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OEE IMPROVEMENT BY TPM IMPLEMENTATION: A CASE STUDY

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ABSTRACT

The manufacturing industry has gone through significant changes in the last decade. Competition has increased dramatically. Customers focus on product quality, product delivery time and cost of product. Because of these, the organization should introduce a maintenance system to improve and increase both quality and productivity continuously. Total Productive Maintenance (TPM) is a methodology that aims to increase the availability of existing equipment hence reducing the need for further capital investment. The aim of this paper is to study the effectiveness and implementation of TPM program in a thermal power plant. Through the case study of implementing TPM in a thermal power plant, the increase in efficiency and productivity of plant in terms of Overall Equipment Effectiveness (OEE) are discussed. On the basis of results a database has been prepared which can be further used.

Keywords: TPM, OEE, PM, AM,QM.

I INTRODUCTION

Maintenance has become more challenging in the current dynamic business environment. It is considered one of the important strategic decisions in operations management.[1] The manufacturing sector has been experiencing tremendous challenges in ensuring all products are delivered to customers on time. However, the current business environment and pressures from various parties such as customers, suppliers, governments and so forth have put manufacturing sectors under severe pressure. To operate efficiently and effectively, manufacturing sectors need to ensure no disruption due to equipment breakdown, stoppages and failure.

Manufacturing systems in particular often operate at less than full capacity, with low productivity, and the cost of producing products are high. Recent study [2] shows that 25-30% of total production cost is attributed to maintenance activities in the factory. The quality of maintenance significantly affects business profitability. The importance of maintenance functions has increased due to its role in keeping and improving the availability, product quantity, safety requirements, as maintenance costs constitute an important part of the operating budget of manufacturing firms [3]. In response to maintenance problems encountered in manufacturing environment, the Japanese developed and introduced the concept of Total Productive Maintenance (TPM), in 1971. TPM is a maintenance system defined by Nakajima [4] in Japan, which covers the entire life of equipment in every

division including planning, manufacturing, and maintenance. It describes a synergistic relationship among all organizational functions, but particularly between production and maintenance, for continuous improvement of product quality, operational efficiency, capacity assurance and safety.

TPM is an aggressive strategy focuses on actually improving the function and design of the production equipment [5]. TPM aims to increase the availability/effectiveness of existing equipment in a given situation, through the effort of minimizing input (improving and maintaining equipment at optimal level to reduce its life cycle cost) and the investment in human resources, which results in better hardware utilization. Another goal of TPM as stated by Schippers [6] is to reduce and to control the variation in a process.

II METHODOLOGY

TPM employs OEE as a quantitative metric for measuring the performance of a productive system. OEE is a core metric for measuring the success of TPM implementation program. The overall goal of TPM is to raise the overall equipment efficiency. OEE is calculated by obtaining the product of availability of the equipment, performance efficiency of the process and rate of quality products.

Overall Equipment Efficiency = Availability x Performance efficiency x Rate of Quality.

Where,

Availability: - Available Time required to produce a finish product.

Availability = (Required availability – Downtime) / (Required availability) *100.

Performance: - It can be defined as the design cycle time to produce the item multiply by the output of the equipment and then divided by the operating time.

Performance = (design cycle time*output)/ (operating time)*100

Quality = It is the ratio of production output to the production input.

Quality = output/input.

2.1 World Class OEE IS:

Table: 1 World Class OEE

OEE FACTOR	WORLD CLASS
AVAILABLITY	99.0%
PERFORMANCE	95.0%
QUALITY	99.9%
OEE	85.0%

III RESULT AND ANALYSIS

3.1 Calculations on OEE of the boiler 1 plant for January, 2015 (before TPM implementation):

Mechanical breakdown=42.92hrs,

Electrical breakdown=12.24hrs

Electronics/safety device breakdown=3.01hrs

Total breakdown=58.18hrs

Setup and other conditions=8.5hrs

Total loss = 66.68 hrs (Summation of all above losses)

Total good hours=738hrs

Net loss = (Total good hours-Total loss) =738hrs – 66.68hrs =671.32hrs

Availability rate= (Net loss/Total good hours)×100 =(671.32 ÷738)×100=90.96%

Thus, availability rate is 90.96%.

Percentage of quality= **(**Total steam produced-Defected steam) ÷Total steam produced

(Defected steam=Total breakdown × Steam produced per hour)

= (7380-581.8) ÷7380 = 92.11%

Thus, quality rate is 92%.

Performance rate= (Net loss-(Management loss+ Start up loss) ÷ Net loss

= [671.32-(88+14)] ÷ 655.19=84.80%.

(Consumption item furnace oil per batch=5610 litters and 210,300 litter's/month, Management loss=88 hrs, Startup loss=14 hrs).

Thus, performance rate is 83.97%.

OEE = (Availability rate) × (Performance rate) × (Quality rate) ×100

= (0.9099) ×(0.8122) ×(0.9211) = 70.21%

[Note: If OEE is less than 85% (world class manufacturing performance for continuous]

3.2 Calculations on OEE of the boiler plant for June, 2015(after TPM implementation):

Mechanical breakdown=15.85hrs

Electrical breakdown=1.50hrs

Electronics breakdown=0

Total breakdown=17.35hrs

Setup and other conditions=6.75hrs

Total loss = 24.10hrs (Summation of all above losses)

Total good hours=738hrs

Net loss= (Total good hours-Total loss) =738 hrs.-24.10hrs. = 713.90hrs

Availability rate= (Net loss ÷Total good hours) ×100 = (713.90 ÷738)×100=96.73%

Thus, *Availability rate is 96.73%.*

Percentage of quality= (Total steam produced-Defected steam) ÷Total steam produced

= (7380-173.5) ÷7380=97.64%

Defected steam=Total breakdown × Steam produced per hour

Thus, *quality rate is = 98%.*

(Consumption item furnace oil per batch= 5600 litters and 210,300 liters per month, Management loss=88hrs, Startup loss=14hrs)

Performance rate= [Net loss-(Management loss+ Start up loss] ÷ Net loss

= [713.90-(88+14)] ÷713.90=85.71%.

Thus**,** *performance rate is 85.71%*

OEE= (Availability rate) × (Performance rate) × (Quality rate) ×100%

= (0.9673) × (0.85.71) × (0.97) = 81.22%..

The results of total loss (hours) and OEE calculation for three months during TPM implementation (before and after) in boiler plant are shown in Tables 1 and 2.

Table 2: OEE loss for three months

Before TPM implementation (2015)		After TPM implementation (2015)	
Month	Total loss	Month	Total loss
January	66.68hrs	May	41.00
February	80.40hrs	June	24.10hrs
March	60.50hrs		

Table3: OEE value before and After TPM

Before TPM implementation (2015)		After TPM implementation (2015)	
Month	OEE value	Month	OEE value
January	70.35%	May	75.60%

February	66.44%	June	80.23%
March	70.81%		

IV CONCLUSION

After successful implementation of TPM, it is found that Overall Equipment Effectiveness is increased (Refer table 2 and figure 3).

After successful implementation of TPM, it is found that Overall Equipment Effectiveness is increased (Refer table 8 and figure 3).

Today TPM may be the only thing that stands between success and total failure for some companies; it has been proven to be a program that works. The results shown above can be much more improved by continuing with TPM.

Today, with competition in industry at an all time high, TPM may be the only thing that stands between success and total failure for some companies TPM can be adapted to work not only in industrial plants, but also in construction, building maintenance, transportation, and in variety of other situations. Employees must be educated and convinced that TPM is not just another "program of the month" and that management is totally committed to the program and the extended time frame is necessary for full implementation. If everyone involved in a TPM program does his or her part, a usually high rate of return compared to resources invested may be expected. TPM success requires strong and active support from management, clear organizational goals and objectives for TPM implementation.

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