ANALYSIS OF PRODUCTIVITY REPAIR BASED ON OEE VALUE ACHIEVEMENT OF SPEAKER SPARE PART PRODUCTION MACHINE IN WEST JAVA

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Abstract

This research was conducted on companies engaged in the manufacture of Speakers, Megaphones and Amplifiers. The purpose of this study is: to determine the Overall Equipment Effectiveness (OEE) value of a machine so that steps can be taken to improve the effectiveness of the machine, in addition to knowing the main root causes of damage that often occur on the machine, and knowing how to solve the problem so that it can increase the productivity of the machine. In addressing this, an analysis of the performance of the machine is done by determining the identification based on the Overall Equipment Effectiveness (OEE) calculation ratio, namely availability time, downtime, machine working time, total output, operating time, cycle time and defect amount. Then calculate and analyze the OEE value: Availability Rate, Performance Rate, Quality Rate, Overall Equipment Effectiveness (OEE) and determine the value of Six Big Losses. The main causes of the low OEE value are the low Performance Rate with an average value of 75.01%, this is due to the value of Reduced Speed Losses which has the largest contribution in the six big losses.

Keywords: injection molding, speaker, OEE, six big losses.

1 Introduction

Effectiveness in the world of manufacturing industry is very important to reduce production costs, especially so that companies can succeed in facing global competition. To reduce the production costs, the company must do is study various types of manufacturing industry losses and classify them (Tekin, 2012).

This research was conducted on companies engaged in the manufacture of Speakers, Megaphones and Amplifiers. The production of this company is exported more to countries in the Americas, Japan, China and Europe. In Indonesia, the company's production speakers are 90% used by Islamic houses of worship (mosques) throughout Indonesia. The problem that arises in this company is the amount of production costs from what should be, the high overtime of employees, and the length of the production process caused by production machines that are often damaged. In this company there is also no machine maintenance scheduling so that many machines are repaired only if the engine is damaged.

The purpose of this study is: a. to find out the Overall Equipment Effectiveness (OEE) value of a machine that produces Speaker Spare Parts so that steps can be taken to increase the effectiveness of the machine, b. to find out the main root causes of damage that often occur on the machine, c. to find out how to solve problems that can increase machine productivity.

When a production machine does not produce a product (idle), the workforce is idle, the machine is damaged, and the reject product produced is high. So in this situation, the concept of Total Productive Maintenance (TPM) has been implemented in industries around the world to overcome problems that arise. TPM builds a close relationship between maintenance and productivity, so that it can show how well equipment maintenance will result in higher productivity (Raut, 2017).

Actually the term Total Productive Maintenance (TPM) originated from Japan in 1971 as a method to increase the availability of production machinery through better utilization and maintenance of production (Vijayakumar, 2014).

Efficiency and effectiveness play a very important role for every company to remain in a competitive environment. The higher the value of efficiency and effectiveness, the higher the productivity of the company. Overall Equipment Effectiveness (OEE) is the main performance indicator, which shows the current production status by calculation (Taywade, 2016). Overall Equipment Effectiveness (OEE) is used to

determine the overall performance of production equipment and to determine how effective the machine works. Overall Equipment Effectiveness (OEE) depends on three basic components (Ghosh, 2016). The three basic components, namely, Availability Rate, Performance Rate, and Quality Rate. These factors help measure production efficiency and effectiveness (Tomar, 2016).

Availability Rate is a ratio that describes the utilization of time available for the operation of machinery or equipment.

Performance Rate is a ratio that describes the ability of equipment in producing goods.

Quality Rate is a ratio that describes the ability of equipment to produce products that are in accordance with standards.

Overall Equipment Effectiveness (OEE) is a method used as a measuring tool (metric) in the application of TPM programs to maintain equipment in ideal conditions by removing Six Big Equipment Losses.

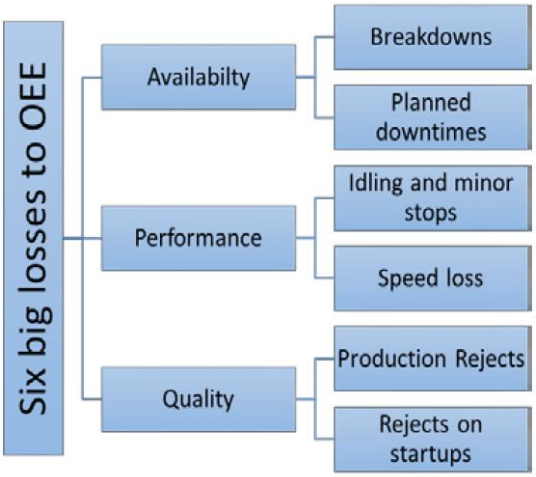

Figure 1 Six big losses

Based on Figure 1 it can be seen that the six losses or often referred to as the six big losses consist of: a. Equipment Failure, (loss due to equipment damage), b. Set up & Adjustment, (adjustment and adjustment losses), c. Idle and Minor Stoppage, (losses due to idle and engine stop), d. Reduced Speed, (loss due to low operation), e. Defect in Process, (product defect loss in process), f. Reduced Yield, (loss due to low yield).

As a guideline for improvement of Overall Equipment Effectiveness (OEE) values that can be classified as follows: a. OEE value of 100% means that production runs perfectly, all production results are of good quality, production runs in a short time, and there is no down time. b. OEE value of 85% means producers are included in world class standards. c. The OEE value of 60% means that the producer includes industry standards in general, but this shows that there is substantial room for improvement. d. OEE value of 40% means that manufacturing companies run poorly and must make improvements to the performance of the company (Dutta, 2016).

Overall Equipment Effectiveness (OEE) Effectiveness Measurement is very important for every company that is committed to eliminating losses in its company through the implementation of Total Productive Maintenance (TPM). The Total Productive Maintenance (TPM) program itself uses the Overall Equipment Effectiveness (OEE) Effectiveness as a quantitative parameter to measure production system performance. A comparison between the measurement of the expected OEE value and the current OEE value can provide the driving force that is needed for manufacturing companies to improve their maintenance policies. Overall, an OEE value of 85% is considered a world class performance that must be achieved where the availability rate is 90%, the performance rate is 95% and the quality rate is 99% (Raut, 2017).

2 Method

The main material used in this research is ABS plastic ore. The raw material will then be processed by melting the plastic ore and printing it to form the desired product (speaker spare part).

Figure 2. Raw material in the form of plastic ore

To process raw materials as shown in Figure 2. the machine used in this research is the injection molding machine Thoshiba IS 350 GS 350 Ton.

Injection molding is one of the processes most often used to produce plastic components, where the printing cycle process runs quickly through an ejection process where liquid plastic fills the mold followed by a cooling process (Raos, 2014).

Figure 3. Injection molding machine Thoshiba IS 350 GS 350 Ton

As in Figure 3, it can be seen that the injection molding machine Thoshiba IS 350 GS 350 Ton. Injection molding itself is a process of particle formation by heating the plastic material to a liquid, then pressing and compacting it into a mold, after which the cooling process is carried out, after the product is cooled it is released by opening two parts of the mold (Vijayakumar, 2014).

The properties of the part of an injection mold depend on the type of raw material and on the processing parameters, such as injection pressure, ability to withstand pressure, resistance to high temperatures, and injection speed (Raos, 2014).

In this study, the focus of the discussion is that machines often experience some obstacles in producing speaker spare parts. These constraints include: the engine is often hot, the engine setting time is too long when installing the mold, and the repair of the mold is too long.

Japan has introduced the concept of Total Productive Maintenance (TPM), in 1971 to address maintenance problems in production machinery. Total Productive Maintenance (TPM) is defined by Nakajima (Nakajima 1988) in Japan. The main goal is to get the ideal performance of a machine, improve product quality, minimize losses, and increase the effectiveness of the machine. (Sivaselvam, 2014). One of the main objectives of the Total Productive Maintenance (TPM) and Overall Equipment Effectiveness (OEE) program is to reduce and eliminate Six Big Losses the most common causes of loss of efficiency in manufacturing (Vairagkar, 2016).

Overall Equipment Effectiveness (OEE) can be expressed as the ratio of the actual output of the machine divided by the maximum output of the machine in the best performance conditions. Overall Equipment Effectiveness (OEE) is used to measure the overall performance of equipment and to determine how efficient a machine is when working. Overall Equipment Effectiveness (OEE) depends on three basic

components: Availability Rate, Performance Rate, and Quality Rate (Sivaselvam, 2014). Overall Equipment Effectiveness (OEE) is an effective tool that fulfills the objectives by analyzing and improving the production process. Overall Effectiveness Equipment Effectiveness (OEE) shows how well a company utilizes its resources, which includes equipment, labor, and the ability to satisfy customers in terms of providing quality products (Sowmya, 2016).

So to overcome the production problem in this study an analysis of the performance of the machine by determining the identification of data needs based on the Overall Equipment Effectiveness (OEE) calculation ratio, namely availability time, downtime, machine working time, total output, operating time, cycle time and defect amount. After that, the calculation and analysis of the OEE value is done: Availability Rate, Performance Rate, Quality Rate, Overall Equipment Effectiveness (OEE). Furthermore, determine the value of Six Big Losses, Losses Value to determine the value of equipment damage, preparation or adjustment losses, product losses and hidden losses such as speed reduction and idle and minor stoppage losses.

3 Result and Discussion

Working time available to the Company is 24 hours/day. The company divides working hours into 2 shifts/ day, each working shift for 7 hours/day, then the available production time is 840 minutes. Working time data is obtained within a period of one month, namely April 2018, this data is adjusted to the records obtained from the production department.

To find out the performance of the Thoshiba IS 350 GS 350 Ton engine, an OEE analysis was performed and data was obtained as shown in Table 1 below.

Table 1 Value of OEE injection molding machine Thoshiba IS 350 GS 350 ton period April 2018

Date	Availability Rate	Performance Rate	Quality Rate	OEE
02/04/2018	96,65%	71,85%	94,88%	65,89%
03/04/2018	96,40%	61,50%	93,74%	55,57%
04/04/2018	96,16%	61,88%	93,57%	55,68%
05/04/2018	95,91%	62,58%	93,22%	55,96%
06/04/2018	96,53%	61,66%	93,44%	55,62%
07/04/2018	97,51%	60,99%	93,34%	55,51%
09/04/2018	96,89%	61,18%	93,08%	55,17%
10/04/2018	95,64%	63,08%	93,11%	56,17%
11/04/2018	96,88%	62,15%	92,05%	55,43%
12/04/2018	97,28%	61,20%	93,69%	55,78%
14/04/2018	97,40%	61,07%	92,86%	55,23%
16/04/2018	96,66%	61,96%	94,08%	56,34%
17/04/2018	97,53%	62,04%	94,28%	57,04%
18/04/2018	76,24%	78,71%	92,78%	55,67%
19/04/2018	98,01%	61,29%	93,96%	56,45%
20/04/2018	97,63%	61,32%	92,83%	55,57%
21/04/2018	96,89%	61,63%	93,27%	55,70%
23/04/2018	96,76%	61,53%	93,08%	55,42%
24/04/2018	97,63%	61,25%	92,86%	55,53%
25/04/2018	97,89%	60,94%	92,92%	55,44%
26/04/2018	76,93%	76,70%	94,36%	55,68%
27/04/2018	96,29%	62,98%	93,35%	56,61%
28/04/2018	97,27%	62,12%	93,02%	56,20%
30/04/2018	96,02%	62,37%	93,04%	55,72%
Total	**2285,03%**	**1523,98%**	**2240,80%**	**1349,39%**
Average	**95,21%**	**63,50%**	**93,37%**	**56,22%**

In Table 1 can be seen the condition of the machine in April 2018. From the data the Availability Rate value is 95.21%, the Performance Rate value is 63.50%, the Quality Rate value is 93.37%, and the OEE value is 56.22% This shows that OEE does not reach the company's target, not even including the industry standard in general, namely the OEE value of 60%. For this reason, the company must make several improvements. If the company wants to be included in world class standards, the OEE value must be 85% where the value that must be achieved requires an Availability Rate of 90%, a Performance Rate of 95% and a Quality Rate value of 99%. Based on Table 1, the company must increase the Performance Rate quite high, because its value is still very low. In addition, the value of Quality Rate also needs to be increased so that the company is included in world class standards.

Table 2 Six Big Losses Calculation Results for April 2018 Period

No.	OEE Factor	Big Loss	Total Time Loss (hours)	Percentage %	kum %
1	Availability Rate	Equipment Failure	13,10	11,31%	11,31%
		Set up & Adjustment	2,33	2,01%	13,32%
2	Performance Rate	Idle and minor stoppage	0,08	0,07%	13,39%
		Reduced Speed	86,90	75,01%	88,41%
3	Quality Rate	Deffect Losses	13,43	11,59%	100,00%
		Scrap Losses	0	0,00%	100,00%
Total			**115,85**	**100%**	

Based on Table 2, it is known that the biggest losses value is on the OEE Performance Rate element, which is Reduced Speed with a value of 86.90 hours or 75.01% which contributes to the main cause of the low Injection molding machine Thoshiba IS 350 GS 350 Ton, this shows the low speed of the actual engine, making the injection molding performance of Thoshiba IS 350 GS 350 Ton become down due to the number of reject products during the production process.

The second factor causing losses is the Defects Losses of 13.43 hours or 11.59%, this is caused by the time the equipment is wasted to produce reject products when the machine runs continuously after the adjustment and adjustment process. Both of these factors led to the production target of the injection molding machine of Thoshiba IS 350 GS 350 Ton was not achieved.

Then an analysis is done with field observations to determine the causes of the low value factors of the six big losses. Interviews with operators and office staff to find out the main causes of the low six big losses value factors. Once it is known that to increase the OEE value, a continuous improvement effort is needed, in table 3 an action plan for OEE improvement is given:

Table 3 Action plans for increasing OEE values

Factor	Problem	Action plan
Man	Operators lack concentration in work due to the pressure of high production targets.	Guidance is made to operators to remain concentrated while working
Material	Unstable raw materials, where raw materials easily clump when production takes place	Involving quality control when checking raw materials and making periodic controls
Method	Low standard knowledge in production	Processes training for operators
Machine	Injection molding machine Thoshiba IS 350 GS 350 Ton which is old	Involves the engineering section to carry out repairs and maintenance on the injection molding machine of Thoshiba IS 350 GS 350 Ton periodically
Environment	The required temperature range is not in accordance with the temperature standards during the production process	Making the right temperature standard in accordance with the conditions of the production room.

4 Kesimpulan

In the calculation and discussion results get the OEE (Overall Equipment Effectiveness) period April 2018 namely, the Availability Rate is 95.21%, the Performance Rate value is 63.50%, the Quality Rate value is 93.37%, with a total OEE value what you get is 56.22%. The OEE value is still below the world class standard of 85%.

The main causes of the low OEE value are the low Performance Rate with an average value of 75.01%, this is due to the value of Reduced Speed Losses which has the largest contribution in the six big losses with a loss of 86.90 hours which results in the machine does not work optimally.

Proposing an improvement in the effectiveness of the equipment through the results of an analysis of the improvement of the steps towards inhibiting factors in an effort to improve the effectiveness of equipment so that the results of improvements can be carried out based on the analysis.

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