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Analysis and Implementation of Total Productive Maintenance (TPM) using Overall Equipment Effectiveness (OEE) and Six Big Losses on Press Machine in PT.Asian Bearindo

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Abstract:- PT Asian Bearindo has implemented Total Productive Maintenance to improve the efficiency and effectiveness of the manufacturing company as a whole. But in its implementation still not optimal which seen from not reaching production target. This study aims to measure the value of equipment effectiveness, find the root cause of the problem and provide suggestions for improvement. The research was conducted on the FDW-02 Press Machine which has the highest breakdown rate. This study begins by measuring the achievement of overall equipment effectiveness (OEE) value, then identifying the six big losses that occur. The results showed that the average value of OEE on Press FDW-02 machine is 26.12%, the effectiveness value is very low because the standard of OEE value for world class company ideally is 85%. The biggest factor that influences the low value of OEE is the performance rate with the percentage factor of six big losses on idling and minor stoppages loss of 41.26% of all time loss. Proposed repair actions are to prepare autonomous maintenance equipment, to provide training for operators and maintenance technicians and to supervise operators on the cleanliness of the workplace.

Keywords:- *Total Productive Maintenance, overall equipment effectiveness, six big lossess.*

I. INTRODUCTION

One of the factors supporting the success of a manufacturing industry is determined by the smoothness of the production process. So that when the production process smoothly, the use of effective machinery and production equipment will produce quality products, the timing of the completion of the proper manufacture and cheap production costs. The process depends on the condition of the resources owned such as humans, machines or other supporting facilities, where the conditions in question is a condition ready to run production operations, either accuracy, ability or capacity. To maintain the condition of the machine so that no damage occurs or at least minimize equipment damage, so that the production process does not stop too long, it is necessary system maintenance and maintenance of a good and proper machine so that the results can increase the effectiveness of the machine and losses caused by engine damage can be avoided.

PT Asian Bearindo operates 37 press machines that are generally divided into manual and automatic type machines. The usual machines experience great downtime and breakdown most commonly on the FDW-02 Press machine. The product produced from this machine is called ball joint bearing, the volume and order type of this product is the highest.

The occurrence of interference on the machine will result in sufficient loss great for the company. To overcome these problems required appropriate steps in the maintenance of machinery / equipment, one of them by implementing Total Productive Maintenance (TPM). Total Productive Maintenance aims to improve the efficiency and effectiveness of manufacturing companies as a whole. In other words the goal of the TPM is to achieve ideal performance and achieve zero loss, meaning without flaw, without breakdown, without accident, without waste in the production process and changeover process. (Nakajima, 1988).

Evaluation of Total Productive Maintenance (TPM) implementation is done by using Overall Equipment Effectiveness (OEE) as an indicator and searching the cause of the ineffectiveness of the machine by doing six big losses calculation to know the influencing factor of six six big losses factors.

The purpose of this research is to analyze the application of TPM in PT. Asian Bearindo, to know the value of Overall Equipment Effectiveness (OEE) based on availability, performance and rate of quality. Secondly, to know the factors causing decreasing effectiveness through the measurement of six big losses and identifying the dominant factors of the six factors of six big losses as well as analyzing the factors that contribute the most using fishbone diagram. And lastly, give recommendation to overcome the main problem of six six big factors.

II. METHODOLOGY

The methodology in this study is described as follows:

A. Collected Data

Data collection was done in two ways, ie direct survey to the field and recording daily report data of FDW-02 Press Machine PT. Asian Bearindo during the last 6 months. Data needed to calculate the value of OEE (Overall Equipment Effectiveness) that is data breakdown machine, stand by engine, and planned maintenance on this machine, operating time data, production quantity and number of defects. Data

obtained from daily reports from September 2017 to February 2018. Data obtained from daily data recap of PT Asian Bearindo is the time of engine trouble including duration, type of engine trouble, and cause of damage every day.

B. Measurement of Overall Equipment Effectiveness (OEE) Value

According to Nakajima (1988), OEE represents the value expressed as the ratio between the actual output divided by the maximum output of the equipment under the best performance conditions. The purpose of OEE is as a performance measurement tool of a maintenance system, by using this method it can be known availability of machine / equipment (availability), production efficiency (performance), and quality of machine / equipment output. Therefore, the relationship between the three elements of productivity can be seen in the formula below.

$$OEE = Avalability \times Performance \times Quality \quad (1)$$

Availability is the availability of machine / equipment is the comparison between the operating time (operation time) to the preparation time (loading time) of a machine / equipment. Then availibility can be calculated as follows.

$$Avaibility = \frac{Avaibility\ Time - Down\ Time}{Avaibility\ Time} \times 100\ \% \quad (2)$$

Performance is a benchmark of the efficiency of a machine's performance running the production process. Perfomance rate is the result of multiplication of operating speed rate with net operating speed. Net operating speed is useful to calculate the decline in production speed. Three important factors to calculate the peformance rate are ideal cycle time, processed amount and operation time. Then the performance can be calculated as follows.

$$Performance\ rate = \frac{Operating\ speed\ rate}{Net\ Operating\ Rate} \times 100\ \% \quad (3)$$

Quality rate is the ratio of the number of good products to the number of products processed. So quality is the result of calculation by factor processed amount and defect amount. This formula is very helpful to reveal the quality problems of the production process.

$$Quality\ Rate = \frac{Processed\ Amount - Defect\ Amount}{Processed\ Amount} \times 100\% \quad (4)$$

C. Identification of Six Big Lossess

The production process certainly has losses that affect its success, the losses by Nakajima (1988) are grouped into the top six: Downtime Losses If the output is zero and the system does not produce anything, the useless time segment is called downtime losses. Downtime losses consist of:

1. Breakdown losses, this loss occurs because the equipment is damaged, unusable and requires repair or replacement. This loss is measured by how long it took for damage to complete repair.
2. Set up and adjustment time, this loss is due to changes in operating conditions, such as the commencement of production or the start of different shifts, product changes and changes in operating conditions. Examples are equipment change, change of mold and change of jig. Speed Losses, When output is smaller than output at reference speed, this condition is called speed lossess. At speed lossess has not been considered about the output in accordance with quality specifications.
3. Idling and minor stoppages losses, is a loss caused by the cessation of equipment because there are temporary problems, such as halting machine (halting), jamming (jamming) and idling machine (idling).
4. Reduce speed losses,is a reduction in the speed of production of the equipment design speed. Measurement of these losses by comparing the ideal capacity with actual workload. Defect or quality losses, If the resulting output ouput does not meet the quality specifications then called quality lossess.
5. Rework and quality defect,this loss occurs due to a product defect during production. Products that do not meet specifications need to be dirework or scrap made. It takes labor to do the rework process and the material that is converted into scrap is also a loss for the company.
6. Yield lossess, occurs because the raw material is wasted. This loss is divided into two, namely the loss of raw materials due to product design and manufacturing methods and adjustment losses due to defects in product quality produced at the beginning of the production process and when there is a change.

- *Identify Causes Factors Using a Fishbone Diagram*

Having known the dominant loses then sought after the root cause of the problem by using a fishbone diagram.

III. RESULT AND DISCUSSION

A. Achievement of OEE

The OEE value of the FDW-02 Press Machine for 6 months from September 2017 to February 2018 is shown in Table 1. On average OEE achievement is only 26.12%, even in the fourth month the OEE only reaches the lowest value of 21.15%. this is still very small when compared to the OEE value of the equipment in ideal conditions which is the standard of the world class company that is 85% (Dal, 2000). The value with the third composition of the ratio as follows.

- Availabilityof 90% or more
- Performance rate of 95% or more
- Quality rate of 99% or more

Month	Avaibility	Performance Rate	Quality Rate	OEE
1	0,9554	0,3456	0,9887	0,3265
2	0,9634	0,2789	0,9778	0,2627
3	0,8879	0,3443	0,9765	0,2985
4	0,7789	0,3129	0,9532	0,2323
5	0,7687	0,3241	0,9458	0,2356
6	0,7589	0,2956	0,9432	0,2116

Table 1. Value of OEE from Press Machine FDW 02 Over the Last 6 Months

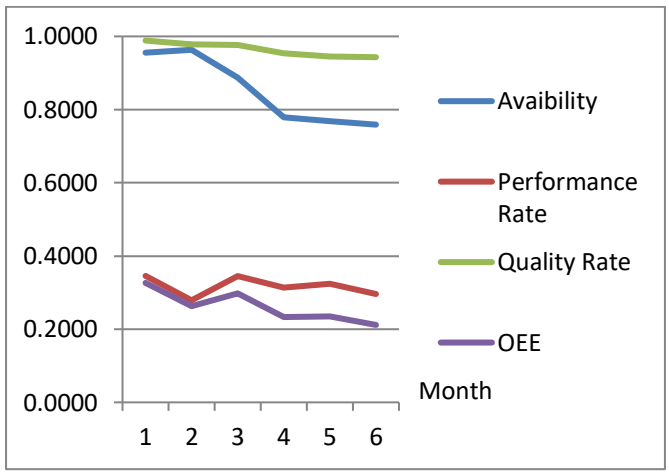

Fig 1:- OEE Performance Percentage

B. Six Big Losses Analysis

After obtained the value of OEE, then performed the process of identifying six big lossess for 6 months. From the data obtained, the six big losses that occur are shown in Table 2 as follows.

Six Big Losses	Total Time Losses (Hours)	Persentase (%)
Idling and Minor Stoppages Loss	875,78	41,26032586
Equipment Failure Loss	575,37	27,107211 5
Reduce Speed Loss	395,12	18,61515444
Setup / Adjustment Loss	275,85	12,99602741
Rework Loss	0,45	0,021200697
Yield / Scrap Loss	0,0017	8,00915E-05
Total	2122,5717	100

Table 2. Percentage of Factor Six Big Losses Of FDW 02 Press Machine

Fig 2:- Graph of Six Big Losses

C. Analysis of Fishbone Diagram

An analysis of the causes of six big losses that resulted in the low effectiveness of machines in OEE calculations is done using a causal diagram (fishbone diagram). Based on the pareto diagram that has been made, the dominant factor affecting the magnitude of productivity and machine efficiency is idling and minor stoppages loss Picture 2 Shows the cause diagram (fishbone) for the idling and minor stoppages loss factor on the FDW-02 Press machine. The losses on idling and minor stoppages loss are caused by the cessation of equipment because there are temporary problems. For example, the cessation of production due to the existence of a workpiece is pinched something, the cessation of equipment because the sensor that detects something that causes a pause. Idling and minor stoppages loss can also be caused by events that block production flow, miss-feeds, obstruction of sensors, cleaning and checking. Categories that result when these external factors arise cause the engine to stop repeatedly or operate without producing the product.

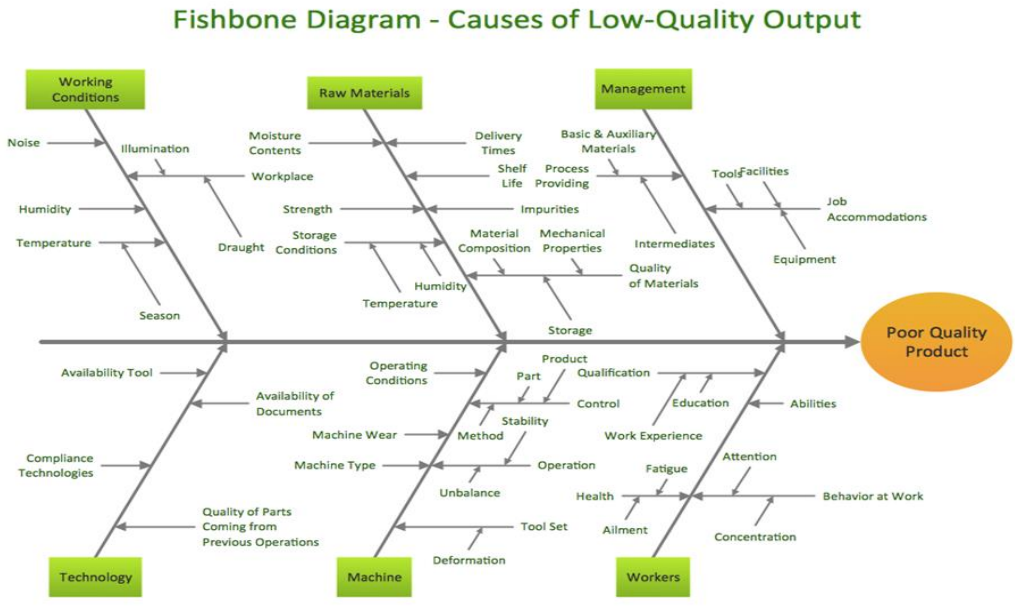

Fig 3:- Fishbone Diagram of Idling And Minor Stoppages Loss

D. Recommendation

The improvement recommendations for idling and minor stoppage loss issues are described as follows:

1. Perform careful machine readiness checks before and after use
2. Conducting briefings prior to shift change, by giving list order, target list, and rod specification to be processed to the operator.Provide guidance, warnings to sanctions to workers when making mistakes
3. Provide incentives to drive operator performance
4. Provide qualified technicians to perform regular repair or maintenance on the machine.
5. Material replacement when change order on FDW-02 Press machine must be guaranteed according to desired product specification.
6. List the complete base rod material specifications for each service man
7. Perform regular checking when base rod will begin to be processed, to reduce base rod picking error by operator.
8. Arranging / arranging the material scheduling of tow material to be sufficient to meet production targets
9. Create a standard list of regular maintenance implementation
10. Setting up an autonomous maintenance checklist every time a shift is changed
11. Preparing supplies of tools and materials for autonomous maintenance, such as greas
12. Do predictive maintenance on the machine
13. Often caused by the high difficulty level of the product, therefore it takes a more expert operator to handle it.
14. Frequent inspection of components prone to damage to the FDW-02 Press machine
15. Provide basic knowledge to operators to improve breakdown-prone points
16. Checking the machine on critical machine components and repairing the wearable machine components.
17. Perform regular cleaning around the work area
18. Conducting training for operators in setting up the machine, as well as basic knowledge in using the machine
19. Perform regular checks to make sure the machine settings are done correctly
20. Provide a list of production targets and specifications desired by the production division to be performed by the operator.
21. Clean the machine and work area before or after the operation.
22. Placing and positioning used components that have been unused
23. Applying 5S (Seiri, Seiton, Seiso, Seiketsu and Shitsuke)

IV. CONCLUSION

Based on the results obtained can be concluded as follows:

Based on the calculation of Overall Equipment Effectiveness (OEE) at FDW-02 PT.AsianBearindo press machine during September 2017-February 2018 obtained Overall Equipment Effectiveness (OEE) value ranges from 21.15888483% to 32.64551355%. This effectiveness value is very low because the standard of OEE value for a world class company ideally is 85%.

The dominant disadvantage that causes low OEE values on the FDW-02 Press machine during the period September 2017-February 2018 is idling and minor stoppages loss, with total time losses of 875.78 hours or 41.26032586% of the six big six losses factors.

The factors that cause idling and minor stoppages loss are the main priorities are: human factors: less thorough, less responsive, and make mistakes in improvement,

material factors: improper specification and lack of raw material stock, method factors: autonomous maintenance is not running well and the scheduling of replacement components has not been effective, engine factor: frequent breakdown machine, easy to wear engine components, dirty machine, and improper engine set up, as well environmental factors: less machine hygiene and many piles of components.

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