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Evaluation of Overall Equipment Effectiveness and Total Effective Equipment Performance: A case study

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Abstract – *Intensive business competition pushes commercial companies to enhance their performance, effectiveness and efficiency. It is therefore very important to accurately measure and track the performance and effectiveness of a company. This can reveal the real picture of the company's performance. Overall equipment effectiveness (OEE) is a widely used metric in production industry, which measures the performance of a company against three factors namely availability, performance and quality. Total effective equipment performance (TEEP) is based on OEE and measures performance with respect to All time. In this study these two metrics are used to analyze the performance of a cattle feed manufacturing plant in Kerala. The study aims to identify the bottleneck in the production process and to calculate OEE and TEEP at the bottleneck. The calculated values are then compared to the values for world class manufacturing processes to find out the present position of the company.*

Key Words:-*Performance analysis, Operations management, Overall equipment effectiveness, Total effective equipment performance.*

1. INTRODUCTION

Improving performance of production lines and equipment is very important to achieve higher return on investment and better productivity. In this context it is very important to quantitatively measure the performance of the production equipment. Overall equipment effectiveness (OEE) and Total effective equipment performance (TEEP) are two metrics that are used to measure the effectiveness and performance of production lines and equipment. They differ in the factor that OEE measure performance against Scheduled time whereas TEEP measure performance against Calendar time or All time.

Overall equipment effectiveness (OEE) is a widely used quantitative metric in manufactory systems for controlling and monitoring the productivity of production equipment, and also as an indicator and driver of process and performance improvements (Reyes et al. 1989). OEE is a key performance measure in the production industry, with three important factors which are availability, productivity and quality. This metric has become widely accepted as a quantitative tool essential for measurement of productivity in manufacturing operations (Samuel et al. 2002).

Total effective equipment performance is a well-established performance metric that takes into account Equipment Losses and Schedule Losses. It measures performance with respect to All Time (the percentage of All Time that is fully productive; All Time is sometimes referred to as Calendar Time or 24/7 Time). By measuring the OEE and TEEP for a production plant we can get an idea about the current performance of the plant. It can then be compared with the world standard plants to know the performance gap.

This paper focuses on a case study undertaken at a cattle feed manufacturing plant in Kerala. The study was done to analyze the performance of the plant. The bottleneck in the production process was identified and then, OEE and TEEP were calculated at the bottleneck.

2. LITERATURE REVIEW

The OEE was first introduced by Nakajima (1988) and deals with equipments/machines. The OEE measure is central to the formulation and execution of a TPM improvement strategy (Ljungberg 1998), and provides a systematic method for establishing production targets, and incorporates practical management tools and techniques in order to achieve a balanced view of process availability, performance efficiency and rate of quality (Bulent et al. 2000). Tsarouhas (2007) implemented the total productive maintenance in a pizza production line, increasing the production rate, improving the quality of the products, and providing a healthier and safer work environment. Ahuja and Khamba (2008) reveal the important issues in total productive maintenance ranging from maintenance techniques, framework of TPM to OEE.

A considerable amount of literature has been published in relation to the definition of OEE and its various applications. For example, Muthiah et al. (2008) reported that the overall equipment effectiveness (OEE) metric is a powerful tool that can be used to measure performance and also perform diagnostics at the equipment level. Braglia et al. (2009) presented overall equipment effectiveness of a manufacturing line to assess the performance of a production line. Nachiappan and Anantharam (2006) defined overall line effectiveness to evaluate the effectiveness of a continuous product line

manufacturing system, and De Ron and Rooda (2006) describe the behaviour of OEE and equipment effectiveness as performance measures for manufacturing equipment.

3. METHODOLOGY

The study is conducted based on the data collected from the plant and from the ERP system of the company. First step is to identify the bottleneck in the production process. The bottleneck was identified by analyzing the percentage capacity utilization of major sections and by calculating their processing times. After identifying the bottleneck an analysis of the bottleneck is done using OEE (Overall equipment effectiveness) and TEEP (Total effective equipment performance) to find out the effectiveness and performance of the system.

3.1 CALCULATION OF OEE AND TEEP

OEE is calculated from three underlying factors: Availability, Performance, and Quality. Each of these factors represents a different perspective of how close your manufacturing process is to perfect production.

OEE = Availability x Performance x Quality

where,

Availability = Run time/Planned production time

$$\text{Performance} = \frac{\text{(Total production/ Run time)}}{\text{Ideal run rate}}$$

Quality = Good count/ Total Count

TEEP is a performance metric that takes into account Equipment Losses and Schedule Losses. It measures performance with respect to All Time (the percentage of All Time that is fully productive; All Time is sometimes referred to as Calendar Time or 24/7 Time).

TEEP = OEE x Utilization

where,

$$\text{Utilization} = \frac{\text{Planned production time}}{\text{All time}}$$

4. ANALYSIS AND FINDINGS

The first step in the analysis is to find the bottleneck in the production process. The production details were noted for a continuous period of one month and the percentage capacity utilization and processing time of major sections were calculated. The findings are given below:

Table 1: Capacity utilization of major sections in the plant

Section	Rated output (tons/hr)	Average production (tons/hr)	Percentage capacity utilization (%)
Feeding	14	11.7	83.5
Batching	12	10.98	91.5
Grinding	14	10.2	72.85
Pelletizing	14	9.92	70.85
Bagging	12	10.75	89.58

Table 2: Processing time at major sections

Section	Processing time
Feeding	5.128
Batching	5.464
Grinding	5.882
Pelletizing	6.048
Bagging	5.581

From the data given above, it was found that the bottleneck in the production process is the pelletizing section. Next step is to calculate OEE and TEEP at the bottleneck. For this production data was collected for a period of 9 months. They are given below:

Data Collected (From April to Dec, 2016)
Total production = 46909.6 MT
Total scheduled time = 5856 hours
All time = 6318 hours
Non productive time = 428 hrs
Down time = 786.34 + 428 = 1214.34 hrs
Run time = 5856-1214.34 = 4641.66 hrs
Ideal run rate = 12 MT per hour
Reject products= 8 MT

Data Analysis (From April to Dec, 2016)
Availability = 4641.66/ 5856 = 0.7926
Performance = (46909.6/4641.66)/12 = 0.8421
Quality = 46901.6/46909.6 = 0.999
OEE = .7926 x .8421 x .999 = 0.6667 = 66.67%
Utilization = 5856/6318 = 0.9269 = 92.69%
TEEP = .6667x .9269 = 0.6179 = 61.79%

In the table below the OEE and TEEP values calculated for the plant is shown along with the values for world class processes.

Table 3: Comparison with World Class Standard

Metric	World Class Standard	Company
Availability	90%	79.26%
Performance	95%	84.21%
Quality	99.9%	99.9%
OEE	85%	66.67%
TEEP	80%	61.79%

The findings from the data analysis are shown above. It was observed that the availability of the plant is nearly 79%. It shows that 20% of the production time is lost due to unplanned and planned stoppages. Also the performance of the plant was found to be 84%. It points to the fact that there are several losses due to small stops and slow cycles. The quality factor was found to be comparable with the world standard for manufacturing processes.

The calculated OEE and TEEP values are 66.67% and 61.79% respectively. By comparing these values with those of world class standard we can see that the performance of the plant is far behind the world standard. These values point to the fact that the plant is not operating efficiently.

5. CONCLUSION

The study was conducted to analyze the performance and effectiveness of the plant at a cattle feed manufacturing firm in Kerala. The analysis was done using Overall Equipment Effectiveness (OEE) and Total Effective Equipment Performance (TEEP). The study revealed that the performance of the plant was far behind the world class standard. From the analysis it was found that 20% of the scheduled time is wasted. The study brought out the fact that the losses in the company are not monitored effectively. Overall the study revealed that the production process is not efficient and the machines are not operating efficiently. It is necessary that the company take appropriate steps to improve the performance, using OEE as a guide and driver of performance improvements.

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