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Evaluation of Overall Equipment Effectiveness in Cold Nut Former 19b6s

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Abstract- **Purpose of this paper is a manufacturing systems used within the fasteners industry involve different machines and processes which are arranged in a sequence of operation in order to manufacture the products. This investigation was made for nut forming machine in a production plant. Overall Equipment Effectiveness is one of the performance evaluation methods that are most common and popular in the production industries. The main aim of this research is to identifying the main loss elements for Availability process. Also result will be compared with world class level. Result of the research determines that although the OEE factor examined process is not meeting the world class level, however with the continuous improvement, performance of the machine can be acceptable. In this paper Overall Equipment Effectiveness is to be calculating for Cold Nut Former, it is six stage nut forming machine.**

Keywords: **Overall Equipment Effectiveness, Nut Manufacturing, Availability**

I. INTRODUCTION

Companies have different ways of measuring their manufacturing performance in order to achieve and maintain a competitive edge in the market. Overall equipment effectiveness (OEE) is the key measure of both Total Productive Maintenance (TPM) and Lean Maintenance. The concept of OEE, introduced by Nakajima (1988), is being used increasingly in industry. It looks at the wider manufacturing aspects, not only the equipment availability and performance, but also the efficiency losses that result from rework and yield losses.

Through short daily inspections, cleaning, lubricating, and making minor adjustments, minor problems can be detected and corrected before they become a major problem that can shut down a production line. The goal of the TPM program is to increase production and at the same time increase employee morale and job satisfaction (Tsang and Chan 2000). Maintenance is one of the areas in modern management to increase machine productivity and to produce quality products. This obviously improves equipment efficiency rates and reduces costs (Lemma (2008).

Sundram Fasteners Limited (SFL) is a part of the US$ 3 billion TVS group, based in South India. It was set up in 1966 for manufacture of high-tensile fasteners. It has diversified over the years into other products like cold extruded parts, powdered metal parts / iron powder, precision formed gears, pump assemblies (water, oil and fuel), rocker arm assemblies, belt tensioners, radiator caps, gear shifters and spare wheel tyre carriers. It was one of the first Indian auto component companies to tap the global markets for its products and set up operations outside India.

CNF-19B6S is the machine is going collect data and calculate the Overall Equipment Effectiveness. CNF is stands for Cold Nut Former. This machine can produce nut in the diameter of 19mm. It is six stage nut forming machine. The six stages are feeding, cutting, die forming, punch forming, kick-out and formation and transfer.

II. OVERALL EQUIPMENT EFFECTIVENESS

The evolution towards a global economy has increased the level of competition for virtually all businesses. In order to maintain the level of competitiveness, it is required that firms get better at what they do and at satisfying customer's expectation. As noted by Fleischer et al (2006), the competitiveness of manufacturing companies depends on the availability and productivity of their production facilities.

Every industry has to make great efforts for improving productivity of in all spheres of activities.

"If you cannot measure it, you cannot improve it."(Lord Kelvin).

It is a common opinion that productivity improvement is nowadays the biggest challenge for companies in order to remain competitive in a global market. One of the best way of measuring efficiency and effectiveness is the Overall Equipment Effectiveness (OEE). New technologies and innovative practices have positioned the maintenance function to be an integral part of the overall profitability of many businesses.

This paper attempts to find the indicator through OEE and to evaluate its contributing components in a manufacturing industry. The level of contribution involves the best performing parameter or department and also the period.

III. PROBLEM DEFINITION

As per the overall analysis in all the process, nut forming machine was found to have a availability loss. OEE helps in indicating the process, performance and as well as equipment problem. OEE was used as a measurement tool to evaluate the plant productivity. Thus this metric help gauge the machine efficiency, effectiveness and categorize these key productivity losses that occur within the manufacturing process.

IV. NUT FORMATION PROCESS

In principle, the following manufacturing processes are differentiated. On the one hand there is forming without cutting and on the other, machining. With forming without

cutting there is a further differentiation between cold and hot forming. The following diagram is intended to make the production processes clearer.

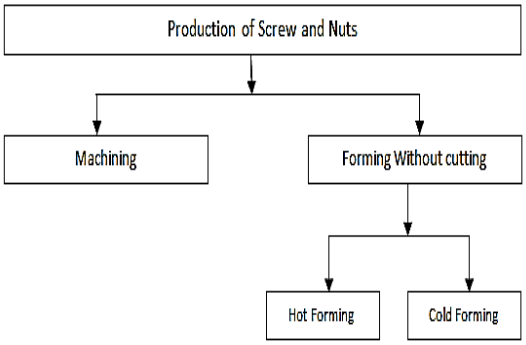

Fig: 4.1.Overview of the various production processes

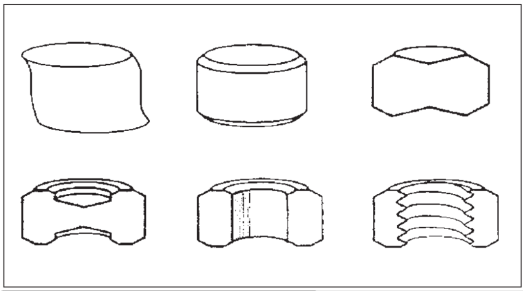

Fig: 4.2. Stage of Hexagonal nut

Nuts are usually produced with the cold or hot forming procedure as well. The choice of one or the other procedure depends on the one hand on the size and on the other on the required quantities.

V. DATA COLLECTION

"Data are defined as symbols that represent properties of objects, events and their environment. They are the products of observation, but are of no use until they are in a useable (i.e. relevant) form. The difference between data and information is functional, not structural."(Ackoff, 1989)

Data collection consists of gathering those symbols in order to have a good basis for deeper studies on a subject. Data collection can be of two types as described in the following Table 5.1: Qualitative or Quantitative. Qualitative data collection methods will be mainly employed through the project, but some from the quantitative part will be employed as well, as the standardization of procedures for example.

Qualitative Data Collection	Phases in the Process of Research	Quantitative Data Collection
• Purposeful sampling strategies • Small number of participants	Sampling	• Random sampling • Adequate size to reduce sampling error and provide sufficient power
• From individuals providing • Institutional review boards • Individuals	Permissions	• From individuals providing access to sites • Institutional review boards • Individuals
• Open-ended interviews • Open-ended observations • Documents • Audio visual materials	Data sources	• Instruments • Checklists • Public documenting

• Interview protocols • Observational protocols	Recording the data	• Instruments with scores that are reliable and valid
• Attending to field issues • Attending to ethical issues	Administering data collection	• Standardization of procedures • Attending to ethical issues

Table 5.1: Phases in the data collection process for qualitative and quantitative research (Creswell, et al., 2007)

a. Interviews

"Qualitative interviewing is a technique of data collection that ranges from semi-structured to unstructured formats. Interviewing is seen as a conversation in which an informant and a researcher interact so that the informant's thoughts are revealed and interpreted by a researcher." (Lichtman, 2010 p. 7)

Interviews will be conducted to some consciously chosen actors within the studied process. It will start with the employees working with the machine; it will continue with the production manager, the CEO and some others related to these first interviews. These interviews (mainly open-ended) are the most important ones in order to build a strong basis to investigate some other issues. All the interviews are and will be driven with the aim to be as complete as possible to provide a good analysis for the research questions.

b. Observation

"Observation provides the opportunity to document activities, behaviour and physical aspects without having to depend upon peoples' willingness and ability to respond to questions." (Taylor-Powell, et al., 1996 p. 1)

Improving a machine process within a company dealing with many types of parts and about 200 employees is not an easy task. Observation linked to the case study is a powerful manner to gather data. Having a walk through the workshop every day is an important and useful accomplishment, just to observe what is going on the shop floor. Something new is showing up to each visit; it can be a very small detail, or operator behaviour or even some comments. This technique to go on site is recommended and detailed later on as a tool to implement Lean Manufacturing.

Downtime details of the machine show in table.

No.	Description for breakdown	In Month of Jan 2015
1	New parts change due to breakage	380
2	Major job change	1370
3	Semi Major job change	350
4	Tool change	805
5	Coil change	360
6	Tool service	560
7	Minor stoppage	190
8	Machine cleaning time	445
9	Planned Maintenance	510
10	Meeting time	120

11	Want of tools	175
12	Awaiting of Instruction/ Drawing	45
13	Want of men	3491
14	Want of air	50
15	Want of power	950
16	Product Approval	60
17	Want of Orders	-
18	Want of Trays/ Trolleys	95
19	Measurement and adjustment loss	240
20	Total	10196

Table 5.1: Downtime details of machine in mm

VI. OEE CALCULATION

The overall goal of TPM is to raise the overall equipment effectiveness. OEE is calculated by obtaining the product of availability of the equipment, performance efficiency of the process and rate of quality products.

The final OEE equations used in all calculations will be presented in this section. The metrics consist of three parts – Overall Availability, Performance and Quality. The three components of OEE can also be used as individual metrics. The components of the OEE equation are presented in the following.

Overall Equipment Efficiency = Availability x Performance x Quality.

Availability

OEE and its components is the first metric in the calculation model. The second metric is Availability. In some cases, the Overall Availability equation is not sufficient and/or applicable, for instance when there is a lack of data. In that case, Availability shows the percentage uptime of the unit and is defined as the ratio between Uptime and Total time

Availability: - Available Time required producing a finish product.

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

After collecting the data, we need to measure the OEE which will give away the lagging areas. According to the study, there are 3shifts per day.

As there are 3 shifts per day with 8 working hours per shift

Available operating time = 26 days* 3 shifts/day * 8 hours/shift = 624 hours

There was a stoppage of 30min for each shift, which gives in total 39 hours, 624-39 = 585 hours

Availability factors

Now the total time needed to produce the whole batch for 26 days is

= (available operating time – downtime)
= 585- 170.1
= 414.9 hours

Therefore, the valuable operating time is 414.9 hours

Availability = Valuable operating time/ available operating time
=414.9/585
=0.7092

Availability Factor =70.92%

Performance

The performance essentially indicates how efficiently the unit has been working, i.e. to what degree the unit has been doing things in the correct way.

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 = (Actual units per min)/ (Theoretical units per hour)*100

Performance factors

To calculate this we need to main factors designed cycle time = 125 pieces / min

Total output = 120 pieces / min

Performance rate = (Actual units per min)/ (Theoretical units per hour)*100

= (120/125)*100
=96%

Quality

Quality - It is the ratio of production output to the production input.
Quality = (production input – quality defects) / (production input)
Quality factors
For calculating the quality factors we need
Total amount of defect =50 kg
Production input =7000kg
Quality = (production input – quality defects) / (production input)
= (7000-50)/(7000)*100
= 99.28%

The Overall Equipment Effectiveness is
OEE = Availability x Performance x Quality
= 0.709*0.96*0.99
= 0.67 *100
=67%
Therefore the OEE of the Nut manufacturing industry is 67%.

VII. RESULT AND DISCUSSION

Based on OEE results we know about where should be improvement to implementin this project.Monitoring the process and precise measurement of its main aspects is the key step to plan and to manage improvement for a manufacturing process.

OEE FACTORS	WORLD CLASS	NUT FORMING M/C(19B6S)
Availability	90.0%	70.92%
Performance	95.0%	96%
Quality	99.9%	99.28%
OEE	85.0%	67%

Table 6.1: Comparison of World Class OEE factor and Nut forming factor

The main aim of taking up this study in the company was to calculate the OEE which gives us an understanding about the machine efficiency and in turn gives the right percentage of the machine utilization there by helping us to detect the bottlenecks.

These losses mainly are downtime losses, speed losses, quality losses which affect OEE. To minimize these losses and to achieve world class OEE there should be reduction in events which are discussed in six big losses section. The main events which are responsible for losses in insulation process are:

a. New parts change due to breakage: Breakage is general process of moving parts wearing against each part. This process happen, the length of time a part is expected to remain and to do the same process. Main parts of Machine shown below.
- Square Die Block and Shortest Die Pitch
- Circular Stripper
- Ratchet Wheel Feeding System
- Crankshaft Roller Bearing
- Double Eccentric Punch Adjusting Device
- Pole Changing Motor and Overload Protection

b. Major Job change: This process occurring when changing dimension of the producing nut in that nut forming machine.
c. Tool change: This process is also the same processing of the job changing method.
d. Coil change: Coil is the raw material of the process. Their chances at the time of require or change the type of material.
e. Tool service: It is the time of servicing the tools, it having the regular time of period to service the tool for the accuracy of product.
f. Machining cleaning time: Cleaning of the machine is reducing the availability of the machine because it's happen when time of switch off position.
g. Want of men: The lack of technician for that particular machine is affecting the continuous Meeting time: Arrangement of meeting time for giving instruction about the status of production or about safety process.
h. Want of tools: The lack of tool is creating searing of tool in company is to reduce the availability of the machine.
i. operating time of that machine.
j. Product approval: The approving of the first product produce that machine is given by the quality department. This process having some quality testing process for the product, it takes some time to get result.

It is important to reduce these non-productive events which affect efficiency of the process. They can be reduce by implementing new techniques and tools, standardized speed for running the line, skilled labours, special purpose machinery which won't affects the environment of the machine etc.

VIII. FUTURE RECOMMENDATION

The aim of the improvement for the future development is highlighted by the recommendations which were done by a series of brain storming sessions and visiting the shop floor, observing the daily activities of the operators and the works.

AREA OF OPPORTUNITY	RECOMMENDATIONS	BENEFITS
New parts change due to breakage	Use the technique of the Single Minute Exchange of Dies (SMED) and One Touch Exchange of Dies (OTED).	Reducing process time of the exchange parts, tools, job and coil.
Major Job change		
Tool change		
Coil change		

Table 7.1: Recommendation for nut forming process

CONCLUSION

The results of the case study show that the proposed method deploys the concept of equipment effectiveness clearer and more applicable. Also, it provides a sound perspective on production improvement of Nut production by taking into consideration all losses within the period for meeting both internal and external market demands. It may be used as a tool of improvement. While, the results for OEE by ignoring a considerable amount of possible hidden losses might be satisfying, the OEE report shows potential room for improvement.

REFERENCES

[1]. RaffaeleIannone and Maria Elena Nenni, "Managing OEE to Optimize Factory Performance", Operation Management.

[2]. H. Imran and Prof. Hamidon A.H, "Embedded Controller for Production Monitoring System Based on Overall Equipment Effectiveness Using FPGA", International Journal of Scientific Research Engineering & Technology, Volume 3, Issue 3, June 2014

[3]. Sauli Kivikunnas1, Esa-Matti Sarjanoja1, Jukka Koskinen1 and Tapio Heikkilä1," Monitoring of Collaborative Assembly Operations: an OEE Based Approach", Springer,pp.121-127, 2010

[4]. Vorne Industries Inc (2010).Calculation *OEE* worksheet. 2002 – 2003 Vorne Industries Inc., Itasca, IL USA.

[5]. Baxter Healthcare Corporation (2005), "Baxter Finds Extra Production Capacity Increases OEE with ABB Solution", 2005 ABB Inc.

[6]. OEE systems, "Case Study Robert Wiseman Dairies", by Operation Excellence Solutions.

[7]. Idhammar Systems Ltd. (2010), "The Business Case for OEE Systems", by Idhammar Systems Ltd. April 2010.

[8]. ICCS Ltd, "The Complete Downtime and OEE Web Based Monitoring System", by PlantSTATS Downtime and OEE.

[9]. Rhombus, "Measuring OEE using the Rhombus Factory Information System", Rhombus Systems Limited, November 2007.

[10]. easy OEE, "The online Productivity Meter for Single Machines", FASTEC Software for Production.