines, which actually reduce the Overall equipment efficiency.
- the 5S audit checklist of the overall manufacturing unit. which helps to audit the 5s Sort, Shine, Set in order, Standardize in an organization.
Through this audit, organizations are able to identify the area which they have to improve. The overall total score for 5s is 71. they need to concentrate more on the Sort and shine in an organization .
- From the Root cause analysis diagram shows the various factors which cause the high waste percentage and low production efficiency during the production process. by identifying the root cause in five important categories like Materials, Methods, Environment, Machinery, Manpower. which help us to rectify and improve the process. improper handling , low quality raw materials, inefficient usage of the humidification plant, improper maintenance schedule , lack of training are the root cause of the high waste percentage and low production .
- three kaizen improvement attempts were made in the production process of the spinning mills. through the PDCA cycle , analyzed and find solution for good improvement in managing the work space efficiency, improve the safety measure for the employees , find solution to implement the open end spinning machine to recycle the waste cotton in to low count yarn product, and

suggestion to organized the waste in effective way. This improvement helps to increase the efficiency of the production process.

- From the Lean manufacturing facility layout analysis, company layout design and machinery arrangement are done in an effective way. to reduce the waste movement and improve the production process flow.
- In ACSML , the waste percentage of carded yarn products is 13.5%- 15%, combed yarn products is 28%- 30%. and they implement various Automation, Poka-yoke, Visual indicators in the system to reduce waste in the production process.

5.2 SUGGESTION

In general, it can be said that there is no such KEY in achieving success, only a LADDER . when a series of continuous steps of dedication in doing the job right every time is all it takes. Hence, it is recommended that to have a Total manufacturing system, a company- wide commitment, proper materials quality, people and equipment always be made available when needed. In addition; the policies and procedures developed and implemented for an internal structure should also be flexible. By integrating the production process; the supplier, manufacturing and customer become an extension of the manufacturing production process instead of independently isolated processes.

- Company should implement the effective waste control and management process, to reduce the manufacturing cost.
- Company should effectively utilize the humidification plant to reduce the invisible loss and yarn breakage during the production process.
- Implementation of an open end spinning machine to recycle the waste cotton material to produce low count yarn products.
- implementation of 5s methodology, which helps the company to organize and improve the working environment.
- Company should remove the old machineries and repair parts from the work space to improve the work space utilization efficiency.

- proper waste management system is suggested to improve the production efficiency and working environment
- Company should provide the employees with proper safety gadgets to protect them from the serious health issues caused by the micro dust in the production unit.

5.3 CONCLUSION

The waste management in the production process helps the organization to maintain the efficiency and reduce the manufacturing cost. For that implementation of lean management into the process helps to control the all form of waste within the organization. various lean tools which help the organization to measure and understand their problems in the process. It helps us to improve efficiency, reduce all forms of waste, improve the working environment, and reduce the manufacturing cost. Through this research at Anna cooperative spinning mills ltd, It is concluded that waste control and management which improve the efficiency of the overall production process and reduce the manufacturing cost .

REFERENCES

- Government of Tamil Nadu, Ministry of handloom and textile, policy note, 2019-2020.
- Bhamu, J., and Sangwan, K. S. (2014). Lean manufacturing: literature review and research issues. *International Journal of Operations & Production Management*, 34 (7), 876-940.
- Green, J., Lee, J. and Kozman, T. (2010). "Managing lean manufacturing in material handling operations", *International Journal of Production Research*, 48 (10), 2975-2993, 2010.
- Piercy, N., and Rich, N. (2015). The relationship between lean operations and sustainable operations. *International Journal of Operations & Production Management*, 35(2), 282-315. DOI: 10.1108/IJOPM-03-2014-0143, 2015.
- Shah, Z.A. and Hussain, H. (2016). An Investigation of Lean Manufacturing Implementation in Textile Sector of Pakistan, *Proceedings of the 2016 International Conference on Industrial Engineering and Operations Management*, Kuala Lumpur, Malaysia, March 8-10, 2016.
- G. L. Hodge, Kelly Goforth Ross, J. A. Joines and K. Thoney, (2011). "Adapting lean manufacturing principles to the textile industry," *Production Planning & Control*, vol. 22, no. 3, pp. 237-247.
- A. R. Mukhopadhyay and S. Ray(2006), "Reduction of Yarn Packing Defects Using Six Sigma Methods : A Case Study Reduction of Yarn Packing Defects Using Six Sigma Methods : A Case Study," *Quality Engineering*, vol. 18, p. 189–206.
- Gurumurthy A. and Kodali R. (2011): Design of lean manufacturing systems using value stream mapping with simulation. A case study. *Journal of Manufacturing Technology Management*. Vol. 22 No. 4, 2011, pp. 444-473
- Irfan Ahmed Mohammed Saleem, Dr. S. Jaisankar(2018), A Study On Kaizen Based Soft-Computing In Electric Vehicle Manufacturing Processes, *International Journal Of Innovations In Scientific and Engineering Research*, Volume5,no5.
- A. Fawaz, Abdulmalek, Jayant Rajgopal, Analyzing the benefits of lean manufacturing and value stream mapping via simulation: A process sector case study *Int. J. Production Economics*, 107 (2007), pp. 223-236

- Jose Arturo Garza-Reyes, Steve Eldridge, Kevin D. Barber, Horacio Soriano Meier, 'Overall equipment effectiveness (OEE) and process capability: A relationship analysis', International Journal of Quality & Reliability Management, Vol. 27, Iss: 1, pp. 48 – 62 (2010).
- Michalska J and Szewieczek D The 5S methodology as a tool for improving the organization, J. of Achievements in Mat. and Manufacturing Engineering Vol. 24, pp 211-214. (2007)
- Zuashkiani, A.; Rahmandad, H.; Jardine, A.K.S. Mapping the dynamics of Overall Equipment Effectiveness (OEE) to enhance asset management practices. J. Qual. Maint. Eng., Vol. 17, pp 74–92 (2011).
- G. L. Hodge, Kelly Goforth Ross, J. A. Joines and K. Thoney, (2011)."Adapting lean manufacturing principles to the textile industry," Production Planning & Control, vol. 22, no. 3, pp. 237-247.

BIBLIOGRAPHY

BOOKS

- James P. Womack, Daniel .Jones, " Lean Thinking" , Pocket UK , 1January 2012.
- Liker Jeffrey K, "The Toyota Way", McGraw Hill Education India, 1 July 2017.
- Pete I. King, "Lean for the Process Industries", Productivity Press, 11 June 2019.
- Senthil Kumar R, "Process Management in Spinning" , CRC Press, 26 September 2019.
- SITRA Norms for Spinning Mills - The South Indian Textile Research Association.

WEBSITES

- <https://www.textilesphere.com/2019/09/waste-management-in-spinning.html>.
- <https://www.leanproduction.com/top-25-lean-tools.html>.
- <https://www.india.gov.in/official-website-department-handlooms-and-textiles-tamil-nadu>

A STUDY ON WASTE CONTROL AND MANAGEMENT BY USING LEAN MANUFACTURING AT SPINNING INDUSTRY

¹Manojkumar S , ²Kavitha Rajayogan
velmanoj4@gmail.com , kavitha2948@gmail.com

¹PG Student, ² Assistant Professor
School of Business Administration
Sathyabama Institute of Science and Technology, Chennai.

ABSTRACT

Organizations today have started incorporating methodologies for reduction or elimination of wastages in various forms thereby focusing on waste management and controlling them in the effective way. one of the powerful methodologies through the implementation of Lean management within the production process. Through the various types of lean tools like 5s, kaizen, Root cause analysis, organization can eliminate the various forms of waste. Generally there is a different form of waste in the company. They are in different forms like over production, waiting, transport, movement, process, stocks, defects, non-utilized talent, by eliminating the waste by implementing the lean manufacturing process. . To analyze the overall production process by using the lean tool to identify the waste and root cause of the waste generating. waste which is generated in the company, it may be the raw material for the other product in the same market. by analyzing the waste to reuse in a way, to promote productivity, reduce the manufacturing cost. Through the lean tool implementation, company can improve the working environment, reduce waste, increase productivity, improve employee safety, and finally the company can be continuously improved.

Key word : waste control and management , lean management, continuous improvement.

1 INTRODUCTION

1.1 A study on waste control and management by using lean

Waste management is the impact full and essential process, which leads to promoting the productively and reduces the environmental impacts. by using the waste management principles along with lean management to control waste and management in an effective way to increase the company revenue and improve the overall company development through continuous improvement. by using the lean manufacturing and management concepts in the process happen within the company to reduce the waste generation , improve the overall efficiency, promote the revenue percentage, improve the product quality, improve the culture within the company.

1.2 LEAN MANAGEMENT

Lean management and its principles are generally derived from the Toyota production system. However , Fredrick Taylor and Henry Ford documented their observations and experimental process relating to this topic, and Shigeo Shingo and Taichi Ohno applied their enhanced thoughts on the subjects at Toyota in the 1930s. this lean manufacturing process which helps to promote continuous improvement in the overall process. Through the lean we are able to improve the productivity, efficiency of the production process by eliminating the different forms of wastes in different points of the production process. by implementing the just-in-time inventory management which results in less warehouse space, fewer forklifts, reduces the unnecessary space etc. once the flow of labor are often interruption free, freed from materials sitting, standing and redo-loops, waste eliminated. Lean is the elimination of different types of waste, to continuous improvement processes.

1.3 INTRODUCTION TO WASTE MANAGEMENT IN THE SPINNING MILLS

In the production economics of a spinning mill, yarn realization plays an important role . To illustrate , in the prevailing cost and yarn selling price, even an 1% improvement in the yarn realization and

waste reduction lead to save some huge amount of money in the production process. In the yarn manufacturing process, generally various measures necessary to improve yarn realization and control waste. Besides controlling process wastes such as blow room and card droppings, flats stripes, comber noil, sweep waste and yarn waste, equal important should also be laid on the control of reusable waste(soft waste) such as lap bits, sliver bits, roving ends, pneumafil and roller waste. This is often because of, aside from loss in production, reprocessing of soft wastes involves extra handling and deteriorates yarn quality. Spinning mills should pay attention to waste management in order to improve the productivity and profit of the mills.

1.4 OBJECTIVES OF THE STUDY

1.4.1 PRIMARY OBJECTIVE

The major objective is to study waste control and management in the spinning industry through lean tools analysis.

1.4.2 SECONDARY OBJECTIVES

- To analyze the waste control and management by using lean tools like 5s, Root cause analysis, Muda.
- To manage the waste in the proper way to improve the employee's safety and working condition by using the Kaizen (continuous improvement).
- To evaluate the waste control and management of spinning industry, and offer suitable suggestions for the improvement of waste control and management.

2 REVIEW OF LITERATURE

Marko Milosevic Etal (2013) This paper explains the methods and implementation techniques of lean management concepts, which is used to increase the efficiency of all processes within the company. It also shows the result of the level of implementation of these lean methods in the domestic and international production company. It can conclude the large companies concentrate much on lean implementation, they attain productivity and employee satisfaction

George L. Hodge et al(2011) conducted research to identify a suitable lean tool for textile industries to eliminate non-value added activities and eliminate waste from the production process in the US to enhance the customer satisfaction. Author identified various drawbacks and barriers in the lean implementation process, both management and shop floor employees find it difficult to adapt to the change in the system. shop floor employees find it difficult to offer suggestions for improvement. It can conclude the lean implementation improves the efficiency in textile industries..

Neha Verma et al (2015) conducted a study to identify waste related problems like cause of equipment failure, low productivity, high wastage, bottleneck problems and rectify them in lean manufacturing implementation in small scale industries. Process was analyzed in concern with rejection control, inventory, waiting time, set time and eliminating non value added time/ activities. In this study no new machines were purchased nor were operators expected to work faster or harder; modification in procedures and layout were needed to be changed to allow the product to flow more smoothly through the manufacturing process efficiency in textile industries.

Dave et al(2015) Study deals with Lean construction and methodology along with information and communication systems. This study reveals that by adopting techniques such as lean principles, process analysis techniques, by implementing the lean methodology into the system to maintain the performance of the process and standardize across the industry will be highly effective and efficient.

Ramune Ciarniene et al 2014 This research reveals the challenges and barriers to be faced while implementing lean concepts in the system. Lean handling is the utilization of assets for any work other than the production of significant worth for the end client, as waste, and hence an objective for disposal. Research shows the following three types of barriers in the lean process implementation: they are the people issue, The process issue, The sustainability issue. Study suggested that first implement the necessary tools and techniques into the system. Trust issues, human motivation and commitment are the real constraints. Secondly clearly understood by top management maintained

properly, thirdly, LI have to be incorporated into the company's strategy. Concluded remarks from this research- specific value to the customer, Value stream mapping, waste elimination, Continuous improvement, continuous flow and pull driven system.

Naga Vamsi Kishna Jasti et al 2014 This research identifies the existing lean product development framework that is helpful in implementation of lean management systems. Research done reliability and validity analysis using questionnaire surveys. Respondents for this research are from top and middle level management determined through cronbach's alpha value. The LPD framework can be categorized under two broad areas, they are: 1. research/academic-based; 2 consultant/expert-based. The study has identified 40 elements from eight frameworks in this search, which reflects these are playing an important role in the implementation of LPD frameworks into the system.

Gulshan Chauhan et al(2012) This research depicts the implementation of , Elimination of waste, Just in time, and Continuous improvement. Various driving parameters towards Lean Management are vertical information system, integration of functions, decentralization, multifunctional teams, Pull, Just In Time deliveries, zero defects, Continuous improvement and Elimination of waste. Just In Time is top priority, then Continuous improvement. He follows the SPSS correlation method to find out the importance of lean implementation. Through this research we can conclude the importance of lean thinking, lean management into the production process helps to improve the overall efficiency and reduce the various forms of waste in the process.

3 RESEARCH METHODOLOGY

It is a logical and precise approach to take care of the exploration issue. It is perceived as a study of concentrating how examination is done experimentally. The researcher has to use information or facts already available and analyze that data and information to make critical evaluations of the waste management The date collection is based on both primary and secondary data for analysis are taken from the company record books and reports. Tools and techniques are used for analysis Lean tools like 5S, Kaizen, Root cause analysis, Lean layout, Muda.

3.1 RESEARCH DESIGN

The research design used in this project is both analytical and descriptive research, In the Analytical research researcher has to use the various facts and information already available and analyze these to make a critical evaluation of the efficiency and performance . In the descriptive research design to describe the phenomenon as it exists in the organization in order to understand and describe the characteristics of the various variables and factors of the situation. it will take the description of the waste control and management techniques.

3.2 LEAN TOOLS USED IN THIS STUDY

- 5s audit analysis
- Root cause analysis
- Kaizen (continuous improvement)
- Muda

3.3 SOURCES OF DATA COLLECTION.

In this project, both primary and secondary collected is collected from the following sources.

- **Primary data** is collected from the various departments within the company.
- **Secondary data** is collected from the production reports which are maintained by the company. Data are collected from the websites, books, journals pertaining to this topic.

4. DATA ANALYSIS AND INTERPRETATION

After the data is collected from the various aspects of this study. This data is analyzed in both analytical and descriptive ways. For the representation of the data use of various charts is made. After data analysis is done, the obtained information is interpreted and various inferences are made and conclusions are drawn related to the objective, Which have been listed in the beginning of the project. Tools used in the analysis

- 5s analysis
- Root cause analysis
- Kaizen
- Muda

4.1 5S METHODOLOGY

The 5s lean strategy is in reality significantly more than a cleaning method. It assists with taking out squander that outcomes from an inadequately coordinated working region inside the association..

- **seiri: sort**
- **seiton: set in order**
- **seiso: shine .**
- **seiketsu: standardize**
- **shitsuke: sustain**

Table 4.1 5S PERFORMANCE INDICATOR

S no	5s SCORE	INDICATION
1	1 - 20	Very Poor
2	20 - 40	Poor
3	40 - 60	Fair
4	60 - 80	Good
5	80 - 100	Excellent

Table 4.2 GUIDELINES FOR 5S SCORE

SCORING GUIDELINES	
6 - Deviation	
5-6 Deviation	
3-4 Deviation	
1-2 Deviation	
No Deviation	

SORT - some old machineries and repaired equipment are stored in the work space. waste materials like used cones, packing covers, green straps are stored

SET IN ORDER - All the Machineries and equipment are neatly arranged, walkways and work areas clearly outlined. Everything in its specified place.

SHINE - All the work area and equipment are kept clean, but waste cotton are near to the electric line cables. it may cause an accident.

STANDARD - All the standards are known and visible, but checklists for cleaning and maintenance are not placed in the workplace.

SUSTAIN - All the stock controls , inventory management, and all the activities are regularly reviewed. but lack of safety measure training for employees

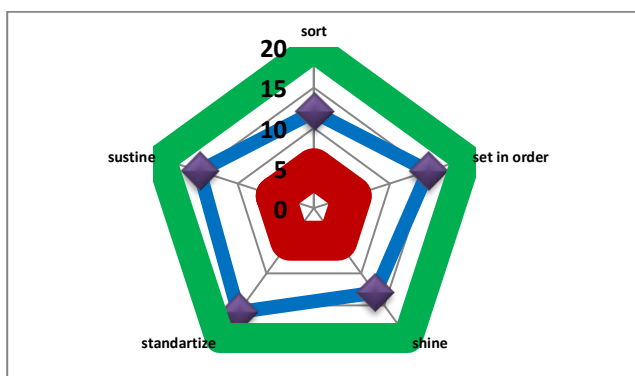
Table 4.3 5S AUDIT CHECKLIST

5S AUDIT CHECKLIST											
		Scores					0	1	2	3	4
SORT 1S (SEIRI)	Distinguish between what is needed and not needed										
	1	Have all unneeded equipment, tools, items been removed?		X							
	2	Are all remaining items neatly arranged ?				X					
	3	If any unneeded inventory, supplier parts, materials are stored?			X						
	4	Are walkways and work areas clearly outlined?						X			
	5	Does a procedure exist for dispensing unneeded items?			X						
	Subtotal>>		0	1	4	3	4				
	Subtotal for Sort>>									12	
SET IN ORDER 2S (SEITON)	A place for everything and everything in its place										
	1	Is there a visually marked, specified place for everything?				X					
	2	Is everything in its specified place?			X						
	3	Are standards and limits easily recognizable?				X					
	4	Is it easy to see what needs to be where?						X			
	5	Are things put away after use?				X					
	Subtotal>>		0	0	2	9	4				
	Subtotal for set in order>>									15	
SHINE 3S (SEISO)	Cleaning and looking for ways to keep it clean										
	1	Are work areas clean?			X						
	2	Is equipment kept clean?				X					
	3	Are cleaning materials easily accessible?				X					
	4	Are cleaning guidelines and schedules easily visible?			X						
	5	Is cleaning used as a form of inspection?				X					
	Subtotal>>		0	0	4	9	0				
	Subtotal for Shine>>									13	
STANDARDIZE 4S (SEIKETSU)	Make standards obvious and maintained										
	1	Is all necessary information visible?						X			
	2	Are all standards known and visible?						X			
	3	Is there a checklist for all cleaning and maintaining jobs?			X						
	4	Are the future standards being considered with a clear improvement plan for the area?				X					
	5	Are the first 3Ss (sort, shine, set in order) being maintained?				X					
	Subtotal>>		0	0	2	6	8				
	Subtotal for Standardize>>									16	
Stick to the rules and follow up											
SUSTAIN 5S (SHUKAN)	1	Is everyone adequately trained in standard procedure?				X					
	2	Are tools and parts being stored correctly?				X					
	3	Are procedures up-to-date and regularly reviewed?			X						
	4	Are stock controls being adhered to?						X			
	5	Are activity boards up-to-data and regularly reviewed?				X					
	Subtotal>>		0	0	2	9	4				
	Subtotal for Sustain>>									15	
	Total>>		0	1	15	35	20				
Grand total 5s score>>									71		

Table 4.4 5S AUDIT RESULT

5S AUDIT	
SORT	12
SET IN ORDER	15
SHINE	13
STANDERTIZE	16
SUSTAIN	15
TOTAL	71

Chart 4.1 5S AUDIT RESULT



INTERPRETATION

The above table represents the 5S audit checklist of the overall manufacturing unit. which helps to audit the 5s Sort, Shine, Set in order, Standardize in the organization . Through this organization is able to identify the area which they have to improve.

The above checklist shows that organization overall total for 5s is 71. They need to concentrate more on the Sort and shine in the organization to improve the efficiency.

4.3 ROOT CAUSE ANALYSIS

A critical thinking philosophy that centers around settling the basic issue as opposed to applying handy solutions that lone treat quick indications of the issue. A typical methodology is to inquire as to why multiple times each time drawing a stage nearer to finding the genuine hidden issue.

- To permit a group to recognize, investigate and graphically show, in expanding point of interest, the entirety of the conceivable reason identified with an issue or condition to find its main drivers
- Enables a group to zero in on the substance of the issue, make a preview of the aggregate information and agreement of a group around an issue.
- Focuses the group on causes, not manifestations

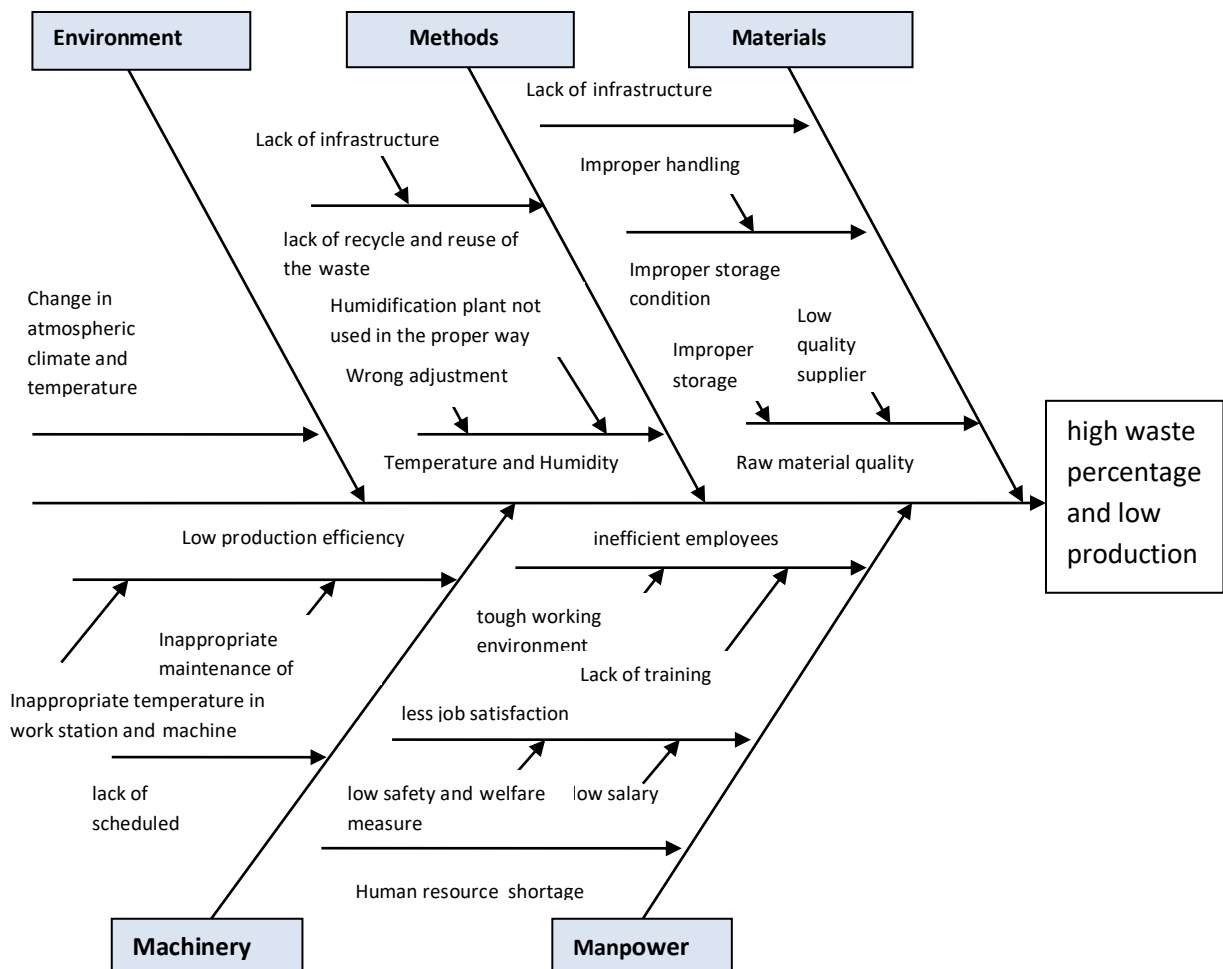
Materials - High percentage of impurities in the raw cotton, which leads to high percentage of waste in the production process. Low quality of the raw materials, improper storage condition and improper handling of the raw material are the factors which cause low production and high waste percentage.

Methods - Cotton materials and production process should be maintained in the proper humidified workstation to produce the cotton from the loss of weight and reduce invisible loss, improper use of humidification plants which cause high wastage in the process. waste cotton is not reused in the proper way.

Environment - Atmospheric conditions like temperature and climate, they plays an important role in the production efficiency .

Manpower - Because of the tough working conditions, lack of training , low salary for contract workers, low safety and welfare measure these major reasons which cause the employees to be more inefficient.

Machinery - Inappropriate maintenance of relative humidity, lack of scheduled maintenance, Inappropriate temperature in the workstation and machineries which affect the machinery to cause breakdowns, low quality of the products.



INTERPRETATION

The above Root cause analysis diagram shows the various factors which cause the high waste percentage and low production efficiency during the production process. by identifying the root cause in five important categories like Materials, Methods, Environment, Machinery, Manpower. which help us to rectify and improve the process

4.4 KAIZEN

A strategy where both management and employees work together proactively to achieve regular , continuous improvement in the manufacturing process, by continuously eliminating waste from the manufacturing process. The continuous improvement is adapted by using the Plan-Do-Check-Act method, it is also known as Deming cycle.

4.4.1 KAIZEN 1: occupancy of old machineries and repair parts

In the production unit, there are lots of old machineries and in the inventory there are a lot of old and repaired parts are stored.

PLAN : Analysis the condition repair parts and old machineries are stored in the inventory and work space. categories the old machineries and part according to the needs. Reuse the part if they are in good condition.

DO : Develop and implement a solution. The possible suggestion were given for the identified problem.

Table 4.5 KAIZEN 1 SUGGESTION

S no	PROBLEM	IMPACT	IMPROVEMENT
1	Work space is occupied with old machineries	It reduces the material and workers movement.	Remove all unnecessary old machines from the work space.
2	Lots of old and repair parts are stored in the inventory	It reduce the storage space in inventory	Repair the part for the better usage or sort the parts from the inventory

CHECK : Once the implementation has been started, the performance of the implemented solution is tracked over for the particular period of time.. The problem is compared before and after implementation. check the inventory and work space , if the old machineries and repaired part clear from the particular place.

ACT : If the solution gives good improvement, the suggestions are implemented or else PDCA cycle is carried out from beginning with different solutions. By organizing the old machines and parts in the separate area. With the given suggestion , old machines and repaired parts are removed and organized in the proper way . It helps to organize the work space in an effective way.

4.4.2 KAIZEN 2 : Employees are not provided with safety gadgets

In the spinning mills, employees are highly affected by the micro dust while managing the raw materials and clean Automatic waste evacuation system. spinning machine operators are affected by the high sound from the machine. but employees are not provided with safety masks and ear buds.

PLAN: Understand the importance of the safety gadgets like face mask, ear buds while handling the waste material. provide the safety gadgets to the needed employees

DO : Develop and implement a solution. The possible suggestions were given for the identified problem .

Table 4.6 KAIZEN 2 SUGGESTION

S no	PROBLEM	IMPACT	IMPROVEMENT
1	Safety gadgets like face masks are not provided to the employees who manage the waste and clean the Automatic waste evacuation system.	Micro dust from the cotton waste which causes high level lungs and breathing problems to the employees.	Providing them with good quality face masks and safety measures to reduce the health problems.
2	Safety gadgets like ear buds are not provided to the operators in the spinning department	High frequency sound from the spinning machine, which affects the hearing sensitivity of the operators.	Providing them with suitable ear buds to the operator. implement the strict rules to wear all safety gadgets during the work time.

CHECK: Once the implementation is started, continuously monitor the employees whether they are wearing the safety gadgets during the waste handling and production process. check the quality and efficiency of the safety gadgets.

ACT : If the provided safety gadgets and measures are good enough for employers safety, the implantation is good or else we have to improve the safety measures. with the given suggestion employees are safe from the micro duct while handling the waste.

4.4.3 KAIZEN 3 : Cotton waste material are not recycled and not stored in proper way

In the yarn manufacturing process, for the 20, 30, 40 count almost 15% is generated and for the combing process 25% - 30% waste is generated. From the waste only a small percentage of the waste is mixed with the raw cotton material in the bale breaking process. remaining waste is not reused or recycled. Various other waste like cones, packing straps, packing covers are not stored in the proper way.

PLAN: Calculate the waste% from all different departments. segregate the waste in the proper way. increase the reusability of the waste in the production process. implement the recycling process into the production process. allocate the proper place for the storage of the waste materials

DO: Develop and implement a solution, the possible suggestion were given for the identified problem.

Table 4.7 KAIZEN 3 SUGGESTION

S no	PROBLEM	IMPACT	IMPROVEMENT
1	Cotton waste materials are not recycled in the efficient way	It highly impacts the efficiency of the production process. increase the manufacturing cost	Categories the waste in a proper way. implement the open end spinning machine to recycle the waste into low end yarn count products.
2	Various other waste like cones, straps, packing covers are not stored in proper place	Waste occupies the most space. it affects the cleanness of the production units.	Segregate the waste in the proper way. stored the waste in the proper place and disposed of it in regular time interval.

CHECK: Once the implementation is started, check the utilization and efficiency of the open end spinning machine and monitor the production level of the yarn from the OE spinning machine. regularly check whether the waste are segregated and stored in the proper way .Finally dispose of them in the regular interval time period.

ACT : If the solutions are good improvement, the suggestions are implemented, or else we have carried out the different PDCA cycle to improve the process. With the given suggestion, the cotton waste is segregated and recycled with the help of an Open end spinning machine to produce low count yarn counts. and various other waste are stored and disposed of in the proper way.

INTERPRETATION

The above table shows three kaizen improvement attempts were made in the production process of the spinning mills. through the PDCA cycle , suggested the solution for good improvement in the manage the work space efficiency, improve the safety measure for the employees , suggest the implement the open end spinning machine to recycle the waste cotton in to low count yarn product, and suggestion to organized the waste in effective way. This improvement helps to increase the efficiency of the production process.

4.6 MUDA

The elimination of waste is the primary focus of lean manufacturing. anything in the manufacturing process that does not add value for both company, customer.

Poka-Yoke - It is the process of Error Proofing to achieve Zero defects in the production process. The various error proofing techniques used in the spinning mills are Metal detector, magnet path to remove the metal from the raw cotton, I- scanning process, Fire sensors throughout the plants to avoid fire accidents. These are various error proofing techniques used in the process to reduce waste and improve quality and efficiency of the production process.

Visual Factory - In this spinning mills various visual indicators , displays and control panels used in the plant, Color light indication in the machineries like Red and Green , which indicate the production status and defects in the production process. Various color cans are used in the production process to

differentiate the yarn counts . 60 K - Green color can, 20's - Pink color can, 30's - Blue color can , 60c, 40's and remaining counts are identified by the physical marks in the can.

JIDOKA - It means Automation. Design equipment and system to partially automate the manufacturing process and to automatically stop when defects are detected. They implement various automated production systems and waste management systems into the production process .

- Blow room with bale breaker, which automatically breaks the bale and cleans the cotton according to the further requirement in the carding machine.
- Automatic waste evacuation system, which automatically collects the waste from the blow room line, carding machine, and separates the waste according to the quality and size.
- **OHTC** - Over head traveler cleaner in simplex and spinning machine are used to collect the waste around the machine.
- Automatic cone winding machine, which helps to improve the production efficiency by reducing the waste and high production ability.

In the above lean tool analysis (5s Methodology, Root cause analysis, kaizen , layout design and efficiency analysis, Overall equipment efficiency , poka-yoke, Jidoka (Automation), Visual factory, company are able to control the different forms of waste like unwanted movement, waiting, in efficient inventory , overproduction, transport. To remove the defects (waste) from the spinning mills by implementing the lean management into the production process .To reduce the waste percentage and electricity waste, which help the organization to reduce the overall manufacturing cost.

Table 4. 8 WASTE PERCENTAGE ANALYSIS

Department	Salable waste %	Usable waste %
Blow room	3 - 4%	-
Carding	5 - 7 %	0.5 %
Drawing	0.5%	0.5 %
Simplex	0.5 %	0.5 %
Spinning	2 %	1 %
Cone winding	1 %	-
Auto cone winding	0.075%	-
Combing	18 - 20 %	-

Chart 4.3 CARDED YARN WASTE %

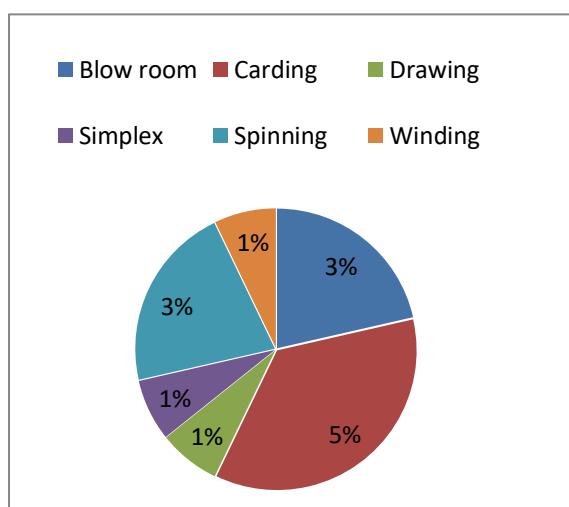
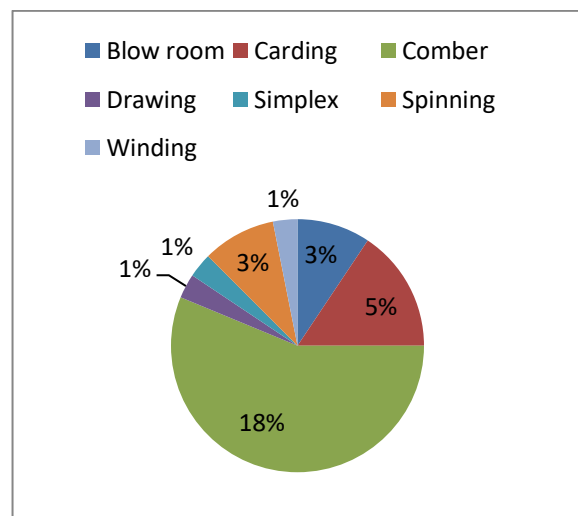


Chart 4.4 COMBED YARN WASTE %



Total waste % for carded yarn =13.50 % - 15%

Total waste % for combed yarn = 28 % - 30 %

To reduce the waste percentage and improve the production efficiency of the spinning mills by

- By improving the cleaning efficiency of the blow room line to reduce waste, maintain the standard setting and beater speed according to the required yarn count.
- By improving the cleaning efficiency of the carding by 5 to 7 % to reduce the waste percentage , Higher flat with high cylinder speed can be used for better removal of seed coats and also reduce neps thick places.
- Analysis and segregate the different types of waste .Weight that waste and record that section wise person and shift wise. always compare with standards.
- Optimal utilization of humidification plant to maintain the suitable humidity in the production plant to improve product quality, maintaining product weight, reducing machine downtime and improving employee comfort. Optimal Relative humidity for the spinning mills is 35 - 65 % RH. In this mills they maintain the RH is from 40 - 50 %, and temperature is from 35 - 40 degree Celsius
 - Maintaining the product weight , up to 3.5 % increase in product yield. by reduce the invisible loss
 - Improve the yarn product quality, by reducing the breakage of the fiber.
 - Reduce the static build-up, to reduce the machine jams and employee discomfort.
- By reducing the electricity waste in the spinning mills, which helps the management to save manufacturing cost. To reduce the electricity waste by
 - Cleaning has to be done in peak hour from (6.00 am to 9.pm) to save 20% of electricity cost
 - Frequently check the working condition of all the machines.
 - Avoid running of empty spindles in simplex and spinning machine
 - use an appropriate compressor line for cleaning purposes, not in the main compressor line.

INTERPRETATION

From the above Table 4.11 and other Lean tool analysis, In this spinning mills waste percentage of the carded yarn is 13.50% - 15%, and waste percentage of combed yarn product is 28% - 30%. In the production process, they implement various Error proofing ,Visual indicators ,Automation in the system to reduce the various forms of Muda (waste) to improve production efficiency and reduce manufacturing cost.

5.2 CONCLUSION

The waste management in the production process helps the organization to maintain the efficiency and reduce the manufacturing cost. For that implementation of lean management into the process helps to control the all form of waste within the organization. various lean tools which help the organization to measure and understand their problems in the process. It helps us to improve efficiency, reduce all forms of waste, improve the working environment, and reduce the manufacturing cost. Through this research spinning mills, It is concluded that waste control and management which improve the efficiency of the overall production process and reduce the manufacturing cost .

REFERENCE

- Ministry of textile - <http://texmin.nic.in/>
- Government of Tamil Nadu , Ministry of handloom and textile, policy note, 2019-2020.
- Bhamu, J., and Sangwan, K. S. (2014). Literature review and research issues on Lean Manufacturing. Published in International Journal of Operations & Production Management, 34 (7), 876-940.
- Fawaz, Abdulmalek, Jayant Rajgopal (2007) A Study on implementation of lean manufacturing in to the system , analyze the value stream mapping via simulation and done a process sector case study Int. J. Production Economics, 107 , pp. 223-236.

- Green, J., Lee, J. and Kozman, T. (2010). Analyzed the importance of implementing and Managing lean manufacturing system in material handling operations within the manufacturing industries, Published in International Journal of Production Research, 48 (10), 2975-2993, 2015
- Piercy, N., and Rich, N. (2015). Study and analyzed the connection between lean operations and sustainable operations. Published in International Journal of Operations and Production Management, 35(2), 282-315, 2015.
- Gurumurthy A. and Kodali R. (2011): A case study on Design of lean manufacturing systems using value stream mapping with simulation. Published in Journal of producing Technology Management. Vol. 22 No. 4, 2011, pp. 444-473.
- Irfan Ahmed Mohammed Saleem, Dr. S. Jaisankar(2018), A Study On importance of Kaizen Based Soft-Computing In Electric Vehicle Manufacturing Processes , Published in International Journal Of Innovations In Scientific and Engineering Research, Volume5,no5.
- Michalska J and Szewieczek D(2007). A study on implementation of 5S methodology as a tool for improving the organization and reduce the waste in the manufacturing industries, J. of Achievements in Mat. and Manufacturing Engineering Vol. 24, pp 211-214.
- Zuashkian A, Rahmandad H, Jardine A.K.S.(2011)A study on Mapping the dynamics of Overall Equipment Effectiveness (OEE) to reinforce asset management practices. J. Qual. Maint. Eng., Vol. 17, pp 74–92 .
- Shah, Z.A. and Hussain, H. (2016). An Investigation of Lean Manufacturing Implementation in Textile Sector of Pakistan to improve the productivity , Proceedings of the 2016 International Conference on industrial management and Operations Management, Kuala Lumpur , Malaysia, March 8-10, 2016.
- G. L. Hodge, Kelly Goforth Ross, J. A. Joines and K. Thoney, (2011) A study on implementation and adapting to lean manufacturing principles and tools in to the textile industry, Production Planning & Control, vol. 22, no. 3, pp. 237-247 .
- A. R. Mukhopadhyay and S. Ray, "A Case Study on Reduction of Yarn Packing Defects in the manufacturing and packing process Using Six Sigma Methods " QualityEngineering,vol.18,p.189–206