ISSN 2828-5174
Ring Mechanical Engineering (RING ME)
Vol. 5 | No. 1 | Juni | Hal. 49-57

ANALYSIS VALUE OF OVERALL EQUIPMENT EFFECTIVENESS ON FOCKE FX 2 PACKER MACHINE AT PT ABC

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ABSTRACT
This study carried out to overcome the performance and efficiency problems of the Packer Focke FX 2 machine at PT. ABC. The study uses descriptive quantitatie approach to analyze Overall Equipment Efetiveness (OEE) value. The resultof OEE value is analyzed by Six Big Losses method to find the losses factors and used the failure mode Effect Analysis (FMEA) method with fishbone diagram to find its root causes and provide suggestion for improvement. The result of the study is OEE value from the period of June 2024 to Ugust 2024, which was 43,4 %. This result is lower than the world standart OEE of 85 %. These result are caused by high value of idling and minor stoppage losses at 15,84% and breakdown losses at 13,46%. The root of problems was found using FMEA method with RPN value of 288, which is failure in blank feeding process with type of failure mode is blank material jamming in blank track area because of spray glue jet was not function optimally. So that, the recommendation of improvements that are given are related to preventive method, spare part management, and employee competency.

Keywords: Packer Focke FX2, Overall Equipment Effectiveness, Six Big Losses, FMEA

INTRODUCTION

In this rapidly evolving era, companies are required to be increasingly productive while maintaining high quality in every product or service they offer. The same applies to PT ABC, a company engaged in the cigarette manufacturing industry, which must pay close attention to the performance and efficiency of its production processes. The effectiveness and efficiency of production are influenced by several factors, such as the condition of production facilities, the quality of human resources, and the availability of supporting equipment.

Based on observations at PT ABC, there is an issue where machine efficiency is not optimal due to downtime occurring during the production process. This problem in the production process makes it difficult for the company to manage the number of machines in operation, which in turn impacts operational or production costs. Therefore, a method is needed to measure the performance of machines or equipment in order to address this issue. One method that can be used to evaluate machine performance and effectiveness is Overall Equipment Effectiveness (OEE).

According to [1], Overall Equipment Effectiveness (OEE) represents an estimate of the efficiency of a production flow and can be used to compare performance across different lines within a company. Through this analysis, companies can identify workflow patterns that do not contribute significantly to productivity, allowing optimization to focus on more critical aspects.There are several components used to calculate the OEE value, including Availability Ratio, which refers to the percentage of time a production machine is available to produce a product [2], Performance Ratio, which indicates the machine's capability to produce a product efficiently and Quality Ratio, which measures the percentage of products produced that meet quality standards [3].

Previous research has shown that the OEE value of a cigarette filter production machine was 73%, which is below the standard, with the lowest contributing factor being the Availability Rate, recorded at 86% [4]. The analysis revealed that reduced machine speed affected both the productivity and effectiveness of the production process. This issue of reduced speed was caused by several factors, including jammed roll components, damaged merging belts, and worn-out bearings.

According to [5], the factors contributing to a low OEE value are not limited to a low Availability Ratio, but also include other performance indicators. In their study on the Screw Press machine at PT Perkebunan Nusantara VI Ophir, West Pasaman, they found that the Availability Ratio from January to December 2016 ranged between 95.090% and 99.527%. However, the Performance Ratio was significantly lower, ranging from only 5.544% to 8.185%. As a result, the OEE value ranged from 60.375% to 80.201%, which is still below the standard. This occurred due to the machine's or equipment's low capability to produce products efficiently

Based on the conclusions of previous studies, the Overall Equipment Effectiveness (OEE) method can be considered a solution to address the existing problems. However, in this study, the researcher also incorporates the Six Big Losses method to identify common factors contributing to machine inefficiency. In general, these factors include: breakdown losses, setup and adjustment losses, idling and minor stoppages, reduced speed losses, quality defects and rework, and startup losses [6].

The implementation of the Failure Mode and Effect Analysis (FMEA) method is also applied in this study to prioritize corrective actions, thoroughly document process changes to support future improvements, enhance product quality, reliability, and safety, and optimize time and cost efficiency. To achieve these objectives, several factors play a role in determining the appropriate steps to eliminate or reduce risks, especially those categorized as high priority. The level of risk priority is evaluated based on the Risk Priority Number (RPN), which is calculated by considering three aspects: Severity (the seriousness of the consequences of a failure), Occurrence (the frequency at which the failure is likely to occur), and Detection (the likelihood that the failure will be detected before it causes an impact) [7].

To support the FMEA method, a diagram is added to illustrate the cause-and-effect relationships of each problem. The Fishbone Diagram is an effective visual tool for evaluating factors that significantly influence issues in the Packer Focke FX-2 machine [8]. The factors used to identify the root causes of problems in the machine include Man, Method, Material, Machine, and Environment [9].

By identifying the root causes of each machine problem, appropriate improvement recommendations can be developed for the company. This study aims to assess and enhance the effectiveness of the Packer Focke FX-2 machine by implementing the Six Big Losses and FMEA methods. Through this research, it is expected that failure factors in the machine can be reduced and the machine's performance improved [10].

METHOD

The research method stage presents the steps used to address the issues occurring in the Packer Focke FX-2 machine, arranged efficiently. These steps include:

1. Problem Identification Stage

The problem identification focuses on determining the effectiveness value of the Packer Focke FX-2 machine and the factors influencing its effectiveness, as well as providing improvement suggestions for the problems encountered.

2. Data Collection Stage

   Data collection is carried out through field observations, interviews with relevant workers, and recording and processing historical data of the Packer Focke FX-2 machine.

3. Data Processing Stage

   At this stage, historical data of the Packer Focke FX-2 machine from June 2024 to August 2024 is compiled into tables. The data is then visualized into graphs, followed by calculation of the components of Availability, Performance, and Quality rates, and analysis of the OEE value. Subsequently, factors causing the low OEE value are identified using the Six Big Losses method, and root causes of the problems are determined using FMEA through the Risk Priority Number (RPN) calculation. Additionally, a Fishbone Diagram is used to identify cause-and-effect relationships to provide improvement recommendations.

4. Conclusion Stage

   This stage answers all research questions based on the results of data analysis that have been carefully compiled.

RESULTS AND DISCUSSION

1. Production Data

The table presented contains production data that has been compiled from June 2024 to August 2024. The data displayed includes various variables required to calculate the OEE value.

Table 1. Production Data June 2024 to August 2024

Production Data June 2024				
Week	**Total Production (pack)**	**Total Reject (pack)**	**Total runtime (minute)**	**Total Downtime (minute)**
1	2.476.346	643.654	3721	1079
2	2.528.800	591.200	3712	1081
3	2.002.271	493.729	3001	816
4	2.197.239	610.761	3075	2078
Total	9.204.656	2.339.344	13509	5054
Production Data July 2024				
Week	**Total Production (pack)**	**Total Reject (pack)**	**Total runtime (minute)**	**Total Downtime (minute)**
1	2.182.247	945.320	3331	1426
2	2.307.336	811.579	3612	1475
3	2.317.672	802.327	3603	1180

4	2.187.813	932.187	3401	1377
Total	8.995.068	3.491.413	13947	5458

Production Data August 2024				
Week	**Total Production (pack)**	**Total Reject (pack)**	**Total runtime (minute)**	**Total Downtime (minute)**
1	1.931.453	1.188.547	3043	1731
2	2.289.046	830.954	3584	1181
3	2.067.948	1.052.052	3315	1460
4	2.136.342	983.658	3355	1432
Total	8.424.789	4.055.211	13297	5804

Source: Data processing

Based on the summarized production data in Table 1, it can be concluded that there is a decline in performance each month. Meanwhile, there is an increase in the total number of rejected packs every month. This indicates that there may be an issue occurring with the machine.

2. Data Calculation

a. Availability ratio

The following is the result of the recapitulation of the Availability ratio value calculated using the formula from production data.

Table 2. Recapitulation value of Availability ratio

Month	**Loading Time (min)**	**Operating Time (min)**	**Availability Ratio**
June	18.240	14.225	78%
July	19.200	13.742	72%
August	19.200	13.396	70%
Average			73%

Source: Data processing

The example of calculation Availability ratio.

$$\text{Availability} = \frac{\text{Operatingtime}}{\text{loadingtime}}\ x\ 100\ \%$$
$$= \frac{14225}{18240}\ x\ 100\ \% = 78\ \%$$

b. Performace ratio

The following is the result of the recapitulation of the Performance ratio value calculated using the formula from production data.

Table 3. Recapitulation value of Performance ratio

Month	Output process (pcs)	Ideal cycle Time (min)	Operating Time (min)	Performance Ratio
June	9.204.656	0,0012	14.225	78%
July	8.995.068	0,0013	13.742	84%
August	8.424.789	0,0012	13.396	80%
Average				80,67%

Source: Data processing

The example of calculation Performance ratio.

$$\text{Performance ratio} = \frac{\text{Output process x ideal cycle time}}{\text{operating time}} \, x \, 100 \,\%$$

$$= \frac{9.204.656 \; x \; 0,012}{14.225} \, x \, 100 \,\% = 78 \,\%$$

c. Quality Ratio

The following is the result of the recapitulation of the Quality ratio value calculated using the formula from production data.

Table 4. Recapitulation value of Quality ratio

Month	Planned production (pcs)	Total lost production (pcs)	Performance Ratio
June	11.544.000	2.339.344	79,7%
July	12.480.000	3.491.413	72%
August	12.480.000	4.055.211	67,52%
Average			73,07 %

Source: Data processing

The example of calculation Quality ratio.

$$\text{Rate of quality product} = \frac{\text{Planned production} - \text{total lost production}}{\text{planned production}} \, x \, 100 \,\%$$

$$= \frac{11.544.000 - 2.339.344}{11.544.000} \, x \, 100 \,\% = 79{,}7 \,\%$$

3. Overall Equipment Effectiveness (OEE)

Based on the recapitulated calculations of the OEE components, the effectiveness of the Focke FX 2 Packer machine for the period from June to August 2024 can be determined using the standard formula. The table below presents the summarized results of the OEE calculation.

Table 5. Recapitulation value of OEE

Month	AR (%)	PR (%)	QR (%)	OEE (%)
June	78 %	78 %	79,7%	48,7%
July	72 %	84 %	72 %	43,3%
August	73 %	80 %	67,52 %	38,3%
Average				43,43%

Source: Data processing

Based on the total OEE calculations, it is observed that the lowest value occurred in August at 38.3%, while the highest value was recorded in June at 48.7%. The average OEE obtained is 43.43%, which is used as the final figure for further analysis, as it does not meet the global standard and indicates significant room for improvement. The results also show that both the availability ratio and performance rate are very low each month, which significantly affects the overall OEE value. To address this issue, further analysis will be conducted using the Six Big Losses and FMEA methods.

4. Six Big Losses

The Six Big Losses analysis in this study serves to identify the factors that influence the OEE value, which has not yet met the global standard criteria. In the Packer Focke FX-2 machine at PT ABC, two loss components will be excluded—quality defect and rework losses and yield or scrap losses—as the production process does not involve product rework or new product processing, making it impossible to calculate material and time losses for these components. Therefore, the Six Big Losses analysis in this study will focus on the following four main loss categories:

1. Breakdown losses
2. Idling and minor stoppage losses
3. Setup or adjustment losses
4. Reduce speed losses

The following presents the analysis results of the four big losses calculation.

Table 6. Recapitulation value of Six Big Losses

Month	Breakdown losses (%)	Idling and minor losses (%)	Setup/adjustment losses (%)	Reduce speed losses (%)
June	10,91 %	13,12%	1,04%	3,71%
July	13,84%	16,68%	1,11%	1,84%
August	15,65%	17,73%	1,35%	2,47%
Average	13,46%	15,84%	1,16%	2,67%

Source: Data processing

Based on the results above, there are two primary losses with higher values compared to the other two: idling and minor stoppage losses and breakdown losses. These two types of losses are closely related, as the Packer Focke FX-2 machine frequently experiences operational stoppages due to component or equipment failures. Therefore, further analysis will be conducted using the Failure Mode and Effect Analysis (FMEA) method to identify the failure modes occurring in the Packer Focke FX-2 machine.

5. Failure Mode and Effect Analysis (FMEA)

After conducting the analysis using the Six Big Losses method, this study continues by identifying the types of damage, their failure modes, and the effects of those failures. The FMEA (Failure Mode and Effect Analysis) is used to assess each failure that affects the production process of the Packer Focke FX-2 machine and to evaluate the severity of each failure. There are three assessment indicators in FMEA used to calculate the Risk Priority Number (RPN): Severity, Occurrence, and Detection. The values for these indicators are obtained through observation of the production process, followed by interviews with personnel involved with the Packer Focke FX-2 machine, including operators, mechanical technicians, and supervisors. After the interviews, an FMEA worksheet is prepared by entering the collected values, and the RPN is calculated to determine the highest priority failure.

The following is the result of the FMEA worksheet.

Table 7. FMEA worksheet with 5 highest value of RPN

No	Failure Mode	S	O	D	RPN
1	Blank material jamming on blank track area	8	6	6	288
2	Inner frame jamming	8	3	8	192
3	Shaft suction device blank material broken	9	4	7	252
4	Broken Cigarette bundle on cigarette track	9	3	7	216
5	Packet cigarette jamming inside pocket drying drum 2	8	5	5	200

Source: Interview and Data processing

6. Fishbone Diagram

Based on the results of the analysis using the FMEA method, the data were then processed using a fishbone diagram to identify the root causes of the failure type with the highest RPN value and to propose improvements for all identified root causes. The following is the result of the fishbone diagram analysis.

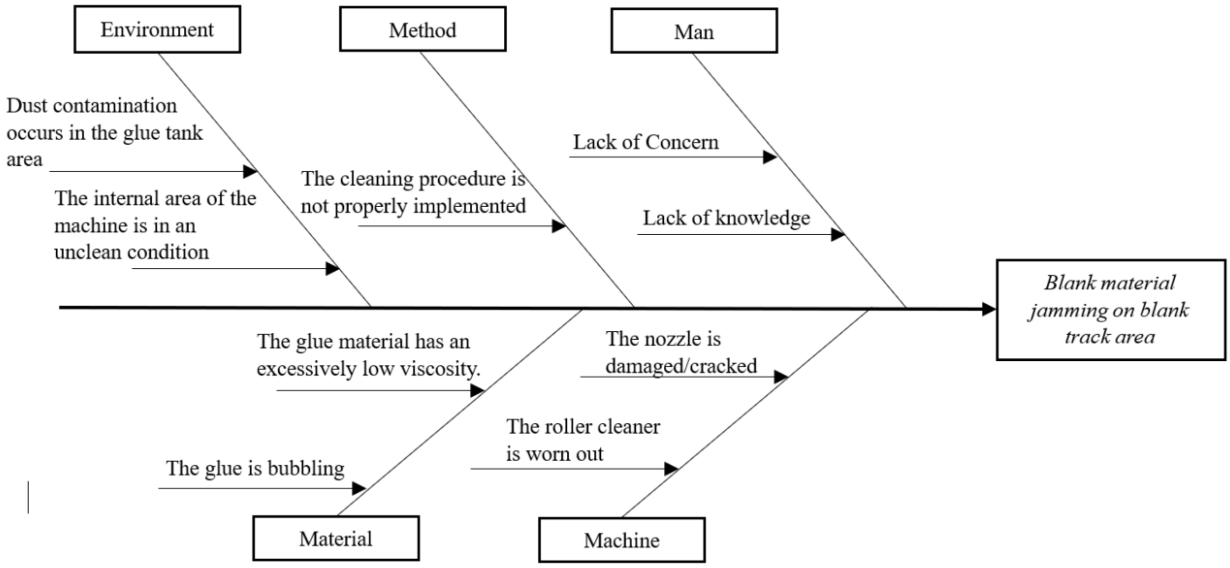

Figure 1. Fishbone diagram blank material jamming on blank track

Referring to the cause-and-effect diagram in Figure 1, the following improvement suggestions are provided.

Table 8. Improvements recommendations

Factor	Solution
Man	Implementing disciplinary actions for assigned operators, enhancing their awareness, and conducting regular training sessions.
Machine	Ensuring the availability of spare nozzle components at all times and maintaining the roller cleaner components in a moist condition.
Method	Providing printed hard copies of the relevant SOP to be consistently placed near the machine area, and conducting regular SOP refresher training sessions.
Material	Consistently performing inspections of the glue material and promptly returning any materials found to have bubbles.
Environment	Ensuring that the machine area and internal components remain clean from contaminants such as tobacco and dust by conducting scheduled and documented cleaning through spraying.

Source: Data processing

CONCLUSION

The average effectiveness value of the Focke FX 2 Packer machine from the period of June 2024 to August 2024 was 43.4%. According to global OEE standards, this value falls into the "below standard" category, indicating that significant improvements are needed.

The highest contributing factor to the machine's inefficiency, based on the Failure Mode and Effect Analysis (FMEA) and the RPN (Risk Priority Number) indicator, was identified as the "Blank missing in turret" failure, caused by the suboptimal performance of the Spray Glue Jet process.

Therefore, the recommended improvement actions to enhance the effectiveness of the Focke FX 2 Packer machine include: increasing operator awareness and skill regarding machine operations; implementing proper failure data management; using standardized materials and spare parts; standardizing all components and materials used; documenting all machine methods and standard operating procedures (SOP); and consistently maintaining cleanliness both inside and around the machine area.

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