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Analysis of Decreasing Lubricating Oil Pressure on Main Engine Case Study: MT Rayong Chemi Ship

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ABSTRACT

This study examines the effect of reduced lubricating oil pressure on the performance of the MT Rayong Chemi main engine. Decreased lubricating oil pressure causes increased friction between engine components, decreased efficiency, and accelerated wear. The method used is a quantitative approach with Structural Equation Modeling (SEM) analysis assisted by the AMOS application. Data were obtained through a questionnaire that has been tested for validity and reliability. The results show that reduced lubricating oil pressure has a significant impact on the decline in main engine performance ($p < 0.05$). This study emphasizes the importance of lubrication system maintenance, including regular filter replacement and pressure calibration to maintain optimal engine performance.
Keywords: *Lubricating Oil Pressure, Main Engine Performance, SEM, Ship Lubrication System*

ABSTRAK

Penelitian ini mengkaji pengaruh penurunan tekanan minyak pelumas terhadap performa mesin induk kapal MT Rayong Chemi. Tekanan pelumas yang menurun menyebabkan peningkatan gesekan antar komponen mesin, penurunan efisiensi, dan percepatan keausan. Metode yang digunakan adalah pendekatan kuantitatif dengan analisis Structural Equation Modeling (SEM) berbantuan aplikasi AMOS. Data diperoleh melalui kuisioner yang telah diuji validitas dan reliabilitasnya. Hasil penelitian menunjukkan bahwa penurunan tekanan minyak pelumas memiliki dampak signifikan terhadap penurunan performa mesin induk ($p < 0,05$). Studi ini menegaskan pentingnya perawatan sistem pelumasan, termasuk penggantian filter secara berkala dan kalibrasi tekanan untuk menjaga performa mesin optimal.
Kata kunci: *Tekanan Minyak Pelumas, Performa Mesin Induk, SEM, Sistem Pelumasan Kapal*

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1. INTRODUCTION

Shipping safety, Lubricating oil pressure is a vital indicator that plays a crucial role in maintaining the smooth operation and performance of the main engine on the MT Rayong Chemi. This pressure ensures proper lubricant flow to all moving engine parts, thus minimizing friction between components, preventing wear, and dissipating heat generated during engine operation. However, in practice, shipping has found that a drop in lubricating oil pressure below the normal value, i.e., dropping below 2 bar when the standard pressure should be around 3 bar, is a serious problem and can have fatal consequences for engine efficiency and durability. This drop in pressure can accelerate engine damage because the oil is no longer able to provide optimal lubrication (Iswansya & Rukmini, 2022).

Based on observations and research, one of the main causes of decreased lubricating oil pressure is a clogged oil filter. This filter functions to filter out dirt particles and other contaminants that enter the lubrication system. When the filter becomes clogged, oil flow to the engine is obstructed, resulting in decreased oil pressure. Furthermore, increased temperatures in the oil cooler also contribute to weakening the lubricating properties because high temperatures can change the oil's viscosity, making the lubricant less effective in minimizing friction and wear (Arisandi, Darmanto & Priangkoso, 2022). Therefore, maintaining the cleanliness and optimal function of the filter and oil cooler is crucial for maintaining stable lubricating oil pressure.

To examine and understand this phenomenon in depth, this study employed a quantitative method with Structural Equation Modeling (SEM) analysis assisted by the AMOS application. This method was chosen because it is capable of testing and modeling complex cause-and-effect relationships between variables, particularly between the decrease in lubricating oil pressure and main engine performance. Data were obtained through a questionnaire that had been tested for validity and reliability, as well as through direct field observations, allowing for an in-depth and accurate analysis of the practical aspects of the problem (Iswansya & Rukmini, 2022).

As a lubricant, lubricating oil has the primary function of reducing friction between contacting parts in an engine, supporting the removal of excess heat generated during operation, and acting as a sound dampener and protecting engine components from corrosion (Siskayanti & Kosim, 2020). Lubricant effectiveness is greatly influenced by physical properties such as viscosity, which must be maintained to ensure stability according to engine operating conditions. The lubrication systems commonly used on ships are dry and wet lubrication systems, both of which require lubricant filters and oil coolers in prime condition to perform optimally. Furthermore, lubricating oil typically contains additives that improve and maintain lubricant stability even under heavy operating conditions and high temperatures, allowing the lubrication system to maintain optimal engine performance under various conditions (Arisandi, Darmanto & Priangkoso, 2022).

Decreasing lubricating oil pressure is clearly a major issue that must be addressed with preventative measures, such as routine maintenance, cleaning and replacing filters, maintaining the oil cooler to prevent clogging or corrosion, and calibrating the oil pressure sensor to ensure accurate readings (Susanto, 2020; Hendra Setiawan, 2022). This will significantly help maintain the efficient performance of the main engine and reduce the risk of damage that could lead to disruption of ship operations. Knowledge and understanding of the effects of decreasing oil pressure are also highly beneficial for maritime professionals, particularly prospective ship engineers and technicians tasked with maintaining the prime condition of the main engine throughout its operational life (Iswansya & Rukmini, 2022). Thus, this research not only contributes to increasing scientific insight but also provides practical solutions that can be applied in the shipping world to improve the safety and effectiveness of ship engines.

2. METHOD

This study uses a quantitative research design with a Structural Equation Modeling (SEM) approach that aims to systematically analyze the relationship between the decrease in lubricating oil pressure and the performance of the MT Rayong Chemi ship's main engine. In the application of SEM, data were analyzed using the AMOS application that is able to test the validity, reliability, and strength of the relationship between latent variables precisely. This approach was chosen because it is able to handle models with complex variables and a limited number of samples, and provides a valid picture of the influence of causes on effects in the context of ship engine problems.

The study population included all components related to the main engine lubrication system, such as the lubricating oil pump, oil pipes, and oil filters, which play a crucial role in maintaining stable oil pressure. Thirty oil pressure measurements and related conditions were recorded during the Merak to Morowali route. The data collection technique used purposive sampling, where samples were selected based on actual occurrences of oil pressure drop experienced by the main engine.

The data collection techniques for this study included direct observation of the condition of the engine and lubrication system on board the ship during the voyage, interviews to obtain additional information from the ship's crew and technicians, and the distribution of questionnaires that had been tested for validity and reliability to ensure the quality of the data used in the SEM analysis. Data collection also involved technical documentation and engine maintenance records to complement the field information. For equipment specifications, this study used a digital lubricating oil pressure sensor capable of providing accurate readings and routine calibration every 2000 hours of operation to ensure the validity of the collected data. The oil cooler system used is a cooling system that functions to regulate the lubricant temperature to maintain optimal conditions during engine operation with quality construction materials to prevent corrosion and oil contamination. The specifications of the material analyzed are lubricating oil with additives that function to maintain viscosity stability and protect against wear at high temperatures.

Data analysis was conducted using AMOS to test the outer model (validity and reliability of variable indicators) and the inner model (testing the relationship between latent variables). The outer loading test was used to evaluate the quality of the indicators, while the inner model measured the strength and direction of the relationship between the research variables with the path coefficient and statistical significance using the bootstrapping method. This approach provides a comprehensive analysis of the effect of oil pressure drops on the performance of the main engine quantitatively and empirically. With this research design, it is expected that the results obtained can provide a realistic picture and effective technical solutions in overcoming the decrease in lubricating oil pressure in the main engine of the MT Rayong Chemi vessel which has a direct impact on the reliability and operational efficiency of the ship during the voyage

3. RESULTS AND DISCUSSION

3.1 Research Results

Based on field observations and data analysis using Structural Equation Modeling (SEM) with the aid of the AMOS application, the lubricating oil pressure measurements showed significant pressure fluctuations, with pressure frequently dropping below the 2 bar threshold, indicating a disturbance in the main engine lubrication system. Table 1 presents oil pressure measurement data from various observation points during the voyage

No	Observation	Oil Pressure (Bar)
1	Point A	2.1
2	Point B	1.9
3	Point C	1.8
4	Point D	2.0
5	Point E	1.7

Table 1. Decrease in Lubricating Oil Pressure in the Main Engine of the MT Rayong Chemi Ship

The data shows that the oil pressure decreased due to several technical factors. Direct observations confirmed that the primary causes of this decrease were a clogged oil filter due to dirt buildup (Table 2), as well as an increase in temperature in the oil cooler, which reduced the oil viscosity, resulting in less than optimal lubrication quality

No	Observation Time	Filter Condition	Handling
1	After 500 o,clock	Starting To Get Dirt	Reguler Cleaning
2	After 1000 o,clock	A Little Clogged	Cleaning
3	After 1500 o,clock	Clogged	Filter Replacement
4	After 2000 o,clock	Very Clogged	Filter Replacement

Table 2. Condition of Lubricating Oil Filter During Observation

Another significant finding is that as the filter becomes dirtier and more clogged, the oil pressure will decrease further and carry the risk of mechanical damage to the ship's main engine.

No	Measurement Time	Temperature (^oC)	Oil Cooler Condition
1	Beginning Of The Voavge	65	Normal
2	Midway	80	Starting To Get Dirty
3	End Of Cruise	95	Dirty And Corroded

Table 3. The phenomenon of increasing oil cooler temperature is measured periodically and presented in

An increase in oil cooler temperature reduces oil viscosity, making the lubricant less efficient in performing its function. This data underscores the importance of regular maintenance of the lubricant cooling system to maintain the overall performance of the main engine. SEM analysis results show a significant negative correlation between decreased lubricating oil pressure and main engine performance. Decreased oil pressure has been statistically proven to reduce efficiency and increase wear on main engine components. This reinforces the importance of lubrication quality control and scheduled maintenance of the lubrication system, including filters and oil coolers.

Overall, the research results indicate that monitoring and early response to reduced lubricating oil pressure are crucial for maintaining main engine durability during shipping. Routine preventive maintenance of filters and oil cooling systems is a key solution to prevent further damage and optimize ship engine efficiency

3.2 Discussion

Factors causing decreased lubricating oil pressure in the MT Rayong Chemi main engine and its impact on main engine performance. Research data shows a decrease in lubricating oil pressure below normal values caused by a clogged lubricating oil filter and an increase in temperature in the oil cooler. Filter puncture by dirt causes obstruction of oil flow, while high temperatures reduce lubricant viscosity, making the lubricant less effective in reducing friction between engine components. These findings are consistent with engine lubrication theory, which states the importance of maintaining oil filters and coolers to maintain stable oil viscosity and optimal oil pressure (Iswansya & Rukmini, 2022; Arisandi et al., 2022).

Furthermore, Structural Equation Modeling (SEM) analysis conducted using the AMOS application corroborates these findings by demonstrating a significant negative correlation between lubricating oil pressure drop and main engine performance, particularly in terms of efficiency and component wear. This confirms that regular maintenance of filters and cooling systems is crucial for maintaining engine performance during shipping, consistent with previous research (Siskayanti & Kosim, 2020; Susanto, 2020).

Field findings also indicate the importance of a real-time oil pressure monitoring system using well-calibrated digital sensors to prevent damage before it becomes more severe. A preventative maintenance approach involving regular oil filter replacement and oil cooler cleaning can minimize the risk of oil pressure drops and maintain stable main engine operation (Hendra Setiawan, 2022). Overall, the research discussion reinforces long-standing theories regarding the crucial function of lubricants in ship engine systems and provides practical recommendations for ship managers in maintaining the sustainable performance of main engines.

4. CONCLUSION

The decrease in lubricating oil pressure in the MT Rayong Chemi main engine is significantly influenced by the condition of the lubricating oil filter and the increase in oil cooler temperature. These two factors cause flow disturbances and reduce lubrication quality, which ultimately negatively impacts the performance of the main engine. Therefore, routine maintenance of the filter and oil cooler is the main step to maintain stable oil pressure and optimize engine performance during the voyage. This study also emphasizes the importance of using the quantitative SEM method as an analytical tool in understanding the cause-and-effect relationship in the ship's engine lubrication system.

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