p–ISSN: 2723 – 6609 e-ISSN: 2745-5254
Vol. 6, No. 1, January 2025 http://jist.publikasiindonesia.id/

Implementation of Pre-Cleaner as An Effort to Preventive Engine Lacks Power Bulldozer D85ess-2 Support Area Rom PT Putra Perkasa Abadi Site Mip Lahat

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ABSTRACT

Bulldozer D85ESS-2 operating in the ROM Support Area of PT Putra Perkasa Abadi Site MIP Lahat often experiences engine power problems, which disrupts productivity and increases maintenance costs. This problem is generally caused by air contamination entering the engine system, resulting in decreased combustion efficiency and component damage. This study aims to analyze the effectiveness of pre-cleaner implementation as a preventive measure in overcoming this problem. The method used was a quantitative approach with the collection and analysis of operational data from the D85ESS-2 bulldozer before and after the installation of the pre-cleaner. The data analyzed included the frequency of occurrence of the engine lack of power problem, downtime duration, and fuel usage. The results showed that the implementation of a pre-cleaner on the D85ESS-2 bulldozer at PT Putra Perkasa Abadi successfully resolved the problem of engine lacks power by reducing the accumulation of coal dust in the air cleaner. The test results show significant improvements in engine performance, with most parameters meeting the set standards. Thus, the use of a pre-cleaner improves combustion efficiency, reduces maintenance costs, and extends engine life.

Keywords: bulldozer, the engine lacks power, pre-cleaner.

Introduction

The D85ESS-2 bulldozer is one of the heavy equipment used intensively in mining operations at PT Putra Perkasa Abadi Site MIP Lahat. However, this heavy equipment frequently experiences engine lacks power issues, characterized by a significant drop in engine performance. This problem disrupts operational productivity and impacts maintenance costs as well as downtime (Wang et al., 2024). These issues are often caused by the entry of dust and dirt particles into the engine system, leading to decreased performance and damage to vital components. Therefore, a preventive solution is needed to address these problems (Wu et al., 2024).

The operational environment, which is full of dust and solid particles in the mining area, is one of the main causes of engine lacks power issues. The conventional air filtration system on bulldozers is not always capable of handling high levels of contaminants, allowing these particles to enter the engine and affect the performance of components such as the air filter, fuel injector, and turbocharger (SWANDARU, 2023).

The accumulation of contaminants reduces combustion efficiency and ultimately results in a loss of engine power. In the long run, this damage can also shorten the engine's lifespan and increase maintenance costs (Aditya et al., n.d.).

The pre-cleaner technology is introduced as a preventive solution to address these issues. A pre-cleaner is an additional device installed in the engine's air system to filter out large particles before they reach the main filter (Barbero-García et al., 2023). The implementation of a pre-cleaner aims not only to reduce the frequency of engine lacks power issues but also has the potential to significantly lower operational costs. By decreasing the frequency of repairs and maintenance, along with improving operational efficiency, it is expected that downtime can be minimized. Additionally, this implementation can enhance the productivity and operational efficiency of heavy equipment in the ROM area (Sampo, 2022).

This research aims to analyze and implement pre-cleaner technology as a preventive effort to address the engine lacks power issues in the D85ESS-2 bulldozer used in the ROM area of PT Putra Perkasa Abadi Site MIP Lahat. The novelty of this research lies in the application of the pre-cleaner to improve engine efficiency and reduce the frequency of damage caused by airborne contamination in the engine system, which has not been widely applied in similar operational environments. This study is expected to provide practical solutions for preventive maintenance and optimize the performance of heavy equipment in the mining industry. (Mega, 2024).

Method

This study uses a quantitative approach by collecting and analyzing operational data from the D85ESS-2 bulldozer unit in the ROM Support Area of PT Putra Perkasa Abadi Site MIP Lahat. The data collected includes the frequency of engine lack of power problems, downtime duration, fuel usage, and engine performance before and after pre-cleaner implementation. Data collection was conducted over some time, noting changes in engine efficiency and operational performance after pre-cleaner installation. The data was analyzed using statistical methods to compare engine performance before and after the intervention, to evaluate the effectiveness of the pre-cleaner in preventing engine lack of power problems.

Results and Discussion

A bulldozer is one of the heavy equipment that functions for the equalization of materials such as soil, sand, and gravel with high thrust or power. This tool can be used for various tasks such as digging, pushing, displacing, leveling, pulling loads, and stockpiling materials (Anisari, 2018). Bulldozers are often applied in various projects, including mines, quarries, military bases, heavy industrial plants, engineering projects, and farms. One type of bulldozer that is commonly used is the D85ESS-2 model, which has the following meaning: D stands for Dozer or Bulldozer, the number 8 indicates the engine size, the number 5 indicates the use of Torque Converter, E means Long Track, SS stands for Super Skidder, and -2 indicates the second modification to the model (Purwono et al., 2023).

In the ROM (Run of Mine) area of PT Putra Perkasa Abadi, Site MIP Lahat, there are two D85ESS-2 bulldozers used to support operational activities. However, there are reports of frequent engine power loss issues, mainly caused by the ingress of contaminants such as dust and sand into the fuel system. This contamination can clog the fuel filter, damage the injectors, and disrupt the combustion process, ultimately resulting in a decrease in engine performance.

Based on observation, information was obtained from the operator that the bulldozer unit experienced a decrease in power (low power) during operation. The conditions at the work site were very dusty, and the dust indicator on the unit was showing red, indicating that the air filter was saturated with dust particles. During inspections, it was often found that the air cleaner was clogged, which prevented air flow to the engine. In addition, the exhaust gases from the engine appear pitch black in color, indicating incomplete combustion. Even so, the fluid level is normal. The air cleaner cover was also full of dust, and the evacuator valve passage was blocked. However, the coolant and torque converter temperatures remained within normal ranges.

These conditions indicate that the engine's performance was hampered due to high dust exposure in the working environment, which resulted in a clogged air filter and a disrupted combustion process, even though the engine's cooling system and transmission were working properly. This means that there are indications that the main problem stems from the air system not functioning optimally, causing a decrease in engine performance. Report related to the observation results based on the figure below.

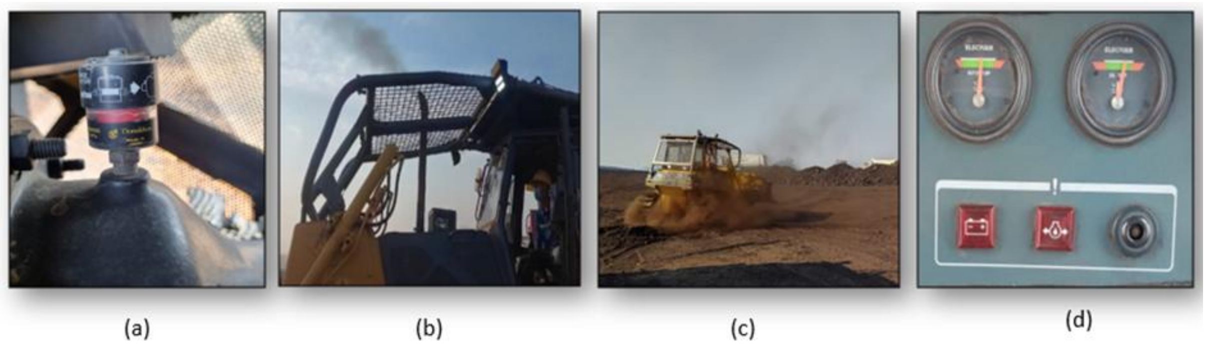

Figure 1
Problems found in the field

In Figure 1 (a), a red dust indicator is shown. Figure (b) shows the black exhaust gas discharge. Figure (c) shows a work area with very thick dust conditions, contributing to air system blockage and reduced engine performance. Meanwhile, figure (d) shows that the engine's working temperature is within normal conditions, indicating that the cooling system is functioning properly despite problems with airflow and combustion.

Figure 2 Problems found in the field

In figure (a), the outer air cleaner is dirty, indicating that dust and particles have accumulated on the outside of the air filter. Figure (b) shows the inner air cleaner also in a dirty condition, indicating that small particles have managed to pass through the outer filter and contaminate the inside of the filtration system. Figure (c) shows the dust-covered air cleaner cover, worsening the condition of the air filtration system. In figure (d), it can be seen that the evacuator valve passage is blocked, which results in the air flow not being able to run smoothly and causes a decrease in engine efficiency.

Furthermore, after observation of the findings in the field, the research also conducted tests based on the standard engine values listed in the table. The test results are presented in the table below.

Table 1
Engine Standard Test Results

Test result	Standard	Result	Remarks
Engine Low Idle (RPM)	800-850	707	Not Ok
Engine High Idle (RPM)	2050-2150	1908	Not OK
Stall Speed (RPM)	1670-1870	1561	Not OK
Blow By Pressure (kPa)	0,49	0,2	OK
Boost Pressure (mmHg)	Min.600	400	Not Ok

Table 1 shows the test results of the engine standards compared to the actual performance of the bulldozer engine. Broadly speaking, the results show that the engine parameters do not meet the predetermined standards, except for Blow By Pressure. This shows that the bulldozer engine requires further improvement in order to return to operating with optimal performance.

Based on previous observations and testing, it was identified that the main cause of the problem was the clogging of the air cleaner. This was caused by the extremely dusty working environment as well as the pre-cleaner built into the unit that was not effective enough to be used in the ROM work area. From these findings, it can be concluded that the engine lacks output due to the blockage of the air cleaner by coal dust, which inhibits the air supply to the combustion chamber. It can be seen from the boost pressure value that does not meet the standard. To overcome the entry of coal dust into the air cleaner, modifications were made to the pre-cleaner to more effectively handle dust conditions in the work area.

The implementation of a pre-cleaner involves installing a device at the air or fuel inlet of the engine to filter out large particles before they enter the system. The main function of a pre-cleaner is to separate large contaminants from the air or fuel stream, thereby preventing potential damage to engine components (Dumatubun & Amir, 2021). The use of a pre-cleaner can significantly reduce the risk of particle accumulation that can interfere with engine performance. The following are the tools needed for the pre-cleaner implementation process can be seen in the figure below.

Figure 3 Pre-cleaner Implementation Tools

In figure (a), there are common tools that include basic tools commonly used in the repair process. Figure (b) shows the PPM tool kit, which contains specific tools for machine maintenance and repair. Figure (c) shows LOTO (Lockout-Tagout), which is a safety procedure to ensure that the machine cannot be started while repairs are being carried out. Furthermore, figure (d) depicts the welding machine, which is used for welding components during installation. Figure (e) shows oxygen and acetylene cylinders, which are required for the cutting and welding process. Figure (f) shows plasma cutting, a tool used to cut metal with high precision. Figure (g) shows a grinder, which is used to smooth or shape metal surfaces. Finally, figure (h) shows a compressor, which is used to provide compressed air in a variety of applications, including dusting or operating pneumatic tools.

The process of installing a pre-cleaner begins with the first stage, the design. The design includes various important elements needed to ensure that the pre-cleaner can function optimally in filtering out large particles before air or fuel enters the engine. A good design also takes into account the ease of installation and maintenance, so that the device can be easily checked and cleaned as needed. The following figure shows the design of the pre-cleaner that will be used.

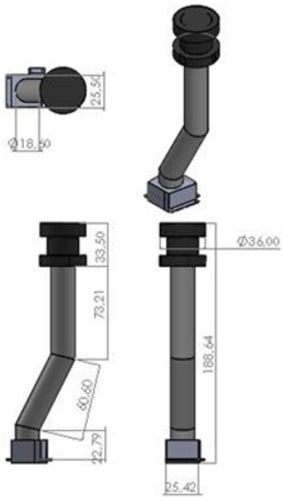

Figure 4 Pre-Cleaner Design

After that, the installation of the pre-cleaner modification is carried out until the device is properly installed. At this stage, all components need to be installed precisely so that the pre-cleaner can function optimally. Once all the steps are completed and the pre-cleaner is installed, the device is ready to perform its function in filtering large particles from the air or fuel before entering the engine.

Figure 5 Pre-Cleaner Modification Process

Figure 6. Installed Pre-Cleaner

(a) (b)

Figure 7 Difference after Pre-cleaner Modification on Air System

In figure (a), the state of the air system is shown before the pre-cleaner is installed. In this condition, the system may be more susceptible to the ingress of large particles, which can cause contamination and potentially damage engine components. In contrast, figure (b) shows the condition of the air system after the pre-cleaner is installed.

After the installation and use of the pre-cleaner modification, the next step is to conduct an evaluation to assess its effectiveness. This evaluation process aims to measure the changes that occur after the pre-cleaner is installed, including its impact on the quality of air entering the engine and the overall performance of the system. Through analysis of the data obtained, it can be determined whether this modification has been successful in reducing contamination and improving engine efficiency. The evaluation results of the implementation can be seen in the figure below.

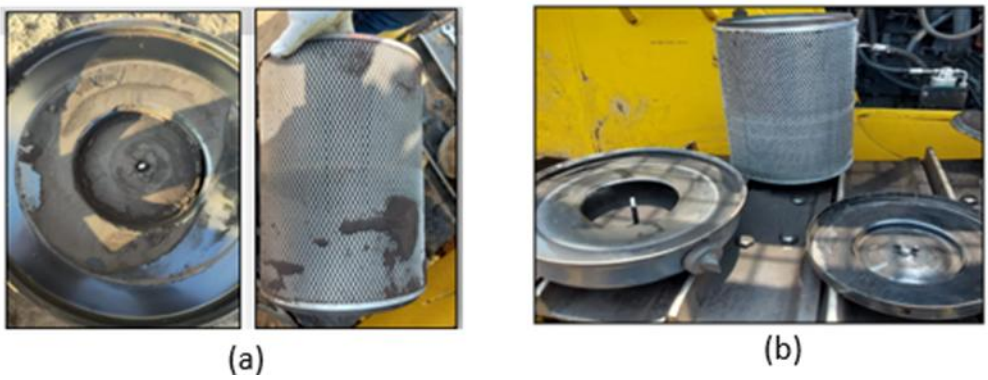

Figure 8 Comparison After Modification

The figure shows a comparison of the system conditions after pre-cleaner modification, with two sub-figures: (a) before modification and (b) after modification. From the figure, it can be seen that the amount of coal dust entering the air cleaner is significantly reduced after the improvement. This shows that the pre-cleaner modification was successful in filtering and reducing dust contamination that could previously enter the system.

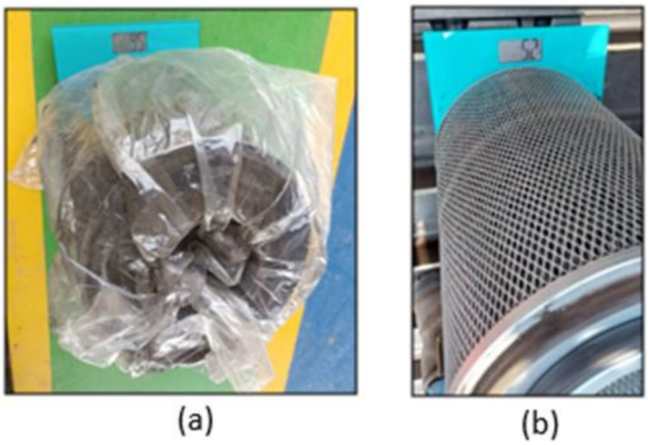

Figure 9 Comparison After Modification

Figure 9 shows a comparison of the air cleaner condition before and after the pre-cleaner modification, with two sub-figures: (a) before modification and (b) after modification. After the pre-cleaner modification, the weight of the air cleaner was recorded to be 5.2 kg, which is a significant reduction compared to its weight before the modification which reached 9.5 kg. This weight reduction reflects the effectiveness of the pre-cleaner in filtering and reducing the accumulation of dust and contaminants previously trapped inside the air cleaner. This weight reduction indicates that the system became lighter and more effective after the modifications were made.

Next, a retest of the standard engine values was conducted after the modification of the pre-cleaner addition. The retest aims to evaluate the impact of the modifications that have been made on engine performance. The results of this test are shown in the following table.

Table 2
Engine Standard Test Results After Modification

Testing Results	STD	Actual	Remarks
Engine Low Idle (RPM)	800-850	830	OK
Engine High Idle (RPM)	2050-2150	2081	OK
Stall Speed (RPM)	1670-1870	1781	OK
Blow By Pressure (kPa)	0,49	0,2	OK
Boost Pressure (mmHg)	Min. 600	550	Ok

These results confirm that after modification, the performance of the engine showed significant improvement. All measured parameters were within the expected standard ranges, with the results indicating that the engine was operating properly. In particular, the Engine Low Idle, Engine High Idle, and Stall Speed measurements are all within the predetermined limits, indicating that the engine can function efficiently under idle conditions. Although the Boost Pressure was slightly below the minimum standard, it still showed quite good results.

These test results indicate that the addition of the pre-cleaner has successfully improved the quality of air entering the engine and reduced dust accumulation, thus having a positive impact on engine performance. This demonstrates the effectiveness of the modification and its contribution to more optimized and sustainable operations.

The use of a pre-cleaner has a range of significant benefits in maintaining engine performance, particularly on the D85ESS-2 bulldozer. One of the main benefits is improved engine performance. Because by reducing the amount of contaminants entering the system, the pre-cleaner can improve combustion efficiency, thus keeping engine power optimized.

In addition, pre-cleaners also play an important role in preventing engine damage, by filtering out large particles before they enter the engine, these devices help avoid abrasion of engine components and reduce the risk of clogging. This in turn contributes to machine reliability and operational continuity.

From an economic perspective, the use of pre-cleaners can reduce maintenance costs. By reducing the frequency of breakdowns that require repair, companies can save on the budget normally allocated to machine maintenance and repair. In the long run, the protection provided by the pre-cleaner can also extend the life of the bulldozer, making the initial investment in this device very profitable.

Based on all these findings, it can be concluded that the implementation of a pre-cleaner on the D85ESS-2 bulldozer engine is an effective preventive measure to address the issue of power loss due to contamination. By protecting engine components and maintaining optimal performance, the use of a pre-cleaner not only increases productivity, but also contributes to reduced operating costs. This creates better conditions for project operations, ensuring the machine continues to function efficiently in the long run.

Conclusion

Based on the research results, it can be concluded that the implementation of the pre-cleaner on the D85ESS-2 bulldozer at PT Putra Perkasa Abadi Site MIP Lahat has successfully overcome the problem of engine lacks power caused by the blockage of the air cleaner due to the accumulation of coal dust. Post-modification test results show that all engine parameters, except boost pressure, have met the set standards, indicating a significant improvement in engine performance. The pre-cleaner modification proved effective in filtering out large contaminants before they enter the engine system, thereby reducing the risk of damage and improving combustion efficiency. Thus, the use of a pre-cleaner not only improves engine performance and reliability, but also has a positive impact on reducing maintenance costs and extending engine life. This study recommends the application of similar technology in other machine units to improve productivity and operational efficiency in dusty work environments.

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