

Total productive
maintenance
increasing efficiency
management essay



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Total Productive Maintenance (TPM) is a manufacturing program whose sole purpose is to maximize the effectiveness of equipment throughout its entire life by the participation and motivation of the entire workforce. The three main objectives of TPM are zero defects, zero breakdowns and zero accidents. These goals can be achieved through implementation of activities planned to increase equipment efficiency, the creation of a program of autonomous maintenance, the establishing of a planned maintenance system, the organization of training courses for workers and design of plant management system. This paper addresses the issue of implementing the total productive maintenance (TPM) philosophy in a pharmaceutical industry. In the first phase, the possible losses and the factors contributing to those losses have been identified. The critical factors which affect the overall equipment efficiency (OEE) of the pharmaceutical industry are loading time, down time, standard cycle time, actual cycle time, unit produced and defect unit. Overall equipment efficiency (OEE) is an indication of eight major equipment related losses which are equipment failure, set-up and adjustment, cutting blade change, start-up, minor stoppage and idling, speed, defect and rework and equipment shutdown. In the second phase of TPM implementation, a planned maintenance program has been suggested to make the production process quite smooth and proficient with increased efficiency.

Key words: TPM; Production Efficiency; Loss Structure; Overall Equipment Efficiency

1. INTRODUCTION

Any industry needs to keep proper vigilance for producing product without defect, reducing product rejection and wastage, reducing equipment breakdown and down time, increasing worker and equipment efficiency, maximize equipment and manpower utilization, eliminate accident of any types. TPM is the new concept evolving to meet this tremendous requirement of the modern competitive industry. TPM ensure the maximum use of the existing equipment and perform the increased production within regular working hour to achieving the cost reduction without sacrificing the product quality. Any company can achieve production efficiency and other excellence by successful utilization of the TPM concepts and the tools and techniques of the TPM. Total Productive Maintenance (TPM) is a maintenance program, which involves a newly defined concept for maintaining plants and equipment. The goal of the TPM program is to markedly increase production while at the same time increasing employee morale and job satisfaction. TPM brings maintenance into focus as a necessary and vitally important part of the business. It is no longer regarded as a non-profit activity.

TPM is an innovative Japanese concept. The origin of TPM can be traced back to 1951 when preventive maintenance was introduced in Japan. The Japanese, based on the planned approach to preventive maintenance (PM), evolved the concept of total productive maintenance (TPM). Nakajima (1986) outlines how, in 1953, 20 Japanese companies formed a PM research group and, after a mission to the USA in 1962 to study equipment maintenance, the Japan Institute of Plant Engineers (JIPE) was formed in 1969, which was the predecessor to the Japan Institute of Plant Maintenance (JIPM). In 1969,

JIPE started working closely with the automotive component manufacturer Nippondenso on the issue of PM, and when the company decided to change roles of operators to allow them to carry out routine maintenance this was the beginning of TPM. Tajiri and Gotah (1992) point out that whilst TPM was communicated throughout Japan only a small number of factories took up the challenge. It was the severe economic situation in the early 1970s that accelerated the adaptation of TPM, propagated by the seven-step programme developed by the Tokai Rubber Industries. In the early 1990s, Western organizations started to show interest in TPM following on from their total quality management (TQM) interventions. While there are a number of publications: Suzuki (1994); Sekine and Arai (1998); Hartmann (1992); Wilmott (1994) on the subject, there is little in the way of empirical study and analysis. The more academic papers focus on the relationship of TPM with other productivity initiatives by Maggard and Rhyne (1992) and discussion of a specific application of TPM and the benefits by Koelsch (1993) show potential advantages of TPM in the industries. McCall (1965) and Bain and Engelhardt (1991) publish papers focusing on modeling the reliability of equipment and on developing policies to inspect, repair, or replace equipment based on its specific reliability characteristics. But there are lagging in academic research that goes beyond these traditional modeling approaches and adequately supports the implementation of TPM activities, practices, and management systems. McKone and Weiss (1995) identify significant gaps between industry practice and academic research and emphasize the need to bridge these gaps by providing guidelines for implementing TPM activities. As the goal of the TPM program is to markedly increase productivity without losing product quality which is the major

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concern of business organizations, enormous companies of Bangladesh are trying to adopt TPM. The Pharmaceutical industry is one of the most promising foreign earning sectors of Bangladesh. So there is a great scope to improve production rate as well as quality product in which field TPM approach can be applied. But unfortunately, a few Pharmaceutical companies are aware of the situation. This paper tries to find out the scope of TPM approach and the way of implementation in Bangladeshi Pharmaceutical companies.

2. OBJECTIVE OF THE STUDY

The objective of the present work is to study how the tools and technique of TPM can be applied in a Pharmaceutical industry, calculate the present Overall Equipment Efficiency (OEE) of the equipment in the tablet manufacturing line in a Pharmaceutical industry, focus on the losses occurred during production activity, develop a loss structure of the equipment in tablet section, design a procedure for the employee to use different type of analytical tool to explore a problem and eliminate it.

3. METHODOLOGY

The work has been carried out in a pharmaceutical company to do this job. Six factors have been identified which affect the overall equipment efficiency (OEE) of drag production. Those are: loading time, down time, standard cycle time, actual cycle time, and unit produced and defect unit. The combined effect of these six factors of this process is shown in Fig. 1.

Availability

Loading time

Operating time

Down time

Standard cycle time

Performance rate

Actual cycle time

Unit produced

Quality product rate

Defect unit

Speed operating rate

Net operating rate

O

E

E

Fig. 1: Effect of different factors on OEE

The measured values of input variables, output variables and overall equipment efficiency are shown in Table 1, Table 2 and Table 3 respectively.

The necessary equations that have been used in this study to find the overall equipment efficiency (OEE) have been listed below:

(1)

(2)

(3)

(4)

(5)

(6)

(7)

Table 1. Values of input variables

Input variables

Measured values

Loading time

420 min

Down time

10 min

Standard cycle time

0.8 $\times 10^{-3}$ min/pcs

Actual cycle time

1. 303Å-10-3 min/pcs

Unit produced

184 kg

Defect unit

3kg

Table 2. Values of output variables

Output variables

Measured values

Operating time

410 min

Speed operating rate

61. 4 %

Net operating rate

95. 34%

Availability

97. 6%

Performance rate

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58. 54%

Quality product rate

98. 3%

Table 3. Value of overall equipment efficiency

Output variable

Measured values

OEE

56. 16%

3. LOSS STRUCTURE ANALYSIS

Though loss is an inevitable scenario of a production system, now the organizations are trying to minimize production related losses as much as possible. To do this a loss structure has to be developed to analyze the losses for an organization. In this paper, equipment related losses have been identified and summarized for a Pharmaceutical industry in order to enhance quality of products as well as to increase the rate of production through implementing the total productive maintenance (TPM) approach.

4. 1 Eight Major Equipment Related Losses

As OEE is an indication of eight major equipment related losses, using the calculated OEE these causes can be easily minimized. These losses are:

4. 1. 1 Equipment failure loss: This is the largest factor which obstructs efficiency is the equipment failure loss. The failure can be classified into two

types; one is the function-stoppage type and the other is the function-deterioration type. The function-stoppage type failure is the one which occurs unexpectedly, while the function-deterioration type failure is the one in which the equipment function decreases.

4. 1. 2 Set-up and adjustment loss: This loss is usually caused by stoppage due to set-up change. The set-up change time is the period during which the production is stoppage to prepare for subsequent production. The factor which spends the most time is “ adjustment”.

4. 1. 3 Cutting blade change loss: The cutting blade change loss is caused by the line stoppage for replacing the grinding wheel, cutter, bit etc.

4. 1. 4 Start-up loss: The start-up loss is the one that occurs until the start-up, running-in and machining conditions of the equipment have been stabilized.

4. 1. 5 Minor stoppage and idling loss: The minor stoppage loss differs from the failure and is the one in which temporary trouble causes the equipment to stop or idle. It might be called a minor trouble. For example, idling of a line caused by a low supply of work in the chute due to clogging and temporary line stops caused when the sensor detects a non-conforming product are examples of minor stoppage loss. These losses can be eliminated and the line returned to normal operation so long as the clogged work is removed. The losses are quite different from natural equipment failure losses.

4. 1. 6 Speed loss: The speed loss is the loss caused by the difference between the designed speed and the actual working speed. For example, when the line was operated at the designed speed, it was found that the line caused poor quality or mechanical trouble in the line. In that case, the line had to be run at a slower speed than the designed one. This loss from this situation is called a speed loss.

5S program

Jishu Hozen

(Autonomous maintenance)

Kobetsu Kaizen

Planned Maintenance

Quality Maintenance

Training

Office TPM

Safety , Health & Environment 4. 1. 7 Defect and rework loss: This is the loss caused when defects are found and have to be reworked. In general, the defects are likely to be considered as waste which should be disposed of. But since even the reworked products need wasted manpower to repair them, this must be considered as the loss.

4. 1. 8 Shutdown loss: This loss is referred to as production shutdown loss, which is caused by stopping the equipment for periodical maintenance inspection and for scheduled shutdown for legal inspection during the production stage.

For a typical pharmaceuticals company, a regular and irregular production loss structure is shown in Fig. 2.

A

C

E

D

B

Time, hr

Production Loss

Fig. 2: Regular and irregular production loss structure in a shift of an industry

Theoretical Production Rate

:

U units/ hr

Regular Production Loss

:

A and E

Irregular Production Loss

:

B, C and D

5. STATUS OF EIGHT BASIC PILLARS OF TPM

After identifying these losses, TPM implementation phase can be introduced.

But to introduce this phase the condition of eight basic pillars (as shown in Fig. 3) of TPM in the company has to evaluate. The scenario of a typical Bangladeshi Pharmaceutical company under TPM perspective has been highlighted in this section.

PILLARS OF TPM

Fig. 3: Pillars of TPM

5. 1 Status of Pillar 1(5s)

This pillar is regarding to make the workplace is an organized one, as problems are really difficult to define in an unorganized organization. It consists of five approaches which are Seiri (Sort out), Seiton (Systematize), Seiso (Shine the workplace), Seiketsu (Standardization) and Shitsuke (Self discipline). According to Seiri the items should be placed and organized according to the frequency of their usage and in this company as per observation they follow this rule to some extent but not for all the equipments and accessories. According to Seiton each and every item should have a fixed place to keep. In the factory, they try to maintain this to some level but not for all the material. Regarding Seiso the workplace must neat and clean. The pharmaceuticals company is very much strict about their

hygiene to maintain the quality product. Seiketsu rule makes us conscious about maintaining the standard to keep the workplace clean throughout the organization and the pharmaceutical company maintains this rule as deals with the human life. Shitsuke says about the employees' self discipline and in the company they pursue all the considerable rules and regulations.

5. 2 Status of Pillar 2 (Jishu-Hozen)

In the Pharmaceutical Company as per observation they carry out this autonomous maintenance to some extent. The operators clean up the machines time to time during the production activities but they don't have any kind of formal training. They just learn the procedures and necessary processes from the seniors and supervisors. By this they cannot solve the some day to day problems. For this they need to call people from engineering section. This is waste of efficiency as well as time.

5. 3 Status of Pillar 3 (Kobetsu-Kaizen)

Continuous improvement through eliminating the losses at zero level is basic concept of kaizen. In the organization presently they are not using any of the tool of kaizen like PM analysis, Why-why analysis.

5. 4 Status of Pillar 4

(Planned Maintenance)

Planned maintenances are needed for maximizing the equipment efficiency and by this producing defect free product. In the Pharmaceutical industry, the employees clean up the machines by two steps; firstly during the running of the machine and at the end of the day and secondly at time of the set-up changes. But they don't have any planned maintenance program.

5. 5 Status of Pillar 5

(Quality Maintenance)

The Pharmaceuticals organization is very much conscious about their quality conformance. The quality control department checks the products after each new set-up of the equipments and taking their clearance the production is carried on. Besides this the quality control department continuously collects samples to ensure quality.

5. 6 Status of Pillar 6

(Education and Training)

The sixth pillar of TPM is the training which focuses on the operators so that they can be able to find out the root cause of any problem and to eliminate that cause making the process problem free. But in this company, they do not have any scope of train up their operators.

5. 7 Status of Pillar 7 (Office TPM)

Office TPM should be started after activating four other pillars of TPM (JH, KK, QM, and PM). But due to lack of implementation of other pillars Office TPM cannot be implemented now.

5. 8 Status of Pillar 8

(Safety, Health and Environment)

Keeping the target of zero accident, zero health damage and zero fires in mind this pillar focuses on to create a safe and hazard free workplace. As a pharmaceuticals company they are very much conscious about a safe workplace and environment but the working procedures are not always safe

for the people and as per our observation sometimes there might have
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chance of hazardous condition as in some cases they do not wipe off the rooms perfectly after washing which cause untidiness.

6. TPM DEVELOPMENT STAGE

As the condition of the industry is analyzed, now comes the TPM development stage.

6. 1 Steps of TPM Development Program

Stage 1

:

Preparation

Step 1

:

Announcement by top Management to all about TPM introduction in the organization

Step 2

:

Initial education and propaganda for TPM

Step 3

:

Establish TPM promotion organization and pilot organization model

Step 4

:

Basic policy and target setting for TPM

Step 5

:

Creation of master plan to develop TPM.

Stage 2

:

Kick off

Step 6

:

TPM kick off

Stage 3

:

Implementation

Step 7

:

Establish the system to achieve production efficiency.

Kobetsu - Kaizen

Planned maintenance

Jishu - Hozen

Education and training for operation and maintenance skill upgrade

Step 9

:

Establish the Hinsitsu - Hozen system

Step 10

:

Establish the system to realize operation efficiency in the administration departments

Step 11

:

Establish safety, hygiene and working environment protection system

Stage 4

:

Steady application

Step 12

:

Application of TPM

7. TPM IMPLIMENTATION STAGE

7. 1Establish System to Improve Production Efficiency

The purpose of this step is to pursue maximum efficiency of production which can be achieved by four concepts. Among them two major phases are discussed below:

7. 1. 1 Kobetsu-Kaizen: After the identification of losses, it needed to identify the root causes, take remedial action and perform Kaizen to prevent the further loss occurrence. Different tools and techniques are available for loss analysis. Four of these analysis techniques applicable in a typical Pharmaceutical Ltd. are shown in Table 4.

Analysis Technique

Purposes

1. WWA (Why-Why Analysis)

Simple breakdown

2. WWBLA (Why-Why Because Logical Analysis)

Repetitive & complicated breakdowns

3. PMA (Phenomenon, Physically Mechanism Analysis)

Chronic losses & quality defect

4. ECRS (Elimination, Combination, Reduction, Simplification)

Changeovers

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Table 4. Loss analysis techniques for Kaizen

7. 1. 2 Planned Maintenance Master Plan: Preventive Maintenance Master Plan is formed for some year forward undertaking a number of activities.

These activities may be are as follows:

Evaluate equipment and understand current status

Restore basic condition of equipment

Establish information management system

Built periodic maintenance system

Built predictive maintenance system

Built spare parts management system

Built lubrication management system

8. CONCLUSION

Present business field is becoming more challenging due to facilitate the inevitability of increased productivity, cost effectiveness and to maintain global standards For this the major focus of the manufacturers now-a-days is on the total productive maintenance (TPM) program which is basically a maintenance program to take the whole production system into a level of zero defects. The study validates the relevance of strategic TPM initiatives into the manufacturing strategy for realization of organizational objectives in the successful organizations. In this work a loss structure has been developed to enhance the production efficiency. Defining the different

equipment loss during the production activities, “ Overall Equipment Efficiency (OEE)” has been calculated and after that the TPM implementation procedures for planned maintenance of the equipment have been prepared so that the production line can remain in smooth operating condition. This study clearly reveals that the successful TPM implementation program can facilitate the manufacturing organization’s quest for achieving enhanced manufacturing performance leading to competitive advantage.

9. REFERANCES

Bain, L. J., Engelhardt, M., 1991. Statistical Analysis of Reliability and Life-Testing Models, 2nd edition. Marcel Dekker, New York

Hartman, E. H. (1992), Successfully Installing TPM in a Non-Japanese Plant, TPM Press, Allison Park, PA.

Koelsch, J. R. (1993), “ A dose of TPM: downtime needn’t be a bitter pill”, Manufacturing Engineering, April, pp. 63-6.

Maggard, B. and Rhyne, D. M. (1992), “ Total

productive maintenance: a timely integration of

production and maintenance”, Production and Inventory Management Journal, Quarter 4.

McCall, J. J., 1965. Maintenance policies for stochastically failing equipment: a survey.

Management Science 11 _5, 493-524.

<https://assignbuster.com/total-productive-maintenance-increasing-efficiency-management-essay/>

McKone, K., Weiss, E., 1995. Total productive

maintenance: bridging the gap between practice and research. Darden School Working Paper DSWP-95-12, University of Virginia.

Nakajima, S. (1986), " TPM a challenge to the improvement of productivity by small group activities", Maintenance Management International, Edition No. 6, pp. 73-83.

Sekine, K. and Arai, K. (1998), TPM for the Lean Factory-Innovative Methods and Worksheets for Equipment Management, Productivity Press, Cambridge, MA.

Suzuki, T. (1994), New Directions of TPM, Productivity Press, Cambridge, MA.

Tajiri, M. and Gotah, F. (1992), TPM

Implementation: A Japanese Approach, McGraw- Hill, New York, NY.

Wilmott, P. (1994), Total Productive Maintenance the Western Way, Butterworth-Heinemann, Oxford.