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OPTIMIZING PRODUCTION LINE PERFORMANCE: A CASE STUDY ON OEE IMPROVEMENT IN FOOD PROCESSING

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ABSTRACT

This paper provides an in-depth examination of the goals and benefits of implementing Total Productive Maintenance (TPM) in the Food Processing Industry. The study focuses on calculating the Overall Equipment Effectiveness (OEE), a critical metric for evaluating the performance of production equipment. Additionally, the paper explores the six major losses that commonly occur in industries, including quality, availability, and speed. A comprehensive case study was conducted at a Food Processing company in Maharashtra, India, with data collected over a period of ten working days. The company aimed to achieve a quality factor of 90% and availability of 70% in the OEE equation, with a performance rate of 70%. Following the calculation of the OEE, the paper provides recommendations for improving the company's maintenance procedures and productivity, including the implementation of Preventive Maintenance, Computerized Maintenance Management System, and Production Planning. These strategies are designed to enhance the overall efficiency and effectiveness of the production process.

Keywords: Total Productive Maintenance, Overall Equipment Effectiveness, Computer Maintenance Management System

INTRODUCTION

Management is a systematic process of accomplishing tasks efficiently and promptly through collaboration with others. The primary objectives of management include attaining organizational goals, ensuring efficiency, and promoting effectiveness. In the manufacturing sector, these principles are crucial for achieving success. However, many manufacturing units face challenges such as high-quality defect rates, minor stops, and unskilled operators, which hinder their competitiveness.

Total Productive Maintenance (TPM) is a methodology that originated in Japan in 1971, focusing on enhancing machine availability through optimal utilization of maintenance and production resources. In today's global market, productivity improvement is a significant challenge for companies seeking to maintain competitiveness. The Overall Equipment Effectiveness (OEE) index is a widely recognized metric for measuring effectiveness. Developed by the Japan Institute for Plant Maintenance (JIPM), OEE is extensively employed in various

industries and serves as the foundation for quality improvement methodologies such as Total Quality Management (TQM) and Lean Production.

The Overall Equipment Effectiveness (OEE) index is a powerful tool designed to identify, quantify, and prioritize losses in manufacturing operations. By providing a clear and concise framework for analyzing performance, OEE enables organizations to pinpoint areas for improvement and optimize plant performance. One of the key strengths of OEE is its universality, as it can be applied to any manufacturing organization, regardless of size, industry, or complexity. Furthermore, OEE is closely aligned with established manufacturing philosophies, such as Just-In-Time (JIT) and Total Quality Management (TQM). In addition, OEE represents a natural extension of Preventive Maintenance (PM) principles, as it emphasizes the importance of proactive maintenance and operator involvement in maintaining equipment performance. By adopting an OEE-driven approach, organizations can create a culture of continuous improvement, where machines operate at high levels of productivity and efficiency, and maintenance becomes a shared responsibility among all workers.

Total Productive Maintenance (TPM): The Japanese approach to TPM is rooted in a distinctive philosophy that emphasizes collaboration, proactive maintenance, and continuous improvement. This approach is characterized by five key elements. Firstly, it recognizes the importance of efficient equipment utilization in achieving productivity gains. Secondly, it involves the establishment of a comprehensive preventive maintenance system that identifies and addresses potential equipment failures. Thirdly, it necessitates the active participation and collaboration of all departments, including operators, designers, and maintenance personnel, to ensure that equipment is properly maintained and operated. Fourthly, it promotes a culture of involvement and ownership among all employees, from shop floor workers to top management, to foster a sense of shared responsibility for equipment maintenance. Lastly, it encourages autonomous, small group activities that focus on preventive maintenance, empowering teams to take ownership of equipment maintenance and drive continuous improvement.

Lean Manufacturing: Lean production is a management philosophy that aims to minimize waste and maximize productivity. This approach recognizes that productivity is a function of both effectiveness and efficiency. Effectiveness refers to the degree to which an organization achieves its desired outcomes, while efficiency refers to the optimal use of resources to achieve those outcomes. In the context of lean production, Overall Equipment Effectiveness (OEE) is a valuable metric for measuring effectiveness. OEE provides a customer-driven approach to evaluating equipment performance, enabling organizations to identify areas for improvement and optimize their production processes.

Overall Equipment Effectiveness (OEE): Seiichi Nakajima's concept of Overall Equipment Effectiveness (OEE) provides a hierarchical structure for assessing equipment performance in a manufacturing environment. A crucial distinction exists between potency and effectiveness, as

these two concepts are often conflated. Effectiveness is defined as the ratio of actual output to reference output, while potency refers to the ratio of actual input to reference input. Equipment potency, therefore, focuses on optimizing performance at the lowest possible cost, without consideration for output or corporate objectives. In contrast, equipment effectiveness is concerned with the ability to consistently produce high-quality output that aligns with the company's goals and objectives.

Focus of this study is on the Enhancement of Productivity of the production line and Drop down the stoppages of production machineries. These two objectives are interrelated with each other. The Productivity is enhanced only when wastages are reduced. For wastage reduction drop down the number of stoppages is must because Edible waste is generated only when production line has breakdowns i.e the quantity of edible waste is directly proportional to the number of breakdowns or number of machine stoppages. As the main objective of the project is to enhance the edible yield, the Total Productive maintenance (TPM) technique of Overall Equipment Effectiveness (OEE) is used.

LITERATURE REVIEW

A case study published in SASTECH Volume 8, Issue 2, September 2009, by Harsha G. Hegde, N. S. Mahesh, and Kishan Doss, presents a systematic approach to improving Overall Equipment Effectiveness (OEE) in a CNC machine shop. The study employed Total Productive Maintenance (TPM) and 5S techniques to minimize breakdowns, increase performance, and enhance quality rates. The TPM techniques utilized, including Preventive Maintenance, Poka Yoke, and Kaizen, were successfully applied to the machines. The results of the study showed a significant improvement in OEE, increasing from 43% to 72%, which is considered a desirable level in the manufacturing industry. This case study demonstrates the effectiveness of TPM and 5S techniques in improving machine efficiency and overall productivity.

The paper "Improvement of Overall Equipment Effectiveness through Total Productive Maintenance" by S. Fore and L. Zuze presents a comprehensive study on the implementation of Total Productive Maintenance (TPM) to enhance Overall Equipment Effectiveness (OEE) in a manufacturing environment. The researchers employed a mixed-methods approach, incorporating both qualitative and quantitative data collection methods. These included interviews with key personnel, reviews of documentation and historical records, and direct observation of production operations. The study's findings highlighted the significant impact of reduced demand and raw material shortages on production operations. In response to these challenges, the authors recommended the implementation of a Computerized Maintenance Management System (CMMS) to optimize maintenance operations and improve equipment efficiency.

Research work entitled as "Total Productive Maintenance review and Overall Equipment Effectiveness Measurement", by Osama Taisir R. Almeanazel, JJMIE, Volume 4, Number 4, September 2010 ISSN 1995-6665 will review the goals and advantages of implementing Total

Productive Maintenance, and it'll conjointly that specialize in calculative the general instrumentation effectiveness in one amongst company in Jordan. As a result the corporate achieved ninety nine in quality issue of overall instrumentation effectiveness equation and seventy six in convenience wherever in performance it got seventy two. The Set of techniques were urged to the business like Single minute exchange die, PC maintenance management system, and production coming up with when calculative the OEE to enhance their maintenance procedures.

S.R. Vijayakumar and S. Gajendran's research work presents a comprehensive case study on enhancing Overall Equipment Effectiveness (OEE) in the injection moulding process industry. The study highlights the importance of injection moulding in the production of plastic parts for the automobile industry, accounting for approximately 70% of all plastic parts. Through a structured approach, the researchers achieved a significant improvement in OEE, increasing it from 61% to 81%. This enhancement was attributed to several strategic initiatives, including the optimization of availability, resource utilization, product quality, and employee morale and confidence.

TPM GOALS: Total Productive Maintenance (TPM) is a holistic maintenance strategy that seeks to minimize all potential losses in production and ensure that equipment operates at full capacity. TPM is built around four primary goals:

1. Improving Equipment Effectiveness: This involves implementing strategies to enhance equipment performance, efficiency, and reliability.
2. Involving Operators in Daily Maintenance: TPM encourages operators to take ownership of maintenance tasks, promoting a culture of collaboration and shared responsibility.
3. Improving Maintenance Efficiency and Effectiveness: This goal focuses on streamlining maintenance processes, optimizing resource allocation, and reducing downtime.
4. Educating and Training Personnel: TPM emphasizes the importance of developing the skills and knowledge of personnel to ensure effective equipment operation and maintenance.
5. Scheming and Handling Equipment for Maintenance Prevention

One of the major goals of TPM and OEE is to reduce or eliminate what are called the six massive losses that they're the foremost common causes of potency in manufacturing:

Nakajima summarised the loss in an exceedingly six huge losses as following:

1. **Down time Losses:** A thorough examination of production systems reveals that time period losses occur when the system is not producing output. These losses can be attributed to various factors, but primarily fall into two categories:
 - i. Breakdown losses: These losses arise from equipment failures or breakdowns, which can be caused by various factors such as wear and tear, poor maintenance, or operator error.

- ii. **Setup and adjustment time:** These losses occur due to the time spent on setting up and adjusting equipment, which can include tasks such as cleaning, lubricating, and calibrating machinery.
2. **Speed Losses:** These losses occur when the actual production rate falls short of the reference speed. Speed losses are evaluated solely based on the quantity of output, without considering the quality of the products.
3. **Defect or Quality Losses:** These losses arise when the produced output fails to meet quality specifications. Quality losses can take various forms, including rework, quality defects, and yield losses. Rework refers to the process of correcting defects or flaws in products, while quality defects refer to products that do not meet quality standards. Yield losses, on the other hand, refer to the reduction in output due to quality-related issues.

OVERALL EQUIPMENT EFFECTIVENESS:

Overall Equipment Effectiveness (OEE) is a widely accepted metric for evaluating the performance of equipment. It is calculated as the ratio of the actual output of the equipment to its maximum potential output under optimal operating conditions. OEE originated from the Total Productive Maintenance (TPM) practices developed by Seiichi Nakajima at the Japan Institute of Plant Maintenance. The primary objective of TPM is to achieve perfect performance and zero loss, which encompasses the elimination of production scrap or defects, breakdowns, accidents, and waste in the production process. Overall Equipment Effectiveness (OEE) is a way to measure how well equipment is performing. It's calculated by comparing the actual output of the equipment to its maximum potential output. OEE comes from the Total Productive Maintenance (TPM) approach, which aims to achieve perfect performance and eliminate losses. This means no defects, no breakdowns, no accidents, and no waste in the production process.

Overall Equipment Effectiveness (OEE) is a widely accepted metric for evaluating the performance of equipment in various industries. It provides a comprehensive framework for measuring equipment effectiveness by considering three key factors: availability, performance, and quality. OEE is calculated as the ratio of the actual output of the equipment to its maximum potential output under optimal operating conditions. The concept of OEE originated from the Total Productive Maintenance (TPM) practices developed by Seiichi Nakajima at the Japan Institute of Plant Maintenance. TPM aims to achieve perfect performance and zero loss, which encompasses the elimination of production scrap or defects, breakdowns, accidents, and waste in the production process.

OEE Calculation:

Overall Equipment Effectiveness (OEE) is a widely accepted metric for evaluating equipment performance. It provides a comprehensive framework for identifying and addressing six major losses that impact equipment effectiveness. These losses include: Downtime losses, Speed losses, Scrap and rework losses

OEE is calculated by multiplying three key factors:

- **Availability:** This factor accounts for downtime losses, which occur when equipment is not available for production due to breakdowns, maintenance, or other issues.
- **Performance:** This factor addresses speed losses, which occur when equipment operates at a slower pace than its designed capacity.
- **Quality:** This factor accounts for scrap and rework losses, which occur when equipment produces defective or non-conforming products.

OEE = Availability x Performance rate x Quality rate (1)

Availability: Availability is a crucial factor in determining Overall Equipment Effectiveness (OEE). It is calculated by subtracting downtime from planned production time and then dividing the result by the planned production time. This can be written in the form of formula as

Availability = ((planned production time – Downtime)/ planned production time) * 100 (2)

Performance: The performance rate of equipment is a critical metric for assessing its efficiency and effectiveness. It can be calculated by multiplying the ideal or theoretical cycle time to produce an item by the output of the equipment, and then dividing the result by the operating time. The formula to calculate the performance rate can be expressed as

Performance rate = ((theoretical cycle time * output)/ Operating time) * 100 (3)

Quality: The quality rate of equipment or a process is a critical metric for assessing its performance and effectiveness. It can be calculated by subtracting the volume or number of quality rejects from the production output, and then dividing the result by the production output. The quality rate can be expressed in a formula as

Quality rate = ((production output – quality rejects)/ Production output) * 100 (4)

RESEARCH METHODOLOGY

RESEARCH STATEMENT:

This research problem refers to the difficulty faced by researcher in the context of obtaining either a theoretical or practical solution or wants to obtain a solution for the same. A research problem is one which requires finding out the best solution. Before study it is observed that organisation is facing higher wastage due to frequent breakdowns in the production line and facing the maintenance issues due to these breakdowns. Breakdown affects idle machine, idle time and lead time of product packaging. The cost of final products by avoiding the wastage of edibles as the edibles are the most costly and consumable item in the production therefore to minimise the cost of maintenance due to frequent breakdowns.

OBJECTIVES

1. To study various causes those are responsible for the low productivity of production line.
2. To find out the origins of minor and major breakdowns, and evaluate downtimes of the maxi production line.
3. To evaluate the overall equipment effectiveness and its optimisation for the increase in the productivity.

4. To find out the alternatives for optimisation in the overall equipment effectiveness of production line.

SCOPE OF THE STUDY

This study is concerned to operations and production department of the Food Processing Industry. It concerns the cost reduction through minimising edible wastage generating during production operations. It is concerned to reduce the lead time for product packaging, also better inventory control. It focuses on the increase the actual productivity against the standard set of goal. It concerns improving quality standards of finished products and reduction of manpower hours required per production machine.

RESEARCH DESIGN:

A research design is a systematic approach to planning and executing a research study. It involves creating a detailed plan for collecting and analyzing data, with the aim of ensuring that the research is conducted in a way that is both relevant to the research purpose and efficient in terms of time and resources. This study employed an exploratory research design, which is a flexible and iterative approach that allows researchers to explore complex phenomena, identify patterns and relationships, and generate hypotheses for further investigation.

Exploratory research

Exploratory research is a type of research design that is typically employed when a research problem has not been clearly defined. This approach enables researchers to gain a deeper understanding of the problem, identify relevant variables, and develop hypotheses for further investigation. Exploratory research involves a more formal and structured approach, utilizing methods such as in-depth interviews, focus groups, projective methods, case studies, and pilot studies.

DATA COLLECTION:

Data collection is the process of gathering facts, figures, and other relevant materials, both past and present, to serve as the foundation for a research study. This involves collecting and recording data in accordance with a predetermined research design, providing a basis for analysis and interpretation.

Primary data:

- ❖ **Cause and Effect Analysis sheet (Production and Maintenance Log Book):**
 - A structured cause and effect analysis sheet is prepared which contains list of reasons for the causes of the minor as well as the major breakdowns causing the frequent stoppages in the production process are recorded in the same report.
 - Pareto charts are used to represent the frequency of occurrence of the breakdown errors and the area of occurrence.
- ❖ **Overall Equipment Effectiveness data sheet:**
 - Daily production and the wastage are recorded in the sheet. Downtime and the operating time are recorded, also the run rate of the production line is been recorded.

DATA INTERPRETATION:

The Food Processing Company has implemented a restricted quality inspection system, complemented by its ISO 9001:2008 certification, obtained in 2017. The company's production process is continuous, with three primary workstations: the Medi Line, Maxi Line, and Easy Line. Notably, the Medi Line exhibits minimal failures and undergoes regular maintenance. In contrast, the Maxi Line is more prone to failures. The company maintains a record of previous maintenance work on the production line, as well as time losses observed during the production process on working days in June 2019.

There are some standards from the industry:

The production line operates at a theoretical speed of 17 modules per minute. To assess its efficiency, the following metrics are considered:

- Downtime: Records of downtime caused by failures over 10 operating days, covering three shifts of eight hours each, have been collected.
- Real Production Line Speed: The actual speed of the production line is compared to the nominal speed of 17 modules/minute, with real speeds calculated for each day.
- Rework and Scrap Products: The number of products requiring revision and those deemed worthless (scrap) are tracked, noting that rework products are negligible.
- Operator Expertise: Operators possess the necessary knowledge and skills to understand the expressions used and the importance of accurate measurements.

In table 1, the data taken direct from the production line for shift I, shift II and shift III, the amount of scrap is the amount of defectives caused by breakdown or malfunction failure. The speed is taken for the period of operating.

Table 1. The Average downtime and amount of total production and amount of rejected production for the First 10 operating days in June 2020 for shift I, II, & III.

Day	1	2	3	4	5	6	7	8	9	10
Downtime	275	267	227	223	273	249	469	262	241	335
Total Production	8273	8687	9648	10359	7585	9338	452	8732	9644	5748
Rejected Production	1943	2641	1847	2641	1980	2067	149	1974	3001	1029

OEE Calculation

The calculation of Overall Equipment Effectiveness (OEE) is a critical step in identifying potential errors or weaknesses in the production process. This calculation is based on four primary equations, which provide a comprehensive framework for evaluating equipment performance. The first equation (1) is used to calculate availability, which involves analyzing downtime and operating time data from the table. The second equation (2) is then applied to determine the availability of the production line. This study, conducted over a 10-day period in

June 2020, provides a thorough understanding of the production process and identifies areas for improvement.

The Availability Factor

As presented in Table 1, the total downtime for the 10 operating days has been recorded. To calculate the valuable operating time for the same period, the theoretical time required to produce the edible products is added to the total downtime. This calculation provides a comprehensive understanding of the production process and serves as a critical step in the Overall Equipment Effectiveness (OEE) analysis.

For Day 1,

$$\text{Availability} = ((\text{planned production time} - \text{Downtime}) / \text{planned production time}) * 100$$

$$\text{Availability} = ((480 - 275) / 480) * 100 = 42.71$$

The Performance Factor

To calculate the performance of the production line, two primary factors are required. The first factor is the designed cycle time, which is the theoretical time required to produce one unit of product. In this case, the designed cycle time is 17 modules per minute (mild/min). The second factor is the total output, which represents the actual number of units produced.

By applying the performance equation, we will get the following results.

$$\text{Performance rate} = ((\text{theoretical cycle time} * \text{output}) / \text{Operating time}) * 100$$

$$\text{Performance} = ((17 * 8273) / 205) = 23.74$$

The Quality Factor

To calculate the quality factor, we need the total amount of rejects for the 10 operating days and we find it from the table 1, and the quality factor is

$$\text{Quality rate} = ((\text{production output} - \text{quality rejects}) / \text{Production output}) * 100$$

$$\text{Quality} = ((8273 - 1943) / 8273) * 100 = 76.51$$

The Overall Equipment Effectiveness

After we got the three main factors, we can now calculate the overall equipment by using the following equation

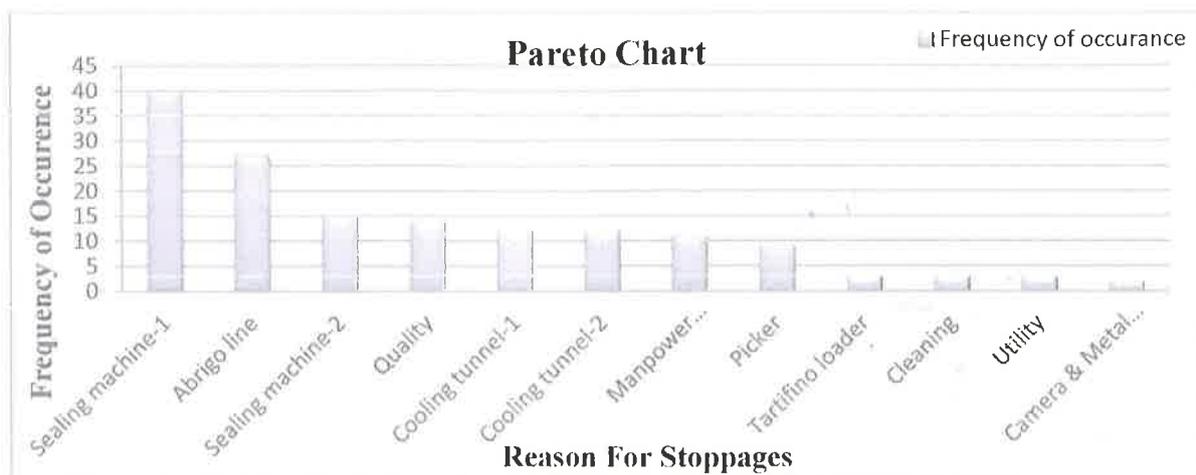
$$\text{OEE} = \text{Availability} * \text{performance} * \text{Quality} = 0.42 * 0.23 * 0.76 = 0.77 = 77\%$$

The world class manufacturing OEE is 90%, and the best OEE score in the company was calculated by the machines designer and it was 77%, the equipment effectiveness is reduced by 13%.

Pareto Analysis and Pareto Chart

Reasons for stoppages	Frequency of occurrence	Percentage	Cumulative Percentage
Sealing machine-1	40	26.49	26.49
Abrigo line	27	17.88	44.37
Sealing machine-2	15	9.93	54.3
Quality	14	9.27	63.57
Cooling tunnel-1	12	7.94	71.51

Cooling tunnel-2	12	7.94	79.45
Manpower shortage	11	7.28	86.73
Picker	9	5.96	92.69
Tartifino loader	3	1.98	94.68
Cleaning	3	1.98	96.66
Utility	3	1.98	98.64
Camera & Metal detector	2	1.32	100
	151		



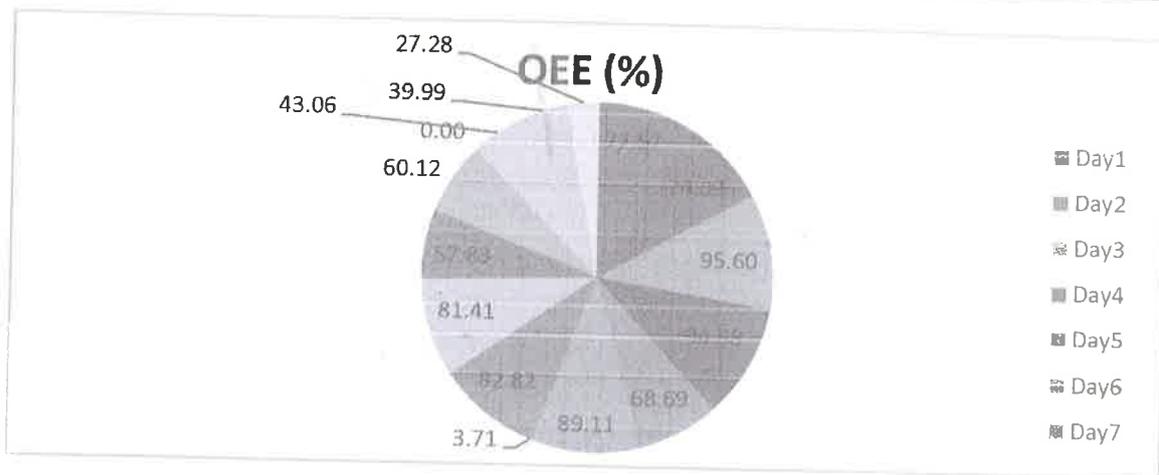
Graph No. 5.1 Pareto Chart

Pareto analysis is used to identify the “vital few” factors that contributed to breakdown errors during production of the Kinder Joy. It has been identified twelve major regions of production line where the errors are occurred, and the data is collected on the frequency of occurrence of each type. When this data is displayed in a Pareto diagram, it is discovered that seven regions of errors accounted for 80% of all errors. Instead of working on all error types, its efforts on these seven “vital few” error regions has been focused.

Analysis of Overall Equipment Effectiveness i.e OEE(%)

Sr. No	Day	Availability (%)	Performance (%)	Quality (%)	OEE (%)
1	Day1	42.71	23.74	76.51	77.57
2	Day2	44.38	23.99	69.60	74.09
3	Day3	52.71	22.43	80.86	95.60
4	Day4	53.54	23.71	74.51	94.58
5	Day5	43.13	21.55	73.90	68.69

6	Day6	48.13	23.78	77.86	89.11
7	Day7	2.29	24.17	67.04	3.71
8	Day8	45.42	23.56	77.39	82.82
9	Day9	49.79	23.74	68.88	81.41
10	Day10	30.21	23.32	82.10	57.83
11	Day11	40.83	17.70	83.21	60.12
12	Day12	0.00	0.00	0.00	0.00
13	Day13	39.17	15.46	71.10	43.06
14	Day14	36.67	15.89	68.62	39.99
15	Day15	62.08	6.65	66.11	27.28



Graph no. 5.8 Analysis of OEE (%)

OEE is the product of Availability, Performance and Quality. OEE is highest on the 3rd June i.e 95.60% due to moderate availability percentage and high-quality percentage while it is lowest on the 12th June. It is observed that for the maximum OEE, production line should be available for maximum operating time and the number of rejections, wastage should be lower to get higher quality percentage.

Implementation TPM Strategy

The company's motivation to implement Total Productive Maintenance (TPM) stemmed from the need to adapt to changing market demands and elevate production performance to international standards. A key objective was to eliminate non-value-added waste, including time and material waste. The initial focus was on enhancing quality through the implementation of a robust quality inspection system and monitoring framework. This endeavor involved the establishment of a quality improvement team, employee training on identifying quality-related issues and root causes, and leveraging data-driven insights for continuous improvement.

To achieve optimal equipment performance and productivity, our organization launched autonomous maintenance tasks. These tasks involve a range of activities, including equipment setup and adjustment, inspection, cleaning, and line checking. By empowering employees to take ownership of maintenance tasks, we aim to improve equipment reliability, reduce downtime, and enhance overall productivity. In addition to autonomous maintenance, we established multidisciplinary teams to foster collaboration and knowledge-sharing across departments. These teams comprise representatives from all departments, including suppliers, and provide a platform for discussing critical aspects such as raw material quality.

Three specialized teams were created to address specific aspects of productivity and efficiency:

1. Solve Problem Unit (SBU): This team identifies and resolves problems, documenting unresolved issues in the "Gap List." The SBU plays a critical role in ensuring that problems are addressed promptly, reducing downtime and minimizing losses.
2. Focus Team: This team assumes responsibility for systematic problem-solving, equipment and process evaluation, and establishing optimal practices to eliminate losses and ensure continuous improvement. The Focus Team works closely with the SBU to ensure that problems are addressed at their root cause.
3. Strategic Planning Team: Comprising managers and department heads, this team develops a safe and profitable strategy for the entire productivity journey. The Strategic Planning Team provides guidance and oversight, ensuring that our productivity initiatives align with our organizational goals and objectives.

Findings

Pareto Chart indicates, 80% of the stoppages are caused due to breakdowns in the Sealing Machine-1, Abrigo line, Sealing Machine-2, Quality checks, Cooling Tunnel-1, Cooling Tunnel-2, Manpower Shortage. The company had not previously calculated its Overall Equipment Effectiveness (OEE) despite having a standard metric in place since the installation of the line. To drive improvement, it is essential to measure performance. An assessment was conducted to evaluate the company's OEE, revealing an overall score of 72%. This comprised three key components: availability, performance, and quality. The results showed that the line was available for 41% of production time, with a performance rate of 23% and a quality factor of 74.8%. To provide context and identify opportunities for improvement, the company's metrics were compared to world-class benchmarks in Table 2.

The comparison between WCM and company

Factors	OEE company	OEE world class
Availability	41.23%	90%
Performance	23.40%	90%
Quality	74.86%	90%

The table highlights the need for the company to achieve world-class quality standards. To accomplish this, a rigorous quality measurement and inspection system has been implemented, covering the entire production process, from raw materials inventory to finished goods inventory. This system ensures that quality is monitored and controlled at every stage of production. However, to achieve significant improvements in efficiency and productivity, the company must focus on upgrading its machinery and systems, as well as reducing waste time. This will involve identifying areas of inefficiency, implementing process improvements, and investing in new technologies and equipment.

CONCLUSION

The implementation of the TPM strategy offers a comprehensive approach to reducing waste and optimizing production efficiency. By empowering both operators and engineers to take ownership of equipment maintenance, the TPM strategy ensures prompt resolution of breakdowns, minimizing downtime losses. Furthermore, three key techniques – Computerized Maintenance Management System (CMMS), production planning, and Preventive Maintenance (PM) – will have a profound impact on improving production line efficiency and streamlining maintenance processes. These techniques enable the company to operate at optimal performance levels without losses, ultimately leading to enhanced productivity and competitiveness.

REFERENCES:

- Rajiv Kumar Sharma, Dinesh Kumar and Pradeep Kumar, "Manufacturing excellence through TPM implementation: a practical analysis", *Industrial Management & Data System*, Vol. 106 No. 2, 2006, 256-280.
- C.J. Bamber, P. Castka, J.M. Sharp, Y. Motara, "Cross-functional team working for overall equipment effectiveness (OEE)" *Journal of Quality in Maintenance Engineering*, Volume 9 Number 3, 2003, 223-238.
- Nich, Rich 'total productive maintenance: lean approach', 1999, Tudor Business limited.
- Nakajima S., *Introduction to TPM*, productivity press, Portland , 1988.
- Total Productive Maintenance review and Overall Equipment Effectiveness (OEE) Measurement, Osama Taisir R. Almeanazel, *JJMIE*, Volume 4, Number 4, September 2010 ISSN 1995-666.