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ANALYSIS OF TOTAL PRODUCTIVE MAINTENANCE USING THE OEE METHOD ON THE HIBBON BLOWER MACHINE AT PT. PERTAMINA EP SUKOWATI FIELD

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ABSTRACT

This research report aims to analyze the effectiveness of the Hibbon Blower machine at PT. Pertamina EP Sukowati Field by applying the Total Productive Maintenance (TPM) approach through Overall Equipment Effectiveness (OEE) calculations. The Hibbon Blower is a vital component in the Sulphur Recovery Unit (SRU), responsible for supplying air for the oxidation process of toxic H2S gas. The primary problem identified was the occurrence of unplanned breakdowns, leading to losses in time and production costs. The research methodology involved collecting operational data from June to August 2025, including downtime, working hours, and machine output. The results showed that the average OEE value for the Hibbon Blower was 75.73%, with average components consisting of 92.66% Availability, 84.66% Performance, and 96.36% Quality. This achievement indicates that the machine's effectiveness is still below the international OEE standard of 85%. The low OEE value is primarily driven by low Performance Rates and fluctuations in Availability caused by unplanned damages, such as the bearing collapse incident in June. The researcher recommends that the company upgrade its maintenance program to Predictive Maintenance through vibration analysis and document repair histories near the machine area to accelerate the troubleshooting process.

Keywords— Downtime; Hibbon Blower; Maintenance Strategy; Overall Equipment Effectiveness (OEE); Total Productive Maintenance (TPM)

I. INTRODUCTION

Oil and natural gas are among the most widely used energy sources in Indonesia and play an important role in supporting the national economy. PT. Pertamina (Persero) through its subsidiary PT Pertamina EP, carries out oil and gas exploration and production activities in several operational areas, including Sukowati Field. In oil and gas production systems that operate continuously for 24 hours, equipment reliability is a critical factor in maintaining production stability. Machine failure or unplanned downtime can result in significant losses, including reduced operating time, increased maintenance costs, and decreased production output. Therefore, an effective maintenance strategy is needed to ensure that production support equipment can operate optimally.

PT Pertamina EP Sukowati Field is located in the Bojonegoro and Tuban regions of East Java. Oil and gas processing activities at this field are carried out at the Mudi Central Processing Area (CPA), which consists of several important processing facilities, including the Sulphur Recovery Unit (SRU). The SRU functions to process natural gas containing Hydrogen Sulfide (H_2S), a toxic compound, into safer elemental Sulphur. One of the critical components in this system in the Hibbon Blower, which supplies air required for the combustion and oxidation process of H_2S in the furnace. The stability of this machine is essential because any failure or performance disruption can affect the air supply, inhibit the SRU process, and reduce the effectiveness of production support operations.

To maintain optimal machine performance, companies require a maintenance approach that can identify losses and improve equipment reliability. Total Productive Maintenance (TPM) is one of the approaches widely used to improve machine performance and reduce the impact of equipment failure. One of the main indicators in TPM is Overall Equipment Effectiveness (OEE), which measures machine effectiveness based on three main components: availability, performance, and quality (Siswanto, 2023). OEE analysis provides a systematic basis for evaluating machine performance and identifying factors that reduce equipment effectiveness. In addition, OEE is used as a key indicator in TPM implementation to support optimal equipment conditions by reducing the six major losses that affect machine effectiveness (Prasmoro & Ruslan, 2020).

Previous studies on TPM and OEE have mostly focused on production machines in manufacturing industries, while studies related to critical supporting equipment in oil and gas processing facilities, particularly the Hibbon Blower in the SRU system, are still limited. Therefore, this study aims to evaluate the effectiveness of the Hibbon Blower machine at PT Pertamina EP Sukowati Field using the OEE method and to identify the dominant factors that contribute to decreased machine performance. The results of this study are expected to provide maintenance improvement recommendations, especially in reducing unplanned downtime and improving machine reliability in the production support process.

II. METHOD

This study used a descriptive quantitative approach with a case study method. The research was conducted to measure the effectiveness of the Hibbon Blower machine at PT Pertamina EP Sukowati Field using the Total Productive Maintenance (TPM) approach through Overall Equipment Effectiveness (OEE) calculation. The quantitative approach was used because the analysis was based on numerical data, such as downtime, loading time, operation time, and machine output.

The object of this study was the Hibbon Blower machine used in the Sulphur Recovery Unit (SRU) system at PT Pertamina EP Sukowati Field. The observation period covered three months, from June to August 2025. This period was selected to evaluate the machine effectiveness based on actual maintenance and operational data recorded during the observation period.

The data used in this study consisted of primary and secondary data. Primary data were obtained through direct observation in the field and discussions with technicians in the Maintenance section. Secondary data were obtained from maintenance records carried out by the mechanical team at PT Pertamina EP Sukowati Field. The data collected included unscheduled downtime, scheduled downtime, loading time, operation time, conforming output, and non-conforming output of the Hibbon Blower machine.

The collected data were used as the basis for calculating the three main components of Overall Equipment Effectiveness (OEE), namely Availability, Performance, and Quality. These components were then analyzed to identify the factors that caused a decrease in machine effectiveness.

A. Overall Equipment Effectiveness (OEE)

Overall Equipment Effectiveness (OEE) is a method used to assess the level of effectiveness of machine performance by referring to three main indicators: availability, performance, and quality (Suliantoro et al., 2017). By knowing the level of machine effectiveness, the magnitude of losses that affect machine performance can be identified. The Overall Equipment Effectiveness (OEE) value obtained in general form can be used as a basis for comparing machine effectiveness levels (Amri Pradaka & Szs, 2021). Overall Equipment Effectiveness (OEE) can be used as a tool to focus efforts to improve machine performance and process quality, particularly in identifying improvement opportunities that have the potential to have a significant impact on operational problems (Zulfatri et al., 2020). OEE consists of three components: availability, performance, and quality. The OEE formula can be seen below.

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

Availability rate is a measure that shows how long a machine can be used effectively in production activities.

$$\text{Avalability} = \frac{\text{Loading Time} - \text{Downtime}}{\text{Loading Time}} \times 100\% \quad (2)$$

Performance determines the maximum speed value of the machine that should be used when carrying out production activities.

$$\text{Performance} = \frac{\text{Ideal Cycle Time} \times \text{Output}}{\text{Operation Time}} \times 100\% \quad (3)$$

Quality measures output that meets standards with total output that meets standards.

$$\text{Quality} = \frac{\text{Conforming output} \times \text{Non} - \text{Conforming output}}{\text{Conforming output}} \times 100\% \quad (4)$$

B. Maintenance

Maintenance is a series of activities carried out to maintain and preserve the condition of factory facilities and equipment, as well as carry out repairs, adjustments, or replacement of components as needed to maintain optimal function (Pasaribu et al., 2021). Maintenance also aims to restore machinery to its proper operating condition, thereby extending its lifespan and minimizing the potential for failure (Putra, 2020). Maintenance also plays a role in reducing the costs a company must incur for machine repairs and assisting in determining an appropriate maintenance schedule so that maintenance activities can be carried out effectively (Afiva et al., 2018). Essentially, maintenance activities aim to ensure that physical assets remain capable of meeting the company's needs and expectations (Haryono & Susanty, 2018).

Preventive Maintenance

Preventive maintenance is a maintenance effort that is implemented in a planned manner with the aim of preventing unexpected damage and identifying conditions that have the potential to cause disruption or damage to production facilities during the operational process (Pamungkas et al., 2021).

Corrective Maintenance

Corrective maintenance is a maintenance activity carried out after a machine experiences damage or a problem that causes its operational functions to malfunction. This type of maintenance is generally repair-based and cannot be scheduled in advance (Pandi et al., 2014).

Predictive Maintenance

Predictive Maintenance is a machine maintenance method that is predictive in nature, namely carried out based on the results of evaluations of periodic maintenance activities or Preventive Maintenance (Ismail, 2016).

C. Total Productive Maintenance (TPM)

Total Productive Maintenance (TPM) is an approach focused on improving and maximizing the effectiveness of facilities or equipment used in operational activities (Asyrof, 2018). The maintenance concept has long been recognized and implemented by companies, and was then further developed into the Total Productive Maintenance (TPM) approach (Ganep Muhaemin & Erik, 2022). Total Productive Maintenance (TPM), implemented through the Overall Equipment Effectiveness (OEE) method, is used to assess production conditions and their overall effectiveness, including availability rate, performance rate, and quality rate (Afif Fahmi & Arif Rahman, 2013).

III. RESULTS AND DISCUSSION

A. Data collection

Data collection was carried out through direct observation in the field, discussions with technicians in the Maintenance section, and secondary data collection from the company's Reliability Availability Maintainability (RAM) system. The collected data focused on the performance of the Hibbon Blower machine in the SRU (Sulphur Recovery Unit) during a three-month period, from June to August 2025. These data were used as the basis for calculating Overall Equipment Effectiveness (OEE), which consists of three main parameters: availability, performance, and quality.

Hibbon blower machine downtime data

Downtime refers to the condition in which the machine cannot operate due to failure or maintenance activities. In this study, downtime data were divided into unscheduled downtime and scheduled downtime. Unscheduled downtime is particularly important because it directly indicates unexpected machine failure that can disrupt production support operations. Hibbon Blower downtime data for the June-August period is shown in Table 1 below.

Table 1. Hibbon Blower downtime data

Month	Downtime unschedule (hour)	Downtime schedule (hour)
June	80	34
July	30	27
August	45	16

Hibbon Blower loading time data

Loading time data show the available working time of the Hibbon Blower machine during the observation period. These data were used to determine the proportion of time in which the machine was actually available for operation.

Table 2. Hibbon blower loading data

Month	Working hours (hour)
June	686
July	717
August	728

Hibbon Blower output data

The output data produced by the Hibbon machine can be seen in Table 3 belowOutput data consist of conforming output and non-conforming output. Conforming output refers to output that meets operational standards, while non-conforming output refers to output that does not meet the required criteria.

Table 3. Hibbon Blower output data

Month	Conforming output (Nm^3)	Non-Conforming output (Nm^3)
June	4.922.235	259.065
July	5.981.537	153.373
August	5.853.276	181.029

B. Data processing

After the data collection stage, the data were processed to measure the effectiveness of the Hibbon Blower machine using the Overall Equipment Effectiveness (OEE) method. The calculation was carried out through three main components: availability, performance, and quality.

Availability

Availability rate indicates the proportion of time in which the machine is available and can be used effectively for production support operations.

$$\text{Availability} = \frac{\text{Loading time} - \text{downtime}}{\text{Loading time}} \times 100\%$$

$$\text{Availability} = \frac{686 - 80}{686} \times 100\% = 88{,}34\%$$

Table 4. Availability rate

Month	Downtime (hour)	Loading time (hour)	Operation time (hour)	Availability (%)
Jun	80	686	606	88,34%
Jul	30	717	687	95,82%
Aug	45	728	683	93,82%
Average				92,66%

The average Availability Rate of the Hibbon Blower machine during the three-month period was 92.66%. The highest availability occurred in July, with a value of 95.82%, because the machine experienced lower downtime and could operate for a longer duration. In contrast, the lowest availability occurred in June, with a value of 88.34%. This decrease was strongly influenced by the bearing collapse incident, which caused 80 hours of unscheduled downtime.

This result shows that the availability problem was not only caused by the amount of downtime, but also by the lack of early detection of critical component failure. Bearing damage generally develops gradually and can often be detected through changes in vibration, temperature, or abnormal sound. Therefore, the high downtime in June indicates the need for a more proactive maintenance strategy, particularly predictive maintenance based on vibration analysis, to detect potential bearing failure before it causes machine shutdown.

Performance

Performance rate is a measure used to determine how effectively a machine produces output compared to its ideal production capacity. In this study, the ideal cycle time used in the performance calculation was 0.006 minutes/Nm^3. This value was obtained from the design specification data of the Hibbon Blower machine at PT Pertamina EP Sukowati Field. Therefore, the ideal cycle time represents the standard time required by the machine to produce 1 Nm^3 of output under normal operating conditions.

In the performance calculation, the output value used refers to the effective output, namely the output that meets the operational standard. This approach was intentionally applied because the performance analysis in this study focuses on the machine's ability to produce usable output according to the company's operational requirements. Meanwhile, non-conforming output is discussed separately in the Quality Rate section to describe the proportion of output that does not meet the standard.

$$\text{Performance} = \frac{\text{ideal cycle time } \times \text{output}}{\text{Operation time}} \times 100\%$$

$$\text{Performance} = \frac{0{,}006 \ \times 4.922.235}{36360} \times 100\% = 81{,}23\%$$

Table 5. Performance rate

Month	Conforming output (Nm^3)	Operation time (minute)	Ideal cycle time (minute)	Performance (%)
June	4.922.235	36360	0,006	81,23%
July	5.981.537	41220	0,006	87,07%
August	5.853.276	40980	0,006	85,70%
		Average		84,66%

Based on the calculation results, the average Performance Rate of the Hibbon Blower machine was 84.66%. The highest performance occurred in July, with a value of 87.07%, indicating that the machine operated more effectively in producing usable output. The lowest performance occurred in June, with a value of 81.23%.

The low performance in June is related to the bearing collapse incident that also affected availability. When a bearing begins to deteriorate, the rotational stability of the blower can be disturbed, which may reduce the effectiveness of air supply and cause the machine to operate below its design capacity. This condition shows that component failure does not only increase downtime, but can also reduce machine speed and output efficiency during operation. Compared with the international performance benchmark of 95%, the average performance value of 84.66% indicates that improvement is still required, especially by controlling potential component degradation before it develops into major failure.

Quality

Quality rate measures the proportion of output that meets the predetermined operational standard. This indicator is used to determine the ability of the machine to produce acceptable output during the production support process.

$$\text{Quality} = \frac{\text{Conforming output} - \text{Non} - \text{Conforming output}}{\text{Conforming output}} \times 100\%$$

$$\text{Quality} = \frac{4.922.235 - 259.065}{4.922.235} \times 100\% = 94{,}74\%$$

The average Quality Rate of the Hibbon Blower machine during the observation period was 96.36%. The highest quality rate occurred in July, while the lowest occurred in June (Table 6). The lower quality value in June was influenced by the higher amount of non-conforming output compared to the other months.

Although the quality value was relatively high, it still did not reach the international quality benchmark of 99%. The result indicates that quality improvement is still needed, particularly by maintaining stable machine operation and improving machine setup. The June condition also shows that machine instability caused by component failure may influence the consistency of output quality. Therefore, maintenance improvements should not only focus on reducing downtime, but also on maintaining stable operating conditions to reduce non-conforming output.

Table 7. Quality Rate

Month	Conforming output (Nm^3)	Non-Conforming output (Nm^3)	Quality (%)
June	4.922.235	259.065	95,00%
July	5.981.537	153.373	97,50%
August	5.853.276	181.029	97,00%
	Average		96,36%

Table 8. OEE

Month	Availability (%)	Performance (%)	Quality (%)	OEE (%)
June	88,34%	81,23%	95,00%	67,98%
July	95,82%	87,07%	97,50%	81,29%
August	93,82%	85,70%	97,001%	77,92%
		Average		75,73%

C. OEE calculation results

The average OEE value of the Hibbon Blower machine during the June to August period was 75.73%. This value is below the international OEE standard of 85%, indicating that the machine effectiveness has not yet reached the expected level. The highest OEE value occurred in July because the machine had lower downtime, better performance, and higher quality compared to the other months. In contrast, the lowest OEE value occurred in June, which was strongly affected by the bearing collapse incident.

The results show that the main losses were related to availability and performance. The bearing collapse in June caused long unscheduled downtime, reducing the available operating time of the machine. In addition, bearing failure may also affect blower rotation stability and air supply performance, causing the machine to operate below its ideal capacity. Therefore, the root problem is not only the occurrence of downtime, but also the absence of an early warning system that can detect component degradation before failure occurs.

Based on these findings, the implementation of predictive maintenance is recommended to improve machine reliability. Periodic vibration analysis can be used to monitor bearing condition and detect early signs of abnormal vibration. In addition, repair history documentation should be improved by recording previous failures, repair actions, replacement components, and downtime duration. This documentation can help technicians identify recurring problems more quickly and support better maintenance decision-making. Through these improvements, the company can reduce unplanned downtime, improve performance stability, and increase the overall effectiveness of the Hibbon Blower machine.

IV. CONCLUSION

1. Based on the analysis using the Total Productive Maintenance (TPM) approach through the Overall Equipment

Effectiveness (OEE) method, the effectiveness of the Hibbon Blower machine at PT Pertamina EP Sukowati Field during the June to August 2025 period was 75.73%. This value is still below the international OEE standard of 85%, indicating that the machine performance has not yet reached the expected effectiveness level.
2. The main factors contributing to the low OEE value are the Performance Rate, which averaged 84.66%, and fluctuations in Availability caused by unplanned breakdowns. These conditions indicate that the Hibbon Blower still experiences performance losses and reliability issues that can affect the continuity of the SRU process.
3. To improve machine effectiveness, the company is recommended to strengthen its maintenance strategy by shifting from corrective maintenance to predictive maintenance. This can be carried out through periodic vibration analysis to detect early signs of failure, especially in critical components such as bearings.
4. In addition, repair history documentation should be improved by placing maintenance records near the machine area or integrating them into a structured maintenance record system. This documentation can help technicians identify recurring problems, accelerate troubleshooting, and support more accurate maintenance decisions.
5. This study is limited to operational data from June to August 2025 and only focuses on the Hibbon Blower machine in the SRU system. Therefore, further research is suggested to use a longer observation period, include other critical machines, and apply additional methods such as Failure Mode and Effect Analysis (FMEA) or Root Cause Analysis (RCA) to identify the causes of failure more comprehensively.

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