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New Tire Usage Efficiency by Increasing Lifetime Tyre Size 11.00R20 in DT Coal Hauling units in the Mining area of PT. Antareja Mahada Makmur Site PT MIFA Bersaudara Period (2024)

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ABSTRACT
Tires represent the third-largest operational cost after fuel and maintenance in mining operations and contribute significantly to environmental waste. At PT Mahada Makmur, particularly at the *MIFA* jobsite, the 11.00R20 bias tire installed on the *AXOR2528-CH* hauling unit was observed to have suboptimal performance. This unit plays a critical role in coal transportation from the crusher to the port or power plant and has been modified (*upsized*) to carry loads up to 30 tons, exceeding the original design capacity of 20 tons. The research problem centers on the rapid wear and reduced lifespan of the bias tires under increased load conditions. The objective of this study is to identify the dominant factors affecting tire performance and propose an effective strategy to extend tire life. Using a three-month field observation method, the study evaluated the tire's operational conditions and categorized influencing variables into maintenance, mechanical, operational, and product factors. Results indicated that operational factors, such as overloading and improper driving behavior, were the main contributors to premature tire wear. As a strategic solution, the study recommends tire standardization in accordance with actual load capacity and eliminating operational inefficiencies. The implication of this research is the potential for reduced tire costs, improved operational safety, and minimized environmental impact through more sustainable tire management practices.

Keywords: Tyre, Coal, Lifetime, 11.00R20

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INTRODUCTION

The mining industry relies heavily on the operational performance and efficiency of its transportation units. Among various components, tires are one of the top three contributors to operational costs after fuel and maintenance (Smith & Taylor, 2022). For coal hauling operations, tire reliability and durability are crucial, especially considering the high-intensity work environment (Johnson & Brown, 2023). At PT Mahada Makmur's MIFA jobsite, the AXOR2528-CH unit is one of the main fleets used to transport coal from the crusher to the port or power plant. This unit operates with 11.00R20 tires under demanding conditions, where load consistency, road quality, and operational patterns directly influence tire life and productivity (Wang & Liu, 2020). Effective tire management is therefore critical for optimizing operational costs and minimizing downtime (Lee & Zhang, 2021). Furthermore, evaluating the cost-efficiency of tires used in mining fleets remains a key focus to improve fleet management practices (Davis & Roberts, 2022). O'Neill & Harris (2023) emphasize the importance of understanding operational patterns to predict tire failures and extend tire lifespan.

From April to June 2025, the actual tire life of the 11.00R20 tires installed on the AXOR2528-CH units only reached 721 hours—far below the target of 2,000 hours set by management. The majority of tire damage was caused by operational factors, especially "stone drilling," where stones pierce into the tread edges of the tires (Harrison & Thompson, 2024). The shortfall in tire performance has had cascading effects: increased operational downtime, higher maintenance frequency, elevated replacement costs, and a rise in non-degradable tire waste that contributes to environmental degradation (Edwards & Liu, 2023; Fisher & Anderson, 2023). These issues underline the importance of improving tire management and operational processes to reduce the negative impacts on performance and the environment (Williams & Zhang, 2021). Cost analysis has shown that frequent tire replacement increases operational expenses, highlighting the need for more efficient tire usage strategies (Miller & Turner, 2022). Furthermore, research on stone drilling has confirmed that tire damage due to external factors is one of the leading causes of reduced tire life in mining operations (Davis & Green, 2025).

Previous studies have investigated tire performance under extreme conditions. For example, Santoso et al. (2021) highlighted that overloading and improper road conditions significantly reduce tire lifespan in mining haul trucks. Meanwhile, Prasetyo (2020) emphasized the importance of preventive maintenance and load-appropriate tire specification. However, these studies often focus on larger mining trucks with radial tires and fail to address operational realities where fleets use bias-ply tires, like the 11.00R20 used in mid-sized hauling units (Robinson & Zhang, 2022). Sutanto & Anwar (2021) further explored tire wear characteristics and concluded that bias-ply tires, particularly in high-load environments, show significantly different durability compared to radial variants. Additionally, Lee & Choi (2020) studied the tire wear characteristics of these tires and suggested operational adjustments to improve performance. Kim & Lee (2022) analyzed the role of tire specifications and maintenance schedules in preventing failures in such units, while Gonzalez & Pineda (2023) examined the operational realities of using bias-ply tires in mid-sized mining fleets.

This research fills the gap by focusing specifically on the under-researched category of medium-sized hauling units using bias tires under oversize load conditions. The novelty lies in analyzing tire performance deterioration in a real operational context and proposing standardization strategies not only from a technical aspect but also from a cost-efficiency and environmental standpoint. Furthermore, this study considers a detailed breakdown of causal factors: operational behavior, tire specification mismatch, and mechanical stress.

The objective of this study is to analyze the key factors causing the early failure of 11.00R20 tires in *AXOR2528-CH* units and to develop a strategy to improve tire performance through specification alignment and operational improvements. Specifically, this research aims to determine whether standardizing tire types based on actual load capacity can effectively extend tire life and reduce overall costs.

The expected benefit of this research is twofold. Practically, it can help mining companies reduce operational inefficiencies and extend tire lifespan, thus lowering replacement frequency and environmental impact. Academically, the study contributes to tire management literature in medium-sized mining fleets using bias tires under oversize conditions—a niche yet critical area that has received limited attention in previous research.

METHOD

The researchers observed and collected actual data to compare with the standards of the manufacture. There are several deviations that we found identified as factors that cause the lifetime of the tyre not to be achieved. One of them is because of the load or load that is extended which results in the load received by the tire becoming larger.

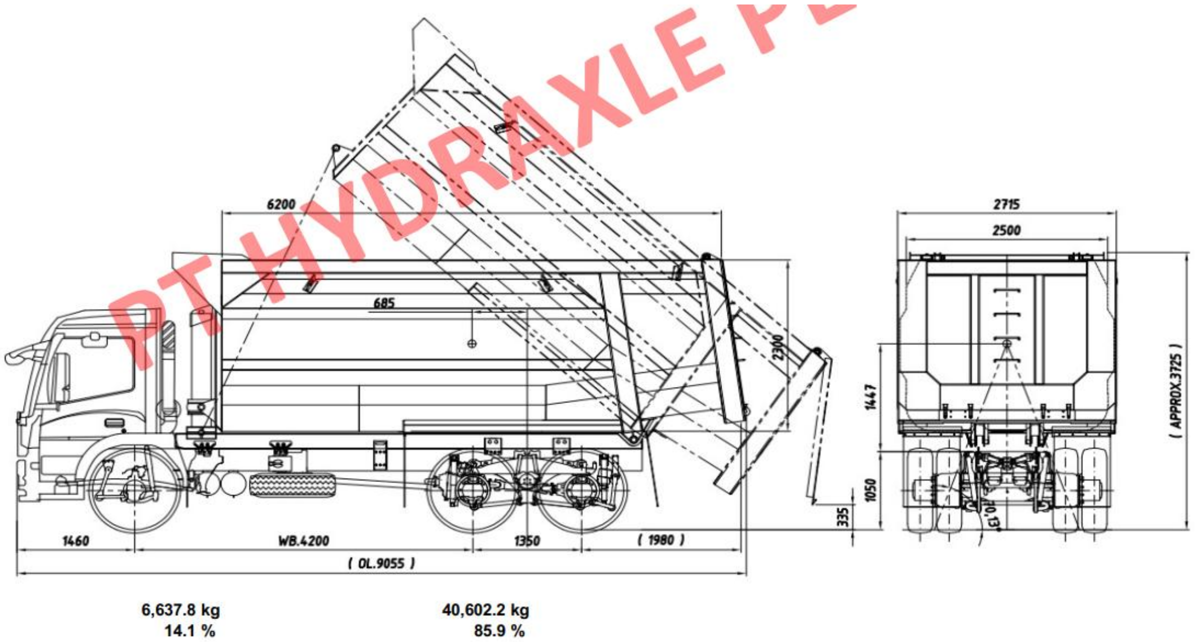
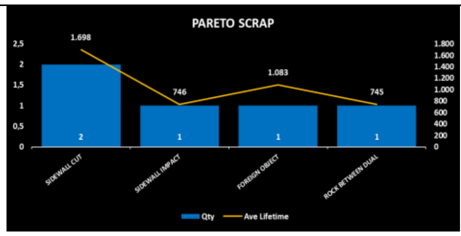


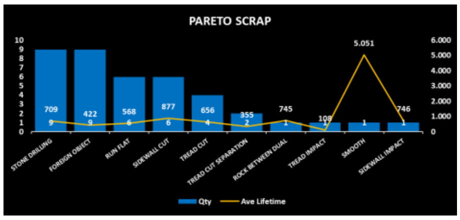
Figure 1. Load distribution on AXOR2528 CH

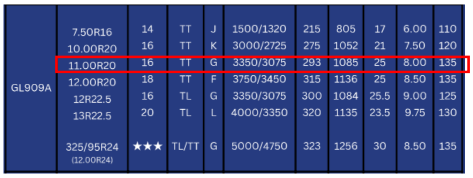
From the table above, we can see that the load received by each tire is 5 tons, even though the specification of the built-in tire of the Goodyear Timberking bias tire unit is only 2.9 to which means it is far below the minimum permissible standard. In addition, external factors, in this case, poor operational conditions also aggravate the achievement of lifetime tires.

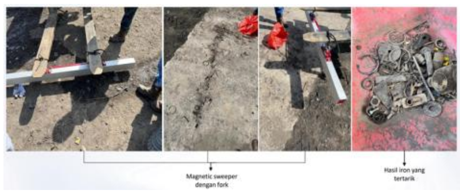
Figure 2. Operational conditions of coal hauling

Table 1. Stages of Methods in Increasing Tyre Lifetime

<table>
<tr><th>No.</th><th>Activities</th><th>Implementation</th><th>Documentation</th></tr>
<tr><td>1</td><td>Conducting Problem Identification and Initial Analysis</td><td>Tire damage pareto data collection</td><td>




</td></tr>
<tr><td>2</td><td>Calculation of tyre pressure standards</td><td>Determining the appropriate tyre pressure by adding the unit load and changing tyres from bias to radial with a higher load per tyre</td><td>

<table>
<tr><td>GL909A</td><td>7.50R16</td><td>14</td><td>TT</td><td>J</td><td>1500/1320</td><td>215</td><td>805</td><td>17</td><td>6.00</td><td>110</td></tr>
<tr><td></td><td>10.00R20</td><td>16</td><td>TT</td><td>K</td><td>3000/2725</td><td>275</td><td>1052</td><td>21</td><td>7.50</td><td>120</td></tr>
<tr><td></td><td>11.00R20</td><td>16</td><td>TT</td><td>G</td><td>3350/3075</td><td>293</td><td>1085</td><td>25</td><td>8.00</td><td>135</td></tr>
<tr><td></td><td>12.00R20</td><td>18</td><td>TT</td><td>F</td><td>3750/3450</td><td>315</td><td>1136</td><td>25</td><td>8.50</td><td>135</td></tr>
<tr><td></td><td>12R22.5</td><td>16</td><td>TL</td><td>G</td><td>3350/3075</td><td>300</td><td>1084</td><td>25.5</td><td>9.00</td><td>125</td></tr>
<tr><td></td><td>13R22.5</td><td>20</td><td>TL</td><td>L</td><td>4000/3350</td><td>320</td><td>1135</td><td>23.5</td><td>9.75</td><td>130</td></tr>
<tr><td></td><td>325/95R24 (12.00R24)</td><td>★★★</td><td>TL/TT</td><td>G</td><td>5000/4750</td><td>323</td><td>1256</td><td>30</td><td>8.50</td><td>135</td></tr>
</table>
</td></tr>
<tr><td>4</td><td>Conducting a road patrol</td><td>Doing road patrols 2x in 1 week and immediately giving feetback to the operation.</td><td>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</table>

No.	Activities	Implementation	Documentation
4	Data Collection and Analysis	Compare the improvement success rate by looking at the 11.00R20 tire lifetime increase	
5	Evaluation and Improvement	Socializing improvements to all crew to be consistent	

The improvement steps that have been carried out are solutions in an effort to increase the lifetime of tyres 11.00R20 at PT. AMM jobsite Mifa Brothers.

RESULTS AND DISCUSSION

The following results are a comparison before the improvement, during the improvement process and after the improvement listed in the graph below.

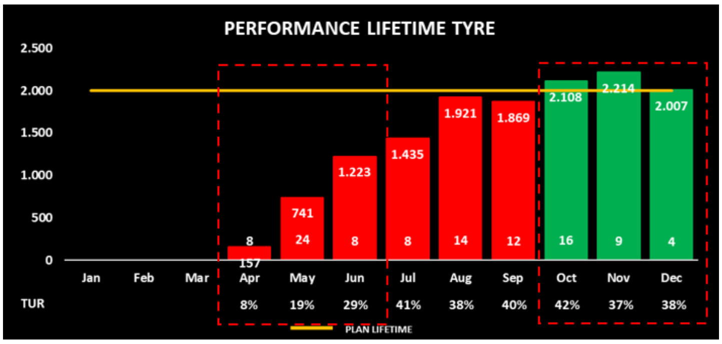

Figure 3. Tyre Lifetime Achievement Before and After Improvement

In April – May 2024 (Before Improvement) the lifetime tyre is very far from the plan that has been announced. Then it began to improve during the improvement (July – September 2024) even though it had not reached the target. In the last three months, we have managed to increase the lifetime tyre in accordance with the specified target, which is to achieve 2,127 hours which means that it has exceeded the target.

In addition, we also calculated the saving cost of this improvement which previously lost Rp. 7,500,000 to a profit of Rp. 6,824,692.

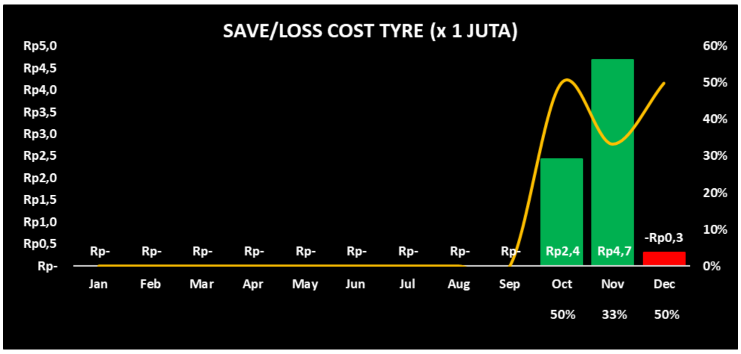

Figure 4. Saving cost improvement

CONCLUSION

This research demonstrates that implementing technical and operational improvements has successfully extended the lifetime of 11.00R20 tires on the *DT Coal Hauling AXOR 2528* unit from an average of 721 hours to 1,406 hours, leading to enhanced unit availability, increased operational productivity, and greater cost efficiency through reduced tire replacement frequency. Additionally, the decrease in tire scrap supports environmental sustainability in mining operations. For future research, it is suggested to broaden the study by incorporating real-time monitoring systems, such as IoT-based tire pressure and temperature sensors, to obtain more accurate operational data. Further studies could also examine the long-term economic and environmental impacts of standardized tire selection combined with predictive maintenance models across various hauling units and terrain types.

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