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Implementation of TPM on Boiler

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Abstract: ***The unit cost of thermal energy depends on the capital investment, operations and maintenance costs, availability, performance, quality. The capital costs are substantial but are incurred only at the inception of the power plant and can be optimized at the inception stage. The greatest part of operation and management costs goes to maintenance cost. To make thermal power plants economical, the maintenance functions should be optimized by carefully selecting and planning the maintenance strategies that will address the maintenance needs of the plant at the least cost. The problems that are incurred during the operation of boiler should be taken care of at the same time. This research was carried out to obtain a clear understanding of the modern management concepts and to assess their suitability to management of maintenance in boiler. The objective of the study was to proposed a methodology that can be used to compare the management methods and determine a method that can optimized maintenance of boiler to make the boiler operate economically. The research involves review of maintenance and management methods. The maintenance methods analyzed were total preventive maintenance(TPM), CBM and CM. The research showed that not one maintenance or management method can effectively address maintenance needs of any system hence a combination is always desirable. it was found that the formal management methods have been widely applied in the different parts of thermal power plant but not much is return on its application in boiler. during informal discussion and observation it is concluded that to optimize maintenance of boiler, a suitable combinations of the management methods should be design. TPM should be applied to address chronic problems to eliminate wastes. A successful combination has great potential to optimize maintenance processes in boiler and make the plants economical.***

Keywords: Total Productive Maintenance, Boiler, Performance measures.

1. Introduction

Performance of the boiler, like efficiency and evaporation ratio reduces with time, due to poor combustion, heat transfer fouling and poor operation and maintenance. Deterioration of fuel quality and water quality also leads to poor performance of boiler. For maintaining the performance of the boiler we have to use effective maintenance and management techniques.

Over past years, various innovative techniques and management practices such as Total Productive Maintenance (TPM), Total Quality Management (TQM), Condition based maintenance and Just in Time(JIT), have become increasingly popular [1] and have been used extensively. For global market survival in the changing and increasing competitive industrial arena, uninterrupted equipment will play a major role in increasing the productivity of production equipment [2]. Therefore, the quality of maintenance itself is important, since it affects equipment performance and consequently, the final product quality [3]. TPM is a partnership between maintenance and production to improve product quality, reduce waste, reduce manufacturing cost, increase equipment availability, and improve the company's over state of maintenance [4]. TPM also has been widely recognized as a strategic weapon for improving manufacturing performance by enhancing the effectiveness of production facilities [5]. However, according to McKone et al,[6] the environment contextual factors, such as country, organizations and managerial factors are important to the execution of TPM programs. The process of TPM implementation is a journey and not all companies are able to implement TPM successfully based on studies by Cooke [7] and [8]. The Small and Medium Enterprises (SMEs) in Malaysia have been slow to adopt and implement TPM due to some difficulties faced in attempts to adopt and implement TPM [4],[9],[10]. The numbers of TPM implementations has grown in various industries throughout the world especially in manufacturing organization and it was identified that TPM offers huge improvement in maintenance activities of various organizations and has significantly shown a positive impact towards their operational and organizational performances [1],[2],[4],[11],[12]. In other words, TPM has become highly recognized as a tool to deal with matters relating to plant maintenance, plant engineering and product design.

This research shows how we applied TPM on boiler with the help of 5s.

1.1 Total Productive Maintenance

Total productive maintenance (**TPM**) originated in Japan in 1971 as a method for improved machine availability through better utilization of maintenance and production resources[14]. Whereas in most production settings the operator is not viewed as a member of the maintenance organization, in TPM the machine operator is trained to perform many of the day-to-day tasks of simple maintenance and fault-finding[7],[15]. Teams are created that include a technical expert (often an engineer or maintenance technician) as well as operators. In this train

the operators are enabled to understand the machinery and identify potential problems, correct them before they can impact production and by so doing, reduce downtime and decrease costs of production.

TPM is a critical adjunct to lean manufacturing. If machine uptime is not obtainable and if process capability is not sustained, the process must keep more stocks to buffer against this uncertainty and flow through the process will be interrupted. Unreliable uptime is arises by breakdowns or badly performed maintenance[5]. Correct maintenance will allow uptime to improve and speed production through a given area allowing a machine to run at its designed capacity of production. One way to think of TPM is "deterioration prevention": deterioration is what happens naturally to anything that is not "taken care of". For this reason many persons refer to TPM as "total productive manufacturing" or "total process management". TPM is a proactive approach that necessarily aims to identify issues as soon as possible and plan to prevent any issues before occurrence. One motto is "zero loss, zero error and zero work-related accident".

TPM is a maintenance process developed for improving productivity by making processes more reliable and less wasteful[4],[11],[16][17].TPM is an extension of TQM(Total Quality Management). The goal of TPM is to maintain the plant or equipment in good condition without interfering with the daily process. To achieve this goal, preventive and predictive maintenance is required. By following the TPM analogy we can minimize the unexpected failure of the equipment.

To implement TPM the production unit and maintenance unit should work jointly. Original objective of total productive management:

"*Continuously improve all operational conditions, within a production system;* by stimulating the daily awareness of all employees*" (by Seiichi Nakajima, Japan, JIPM)*

TPM focuses primarily on manufacturing (although its benefits are applicable to virtually any "process") and is the first methodology Toyota used to improve its global position (1950s). After TPM, the focus was stretched, and also customers and suppliers were involved (Supply Chain), this next technique was called lean manufacturing. This sheet gives an overview of TPM in its original form.
An accurate and practical implementation of TPM, will increase productivity of the complete organization, where:

1) A transparent business culture is designed to continuously enhance the efficiency of the total production system.
2) A system and standardized approach is used, where all losses are prevented and known.
3) All departments, influencing productivity, will be involved to move from a reactive- to a predictive mindset.
4) A multidisciplinary transparent organization in reaching zero losses.
5) Steps are applied as a journey, not as a quick menu.
6) Finally TPM will provide transparent and practical ingredients to reach operational excellence.

1.2 Boiler

Boiler is a heart of thermal power plant, so its efficiency is directly affected to the all over efficiency of the plant. The boiler is a rectangular furnace about 50 feet (15 m) on a side and 130 feet (40 m) tall. Its walls are made of a web of high pressure steel tubes about 2.3 inches (58 mm) in diameter.

Pulverized coal is air-blown into the furnace from fuel nozzles at the four corners and it quickly burns, forming a large fireball at the center. The thermal radiation of fireball heats the water that circulates through the boiler tubes near the boiler periphery. The water circulation rate in the boiler is three to four times the throughput and is typically driven by pumps

As the water in the boiler circulates it absorbs heat and changes into steam at 700 °F (370 °C) and 22,000 kPa. It is separated from the water inside a drum at the top of the furnace. The saturated steam is introduced into superheat pendant tubes that hang in the hottest part of the combustion gases as they exit the furnace. Here the steam is superheated to 1,000 °F (540 °C) to prepare it for the turbine.

There are many major losses occurring in boiler due to which effectiveness of boiler reduced like In process quality loss, start up quality loss, fuel moisture loss, speed loss, incomplete combustion loss, air moisture loss, radiation & convection loss, idling and minor losses, etc. these losses are overcome by applying TPM on boiler.

2. Methodology

All the losses occurring in the boiler are categories into nature of cause due to which losses occurring and the remove the cause by applying specified 'S' from the 5s(Sort, set in order, Shine, Standardize, Sustain).

2.1 TPM Implementation Stages

a) Stage A-preparatory stage
Step 1- Announcement by management to all about TPM introduction in the organization.
Step 2- Initial training and propaganda for TPM.
Step 3- Setting up TPM and departmental committees.
Step 4- Creating the TPM working system and target.
Step 5- A master plan for education and training.

b) Stage B- Introduction stage
A small get-together, which includes our suppliers and customer's participation, is conducted. Supplier as they should know that we want quality supply from them. People from concerned companies and affiliated companies who can be our customers, etc. are also invited. Some may learn from us and some can help us and customers will get the message from us that we care for quality output, cost and keeping to delivery schedules.

c) Stage C- TPM Implementation
In this stage 8 activities are carried which are called pillars in the development of TPM activity. Of these four

activities are for stabilizing the system for production efficiency, 1 for initial control system for new products and equipment, one for enhancing the efficiency of administration and are for control of safety, promoting as working environment.

d) Stage D- institutionalizing stage

By now the TPM implementation activities would have reached maturity stage. [13] now is the time to apply for preventive maintenance award.

2.2 5S Implementing On Losses Mentioned

- In process quality loss(sort + standardize)
- Start up quality loss (sweep)
- Speed loss (systematic arrangement)
- Idling and minor losses (sweep).

3. Assessment Of Boiler Efficiency (Heat Balance)

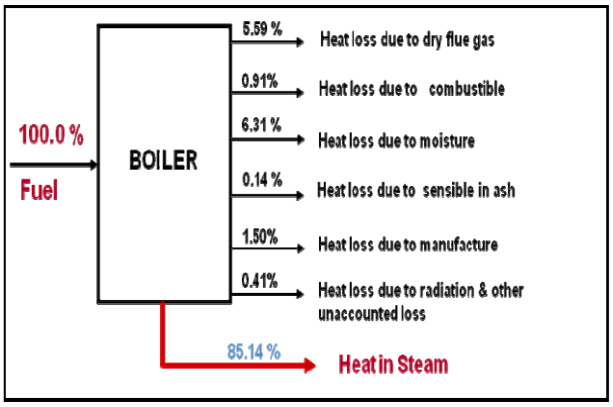

Figure 1: Before Implementing TPM

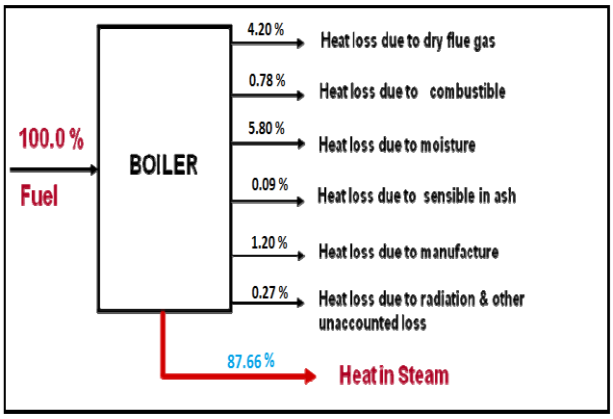

Figure 2: After Implemnting TPM

4. Conclusion

Above illustration shows that due to implementation of TPM losses occurred in boiler are reduced and how the thermal efficiency of boiler increases. By implementing TPM losses are reduced, skill of employees of the whole plant increases, safety enriched, idle time of all parts of the power plant reduced and so that overall equipment effectiveness of the power plant increases and get stability. The TPM is a straight forward approach that assist plant analyst or a designer in achieving cost effective management while considering both qualitative and quantitative aspect in Thermal power plant.

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Author Profile

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