International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 5 Issue 7, July-2016

Implementation of Total Productive Maintenance Pillar (Autonomous Maintenance & Kobetsu kaizen) for improvement-A case study in bottling plant

Naresh Kumar[1], Er. Dinesh Kumar[2]

[1]PG Student- Department of Mechanical Engineering- JCDM college of Engineering -Sirsa, (GJU-Hisar) India
[2]Associate Professor & HOD-Department of Mechanical Engineering- JCDM college of Engineering-Sirsa, (Hry.) India.

ABSTRACT

In today's scenario of industrialization & globalization, the global market place becomes highly competitive and every organization has to set its limits in terms of productivity, quality, continuous improvement, cost cutting and customer satisfaction in order to survive in this environment. The main purpose of this paper is to understand the implementation process of Total Productive Maintenance pillars- Autonomous Maintenance & Focused Improvement in a large volume bottling plant and to investigate its results in order to find out, how much TPM is beneficial for the growth of the organization. In order to achieve effective implementation of TPM at various production lines in bottling plant a Master Plan has been made which described the complete timeline and stepwise process layouts. Data from past have been collected & analyzed. Moreover, the results achieved are encouraging in terms of reduction in breakdowns, improvement in OEE, improvement in quality and satisfaction of employees.

Keywords: Total Productive Maintenance (TPM), Kaizen, Overall Equipment Effectiveness (OEE), Autonomous Maintenance (Jishu Hozen), 5-S

INTRODUCTION

TPM is an approach which involves employees from TOP management level to grass root level with both production & maintenance departments. Also TPM is a proactive & cost-effective approach to keep the equipment at its perfect working condition, to understand the equipment functions, its failures with the support of all levels of organization, in order to increase the productivity by maximizing OEE and to increase the employee's satisfaction & their morale by providing friendly working environment [2]. According to Angeles (2009), TPM can be described as a plant improvement methodology which enables continuous & rapid improvement of the manufacturing process through the use of employee's involvement, employee empowerment & closed loop measurement of results. In order to setup Total Productive Maintenance framework in any organization, its understanding must be required. According to Nakajima (1989), the goal of the Total Productive Maintenance (TPM) is to continuously improvement of all operational conditions, within a production system by motivating the daily understanding of all employees. It is also defined as, bringing both functions (i.e. production & maintenance) together by a combination of good working approaches, team spirit, team working & continual improvement [7].

LITERATURE REVIEW

Frequent advancement in the technology & automation in Indian manufacturing industries has increased the complexity of equipment & its operation. Also due to the increasing competition scenario among Indian manufacturing industries, it is necessary to operate the equipment at their full efficiency by improving the quality & reductions in maintenance costs. By keeping in mind the above scenario this research, study & work has been done. The study aimed at implementation of Total Productive Maintenance Pillar- Autonomous Maintenance (Jishu Hozen) & Focused Improvement in Soft drink Beverage Bottling plant located in North India. The study critically examines the factors which are totally affected in a positive way after implementation of TPM [1]. It also highlights the obstacles occurred during the period from introduction of TPM to its implementation in plant. Moreover, the study illustrates how Autonomous Maintenance & Kaizen can be helpful approaches for Indian industries in order to achieve their goals &

targets in terms of productivity & growth. The major objective of this study is to implement the TPM in the organization and to find how TPM is beneficial for the growth of the organization. The study also develops the step wise detailed phases of Implementation of Total Productive Maintenance pillar- Autonomous Maintenance & Focused Improvement in the plant and also describes how TPM system integrates every activities of the company with maintenance department as well as involving the operators in maintenance activities [9].

AUTONOMOUS MAINTENANCE (JISHU HOZEN)

Also known as operator's pillar. It aims to create a scenario where all operators look after own equipment, carrying out routine checks, oiling, greasing, replacing parts, doing repairs, spotting problems at an early stage, checking precision & so on [13]. When the equipment works better, the people works better & when the people woks better, the whole factory works better. Autonomous Maintenance should be introduced gradually under the guidance of management, with each step implemented thoroughly [8].

Seven steps pf implementation of Jishu Hozen pillar-

Step 0: Safety

Step 1: Initial Cleaning

Step 2: Elimination of sources of contamination & inaccessible places.

Step 3: Standards for cleaning & lubrication of equipment.

Step 4: Regular Inspections

Step 5: Autonomous Inspections

Step 6: Standardization

Step 7: Fully implemented autonomous maintenance pillar.

FOCUSED IMPROVEMENT (KOBESTU KAIZEN)

Kaizen realize the zero loss situation in such as in equipment failure and product defect and that affect ultimate production efficiency situation [6].

Kaizen policy- improve overall plant equipment effectiveness.

- Use PM analysis as a tool for eliminating losses.
- Practice concepts of Zero defects.
- To achieve cost reduction.
- Focus of easy handling of operators.

Focused improvement includes all the activities/practices that maximize the overall equipment effectiveness of the equipment, processes and organization through elimination of loss [8]. Kaizen forms an essential part of TPM. A number of Kaizens were applied in the different areas of the plant where there was some improvement to be needed in the machine, in the equipment or in the process so as to make the work flow smoother and easy operation and to improve the efficiency of the machine or process [13].

OVERALL EQUIPMENT EFFECTIVENESS (OEE)

The effectiveness of the equipment is the actual output over the reference output. The overall performance of the equipment can be enhanced by identifying & elimination the root causes. OEE is used as a tool to measure the effectiveness of equipment & its current condition. It has been developed by the JIPM [10]. Overall Equipment Effectiveness is an important measurement tool for assessing the performance of the equipment [6].

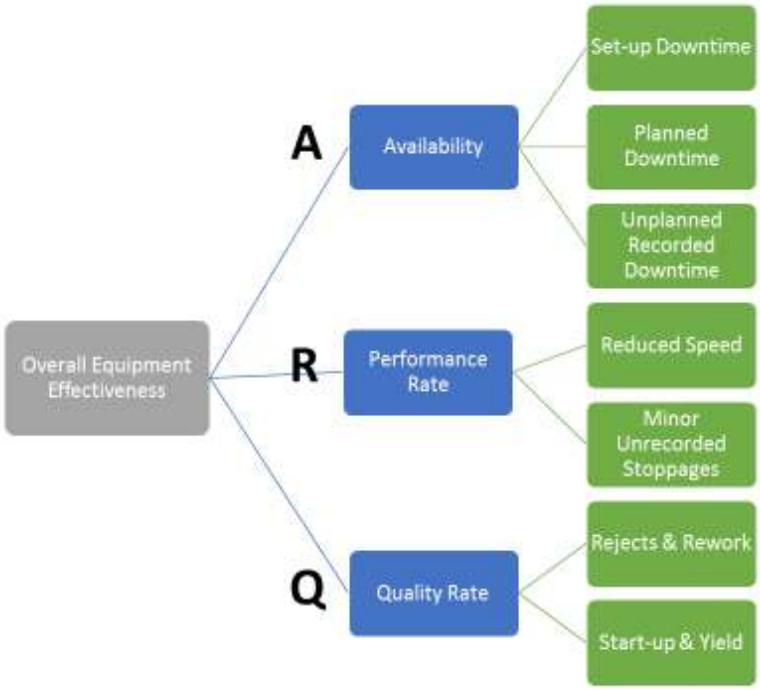

Fig. 1 Overall Equipment Effectiveness Model

TAGGING

Tagging is an another approach to find out the problems, issues that we are facing in day to day activities in equipment. We used two types of tags i.e. White tags & Red tags. White tags are used when abnormalities found in the machines or equipment can be resolved by operator himself or with the help of production staff. On the other hand, Red tags are used when the abnormalities are only rectified with the help of special equipment & with the help of maintenance staff [16]. Tag recording sheet were prepared that shows complete detailed tag records of that particular day along with the tag summary report that shows the all tag status for a particular month.

S approach

5-S is a technique that results in a well -organized work place compete with visual controls & order. 5-S produces a workplace that's clean, uncluttered, safe & organized [2]. The 5-S stands for 5 Japanese words that constitute good housekeeping. They are-

1. Seri- Sorting
2. Seiton- Set in order
3. Seiso- Shine
4. Seiketsu- Standardize
5. Shitsuke- Sustain

REASONS FOR LOW PRODUCTIVITY

There are several reasons which were casing low productivity in the plant are as follows: -

1. Lack of trainings & motivation
2. Improper maintenance
3. Unplanned maintenance
4. Regular & unexpected breakdowns
5. Improper planning to attend the breakdowns
6. Workers idleness & training
7. Shortage of input

OBJECTIVES

The objectives of this case study were-

1. To implement the Total Productive Maintenance Pillar- Autonomous Maintenance & Focused Improvement.

2. To increase productivity of production lines.
3. To minimize the breakdowns & reduce the stoppage times and minor production losses.
4. To implement the Kaizens in different area of plant so as to provide better work process, operation and smoother work flow.
5. To provide better employees engagement with the work process, machine or equipment.

METHODOLOGY & TOOLS USED

Now that the top management and employees are on the same boat, the first thing to do is to establish a team that will coordinate the activities of TPM. The team should necessarily consist of employees from all the levels of the organization right down to the operator level i.e. a team of Team members & Team mates with supporting hand of Management. This team – the TPM team will be responsible for identifying the goals and laying down strategies and outlining resources required to achieve the goals. These goals should be very specific, precise, quantifiable and profitable with all the members having a clear idea of what to achieve. Teams to be formed in such a way that each member have expertise in particular specific areas. These teams to be given the responsibility of identifying and rectifying issues in the equipment's to which they are assigned and developing master plan for failure prevention.

Once the teams are formed, then a complete introduction has given to all of the team about the complete process. They have to identified the equipment's they would work on, the first set of activities to be carried out is grouped under what is called as 5S. The next task, once the area is cleared and in order, is to convince and persuade the operations personnel especially the operators to carry out the routine maintenance activities and inspection and to prepare work instructions for the machines under their control and responsibility. The most important requirement for operators is to have ability to detect abnormalities in the working of the equipment with respect to operation and quality of output, based on a sense that there is something wrong.

Some of the activities may be - regular cleaning of machines, checking the operating parameters, greasing, general inspection for any abnormalities like increased sound, dripping of lubrication oil or grease, disconnection of machine earthing etc. This attitude can be developed only if machines are allocated to each of the operators to inculcate a sense of belonging among the operators. This is the concept of autonomous maintenance. When using TPM, the operator and maintenance staff become partners in seeking to improve equipment performance while the maintenance staff and engineers become partners in designing equipment for enhanced performance. Approaches & tools used- Trainings, 5-S technique, Visual Management, Tagging, Autonomous Maintenance, Kaizen and Overall Equipment Effectiveness, Safety, List & classification of hard to access areas & abnormalities.

DATA COLLECTION & PRESENT STATE ANALYSIS

In order to better understand the current situation of the plant, various data of last 6 months were collected from the different sources; -

1. **Time spent in production** with operators, foreman so as to obtain the real problems occurred in machines, process in day to day operations.
2. **Getting to know TPM**- Because everyone in the company had lack of TPM knowledge, so there was a certain need for information. This was accomplished in part by Literature studies and also through training sessions by experienced and expert consultants.
3. **Daily Production Data**- various data were collected from the daily production log books, records like machines efficiencies, process route, change over time etc.
4. **Maintenance records**- Breakdown and maintenance records were collected from the maintenance department log books in order to clearly understand the frequency of breakdown for the particular machines & particular time.

OEE Calculation-

OEE = Availability x Performance Rate x Quality Rate

From the observations and data collected, we consider filling machine as a whole as one machine and considered the available machines in that area.

Schedule running time - 6am to 10pm = 16 hrs. (960 mins.)
Unplanned stoppages = 124 mins.
Schedule running time for 1 month= 30 days= 30 x 16 = 480 hrs. (28,800 mins.)
Unplanned stoppage for 1 month = 124 x 30 = 3720 mins.

$$\text{Availability} = \frac{28800 - 3720}{28800} \text{ x } 100 = 87.08\%$$

Total production in 7 months – 60 lacs cases
No. of working days in 7 months - 200
Standard production – 30,000 cases

$$\text{Actual average production} = \frac{6000000}{200} = 30{,}000\ cases/day$$

$$\text{Performance Rate} = \frac{30{,}000}{34000} \text{ x } 100 = 88.24$$

Total average rejection per day = 4% i.e. 1200 cases/day
Total rejection for 1 month = 36000 cases
Total production for 1 month = 30,000 x 30 = 9,00,000 lac cases

$$\text{Quality Rate} = \frac{900000 - 36000}{900000} \text{ x } 100 = 96\%$$

Therefore, the Overall Equipment Effectiveness of the production line is
= 0.8708 x 0.8824 x 0.96 x 100 = 73.77 %

RESULTS & CONCLUSIONS-

After successful implementation of TPM pillar Autonomous Maintenance and doing of effective Kaizens in different areas of plants, we obtained better results in terms of increase productivity, reduction in breakdowns, better work process and operators understanding about their work, machines. Overall Equipment Effectiveness increased from 73.77% to 86.38 %

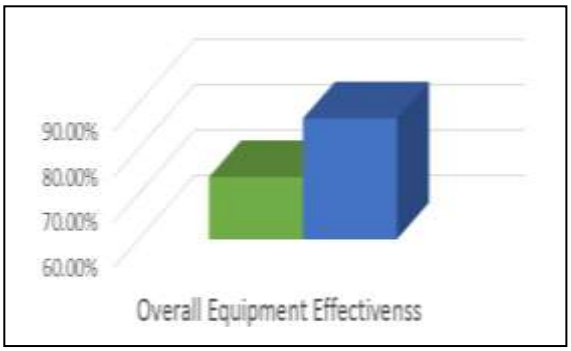

Fig. 2: OEE before & after TPM implementation

After complete analyzing the data we obtained following results: -

1.Approx. 15-20% reduction in daily breakdowns.
2. Machine availability time increased.
3.Better machining operations, improves machine life and its working condition.
4. 25-30% reduction in Mechanical Breakdowns.
5. No customer complaints.
6. Zero Accidents.

REFERENCES

[1]. Priyanka Malviya (2015), "The Impact of Total Productive Maintenance on Manufacturing Performance" in IJESRT. Vol.-4, Issue-1, ISSN: 2277-9655.
[2]. Prof. Shahzad Ahmad & Syed M.D. Shahwaz- (2015), "Implementation of Total Productive Maintenance in Thermal Power Station" in IJOER. Vol.-1, Issue-3.
[3]. Dr. Sandeep Jindal and Rachin Goyal- (2015), "A Systematic Approach Towards Implementation of TPM in an Automobile Industry" in International Journal of Engineering Research in Management & Technology. Vol.-4, Issue-10, ISSN:2278-9359.
[4]. P.K Suresh- (2012), "TPM implementation in a Food Industry-A PDCA approach" in International Journal of Scientific & Research Publications. Vol.-2, Issue-11, ISSN: 2250-3153.

[5]. Halim Mad Lazin, Mohamed Najib Salleh and Siti Norezam Othman- (2013), "Total Productive Maintenance & Manufacturing Performance: Does Technical Complexity in the Production Process Matter?" in International Journal of Trade, Economics & Finance. Vol.-4, No.-6.
[6]. Hemant Singh Rajput and Pratesh Jayaswal-(2012), "A Total Productive Maintenance approach to Improve Overall Equipment Efficiency" in International Journal of Modern Engineering Research (IJMER). Vol.-2, Issue-6, ISSN: 2249-6645.
[7]. Prasanth S. Podwal, Dr. V.R. Pramod and DG. Jagathy Raj V.P.-(2013), "Barriers in TPM Implementation in Industries" in IJSTR. Vol.-2, Issue-5, ISSN: 2277-8616.
[8]. Vijay D Kedaria and Prof. Vivek A. Deshpande- (2014), "Implementation of Total Productive Maintenance Methodology: A Review" in International Journal of Emerging Technology and Advanced Engineering. Vol.-3, Issue-4, ISSN: 2250-2459.
[9]. Melesse Wakjira, Workineh Ananth and Shalvapulle Iyengar- (2014), "Autonomous Maintenance: A Case Study on Assela Malt Factory" in Bonfring International Journal of Industrial Engineering and Management Science. Vol.-4, No.-4.
[10]. S.R.Vijayakumar , S.Gajendran, " Improvement of overall equipment effectiveness (oee) in injection moulding process industry" in IOSR-JMCE, PP 47-60.
[11]. Glenda Williamson- "Case Study- Implementing Visual Management" in Kangan Institute of TAFE."
[12]. Khairul Hafiz Norddin Mohd Norddin and Muhamad Zameri Mat Saman- (2012), "Implementation of Total Productive Maintenance Concept in a Fertilizer Process Plant" in Jurnal Mekanikal. June 2012, No. 34, 66-82.
[13]. Article in Production and Operations Management "TPM- Planned and Autonomous Maintenance: Bridging the Gap between practice and Research" by Kathleen E. Mckone and Elliott N. Weiss- Vol. 7 No.4 Winter 1988.
[14]. Total Productive Maintenance – Quality Circle Forum of India.
[15]. Ajit Pal Singh, "Total Productivity Maintenance, Case Study in manufacturing" in Global Joirnal of Research engineering ISSN 2249-4596.
[16]. Harsha G. Hegde, N. S. Mahesh & Kishan Doss (2009), "Overall Equipment Effectiveness Improvement by TPM and 5S Techniques in a CNC Machine Shop", in SASTECH, Volume 8, Issue 2.