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Optimizing Preventive Maintenance to Reduce Downtime On CAT KT4 Axle Loader Components in The Mining Industry

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Abstract. *Damage to rotable axle components on CAT KT4 Loaders in the mining industry is often the main cause of operational downtime. This study aims to analyze the frequency of damage to axle components and evaluate the effectiveness of preventive maintenance to reduce downtime duration and repair costs. Damage data collected from January to August 2024 were quantitatively analyzed to identify the most frequent damage patterns, especially seal leaks and brake modules. The results show that the implementation of preventive maintenance, such as regular seal replacement and hydraulic pressure checking, can significantly reduce the frequency of breakdowns and improve operational efficiency. The research also provides recommendations on maintenance strategies that can be implemented to extend component life and reduce overall downtime.*

Keywords: *Preventive maintenance,Downtime,CAT KT4 Loader axle,Leak seal,Brake module*

1. INTRODUCTION

The mining sector relies heavily on the reliable functioning of heavy equipment to ensure smooth operations every day. One important piece of equipment in this industry is the loader, specifically the CAT KT4 Loader, which is used to move materials with high efficiency. These loaders operate in harsh environmental conditions, including rocky terrain, extreme temperatures, and high working pressure, all of which contribute to a huge workload on critical components, such as axles (Mardian, 2020).

The axle, as one of the vital components, is responsible for transferring power from the engine to the wheels, allowing the loader to move and operate with high efficiency(Singh et al., 2021). However, damage to the axle is often unavoidable, mainly due to severe operational conditions and lack of timely maintenance. Seal leaks and brake module problems are some of the common causes that trigger downtime, which not only slows down mine operations but also increases repair and maintenance costs (Aldyansyah, 2023).

With a strategy of optimizing preventive maintenance, the mining industry is expected to reduce the frequency and duration of downtime caused by axle failures (Putro & Ardjo, 2016). Preventive maintenance involves preventive measures designed to keep components in optimal condition, such as regular hydraulic pressure checks and seal replacement before significant damage occurs (Anhar & Kurnila, 2018). This study aims to analyze the effectiveness of preventive maintenance strategies on CAT KT4 axle loaders to identify the best way to improve operational efficiency and reduce repair costs.

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2. METHODS

This research uses a quantitative method with data analysis of CAT KT4 Loader axle damage from January to August 2024. Data is taken from maintenance reports which include the frequency of damage, duration of downtime, and type of damage to axle components. The Independent Variable of this study is the Frequency of preventive maintenance, such as checking hydraulic pressure and seal replacement while the Dependent Variable is the Number of axle damage and downtime duration. The Independent Variable of this study is the Frequency of preventive maintenance, such as checking hydraulic pressure and seal replacement while the Dependent Variable is the Number of axle damage and downtime duration.

3. RESULTS

In the CAT KT4 Loader there are several axle components which can be seen in Figure 1.

Fig 1 Main Components of the Power Train System of the R1700

Based on Figure 1, there are several axle components including, the suspension functions to absorb shocks when the Loader moves, the brake system functions to control or stop the movement of the vehicle, the differential functions to regulate the difference in wheel rotation speed when turning, the rear final drive axle (rear axle) functions to increase stability and traction, the front final drive (front axle) functions to support the front weight of the vehicle and transfer power from the front differential to the front wheels, and the axle which functions to support and transfer power from the engine to the wheels. These axle components are susceptible to damage that can affect the overall performance of the loader (Muhlis, 2020). Table 1 below summarizes the frequency of damage and duration of downtime for each type of damage identified.

Table 1. Type of Damage to KT4 Axle Loader Components GBC Area

Type of Damage	Frequency	Downtime Duration (hours)
Oil Hydraulic Transfer	12	346,74
Brake Module Seal Leakage	3	142,31
Gear Planetary Hit by Boulder	1	34,22
Internal Leakage on Rear Axle	2	60,86

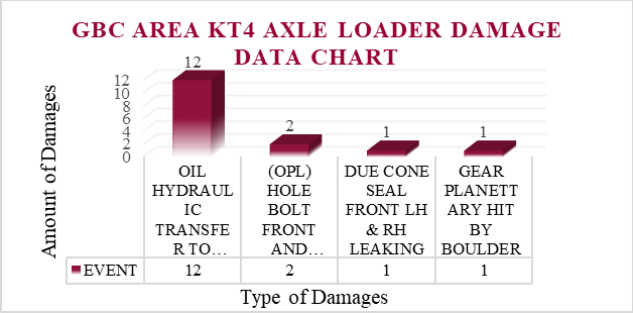

Fig 2 Total Component Damage Axle loader KT4 Area GBC

Based on table 1 and figure 2 shows damage data that has been classified into 4 types with each different total damage. The types of damage that occur are Oil Hydraulic Transfer to Front and Rear Axle with a total damage of 12, Hole Bolt Front and Rear Rh Tire Broken (OPL) has a total damage of 2, Due Cone Seal Front Lh & Rh Leaking and Gear Planettary Hit by Boulder with the same total damage of 1.

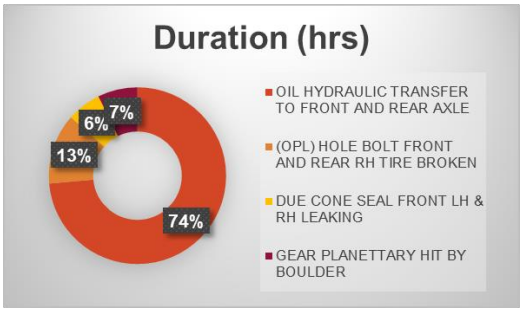

Fig 3 Persentase Downtime Axle loader KT4 Area GBC

Based on table 1 and figure 3 shows the duration data (HRS) or damage time until repair in 4 types of damage to the KT4 Loader rotable axle components. Data with total duration (hrs) type of damage to Oil Hydraulic Transfer to Front and Rear Axle is 346.74 and a percentage of 74%. As for damage type (OPL) Hole Bolt Front and Rear Rh Tire Broken has a total duration (hrs) of 60.86 and a percentage of 13%, damage type Due Cone Seal Front Lh & Rh Leaking has a duration (hrs) of 29.46 and a percentage of 6%, and damage type Gear Planettary Hit by Boulder has a duration (hrs) of 34.22 and a percentage of 7%.

Based on the analysis of the breakdown data from January to August 2024, it was found that the most frequent type of breakdown was Oil Hydraulic Transfer, which is the improper transfer of hydraulic oil from the axle system. This malfunction occurred 12 times during the

study period, accounting for 74% of the total downtime. This condition was caused by a seal leak that caused oil from the hydraulic system to mix with axle oil, affecting the overall performance of the braking system and axle.

In addition, it was also found that leaks in the Brake Module occurred 3 times, with a downtime duration of 142.31 hours. Leaks in the brake module cause the braking system to not work properly, which is a serious threat to the operational safety of the machine at the mine site.

4. DISCUSSION

Cause and Effect Analysis of the Most Damage

The KT4 loader experienced significant damage between January and August 2024 due to mixing of hydraulic oil with axle oil. A leak in the seal or brake module was the main cause of the problem. Factors contributing to the breakdown include degraded component quality, component age, and severe operational conditions.

The impact of this malfunction is extensive and detrimental. The braking system of the KT4 Loader could not function properly due to inconsistent hydraulic pressure. This resulted in decreased operational efficiency, increased repair costs, and an increased risk of occupational accidents. To solve this problem, routine checks and maintenance must be carried out regularly by operators and technicians. Therefore, preventive maintenance is carried out. This maintenance is based on the condition of the axle which has a leak, then an inspection or monitoring is carried out.

If the components that show signs of damage symptoms should be immediately held corrective action to prevent further damage if there are no symptoms of damage, monitoring continues every day so that if symptoms of damage occur immediately known as early as possible. Thus, the negative impact of Loader KT4 damage can be minimized, so that operational efficiency and work safety can be improved.

Analysis of Most Damage Recommendations

KT4 loaders require a comprehensive set of preventive and corrective measures to overcome frequent breakdowns. Replacement of components with good quality and according to specifications must be done to prevent premature damage. Regular hydraulic pressure checks are also important to keep the system operating within safe limits (Wibowo et al., 2020).

Seals and brake modules need to be checked regularly to identify sources of leakage as early as possible. Hydraulic oil changes must be carried out according to a predetermined

schedule to maintain optimal system performance. In addition, the condition of the production area should be improved so as not to accelerate damage to machine components(Prasasta Learning Centre, 2021).

Comprehensive training for operators should also be facilitated to improve performance in the operation and maintenance of the KT4 Loader. By implementing these recommendations, it is expected that the frequency of Loader KT4 breakdowns can be reduced, downtime reduced, and repair costs minimized.

5. CONCLUSION

This study shows that breakdowns in CAT KT4 Loader axle components, particularly those caused by Oil Hydraulic Transfer, are a major cause of downtime in mine operations. Implementation of an improved preventive maintenance strategy, particularly involving regular seal replacement and hydraulic pressure checks, was shown to significantly reduce the frequency of breakdowns and duration of downtime.

Recommendations include increasing the frequency of preventive maintenance, training operators to detect early symptoms of breakdowns, and replacing components that are more prone to wear and tear such as seals and brake modules. By implementing these measures, it is expected that operational efficiency can be improved and repair costs can be reduced.

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