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Analysis Of The Occurrence Of Hydraulic Oil Leakage In The Steering Gear On The AHT Iron Tug Ship

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ABSTRACT

This study aims to analyze the cause of hydraulic oil leakage in the Steering Gear system of the AHT Iron Tug ship operated by Y&Y Maritime Management. Observation and data analysis showed a decrease in hydraulic pressure and decreased system responsiveness due to oil leakage in the worn seals and O-rings. Causative factors include excessive working pressure, mechanical vibration, use of substandard parts, and lack of regular maintenance. The ultrasound (Urgency, Seriousness, Growth) method is used to prioritize problems and show that seal damage, O-rings, as well as the use of non-standard spare parts are major issues with high impact. Repair recommendations include periodic replacement of components, strict supervision of the use of spare parts according to manuals, and improvement of maintenance programs. The results of this study are expected to help improve the reliability of the Steering Gear system and support the safety and efficiency of ship operations.

Keywords: *Hydraulic Oil Leakage, Steering Gear, Seal, O-Ring, Hydraulic Pressure, Preventive Maintenance*

ABSTRAK

Penelitian ini bertujuan menganalisis penyebab kebocoran oli hidraulik pada sistem *Steering Gear* kapal AHT Iron Tug yang dioperasikan oleh Y&Y Maritime Management. Observasi dan analisis data menunjukkan penurunan tekanan hidraulik serta menurunnya responsivitas sistem dikarenakan kebocoran oli pada *seal* dan *O-ring* yang aus. Faktor penyebab meliputi tekanan kerja yang berlebihan, getaran mekanis, penggunaan suku cadang yang tidak sesuai standar, serta kurangnya pemeliharaan rutin. Metode USG (*Urgency, Seriousness, Growth*) digunakan untuk memprioritaskan masalah dan menunjukkan bahwa kerusakan *seal, O-ring*, serta penggunaan *spare part* tidak standar adalah isu utama dengan dampak tinggi. Rekomendasi perbaikan meliputi penggantian berkala komponen, pengawasan ketat penggunaan spare part sesuai manual, serta peningkatan program pemeliharaan. Hasil penelitian ini diharapkan dapat membantu meningkatkan keandalan sistem *Steering Gear* dan mendukung keselamatan serta efisiensi operasi kapal.

Kata kunci: Kebocoran Oli Hidraulik, *Steering Gear, Seal, O-Ring*, Tekanan Hidraulik, Pemeliharaan Preventif

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1. INTRODUCTION

Each ship has its own way of controlling and regulating motion when sailing or docking at the port. One of the main systems that plays an important role is the Steering Gear, a tool that functions to steer as the operator wants. On the AHT Iron Tug ship, the type of Steering Gear used is the Piston type with Electric Hydraulic drive. This system uses a hydraulic pump that flows oil through multiple valves to move the cylinder and rudder to maneuver.

Anchor Handling Tug (AHT) ships such as Iron Tug are indeed specifically designed to hook anchors and pull other ships, especially on the high seas. Because the crowd demands precise and fast maneuvering, the sound of the Steering Gear is indispensable for operations to run smoothly. But unfortunately these maintenance systems are often underpaid for a variety of reasons, such as resource limitations and high work pressure, which can eventually lead to breakdowns and disruptions in the ship's operations.

A clear example occurred on February 12 of the 2024 ship when AHT Iron Tug was conducting operations in the waters of the Batam Sea. The Steering Gear hydraulic system suddenly experiences a pressure drop due to oil leakage in the shaft and actuator cylinder connections. Worn seals and o-rings cause oil to spill up to about 2 liters, forcing the steering to switch to manual mode until emergency repairs are completed.

Problems like this are the main reason for the research with the title "Analysis of Hydraulic Oil Leakage in Steering Gear on AHT Iron Tug Ships". The purpose of this study is to find out what causes oil leaks, their impact on the performance of the Steering Gear, and the repair efforts that can be made. It is hoped that this research can provide a better understanding for drivers and scientists so that they can perform better maintenance and prevent interference with the steering system. This research also has theoretical and practical benefits. From a theoretical perspective, the results can add insight in the field of ship engineering

and become a reference for future studies. In practice, this research is expected to assist machinists and technicians in recognizing problems and addressing hydraulic oil leaks more appropriately, so that the ship's steering system, especially at the AHT Iron Tug, remains optimally functioning and supports safe and smooth operations at sea.

2. METHOD

This study uses a mixed method with a case study approach to examine hydraulic oil leakage in the Steering Gear of the AHT Iron Tug ship. This method was chosen to combine qualitative data in the form of observation of the condition of components such as seals, O-rings, and cylinders, as well as interviews with crews and technicians, with quantitative data in the form of hydraulic pressure measurements, oil volume, and other technical parameters.

Data was collected through direct observation, documentation of treatment and disorder reports, and questionnaires using the ultrasound (Urgency, Seriousness, Growth) method to determine the priority of the problem. This approach allows for a thorough and objective analysis of the causes of leaks as well as their impact on the Steering Gear system.

Data analysis is carried out descriptively by comparing the system conditions when it is normal, when the leak occurs, and after repairs. The ultrasound method is used to prioritize causative factors based on the level of emergency, seriousness, and potential problem, so that recommendations for improvement can be on target. The research schedule is made systematically starting from data collection, proposal preparation, field data collection, data processing, to the preparation and seminar of results. With a regular time plan, the research is expected to run smoothly and provide useful results for the improvement of the ship's Steering Gear system.

3. RESULTS AND DISCUSSION

a. Research Overview

This study discusses the AHT Iron Tug Tug, an Anchor Handling Tug Supply (AHTS) type vessel operated by Y&Y Maritime Management to assist with various offshore operations such as anchor handling and towing of ships. The vessel is equipped with an electric hydraulic steering system that allows for high-precision

maneuvering, essential for operations in complex open waters. Since its inception, AHT Iron Tug has become a major player in the Southeast Asian maritime industry, particularly in the petroleum and ship-to-ship shipping sectors.

Figure 3. *AHT Iron Tug Ship*

The ship was built in 2005 in China and is nearly 50 meters long and relies on Yanmar's powerful dual engines to support various operational activities. Regular maintenance and strict management from the management ensure that this ship is always ready and reliable in facing a challenging working environment.

In this study, the ultrasound (Urgency, Seriousness, Growth) method is also used to identify and prioritize the problem of hydraulic oil leakage in the Steering Gear system on the ship. The results show that damage to the seals and O-rings as well as the use of substandard parts are major issues that need to be fixed immediately as they are high risk.

The damage has a serious impact on the hydraulic pressure, which causes the steering movement to become slow and unresponsive and even potentially lead to a complete failure of the ship's steering system. In addition, unmaintained pressure also accelerates the deterioration of other components such as pumps and cylinders, so repair costs and the risk of operational disruption increases. Therefore, the study recommends that the maintenance and supervision of seals, O-rings, and the use of spare parts according to standards be strictly carried out, and that hydraulic pressure regulation be maintained to keep the ship safe and running smoothly.

b. Object Data Studied

a) Normal operating data (11 February 2024)

Table 1. Normal operating data

Hydraulic Pressure (psi)	500 psi
Rudder Movement Speed (sec)	30 seconds
Volume was hydraulic	50 liters
Sound and Vibration	Normal, without excessive noise or vibration
System Reliability	100% operational, responsive
Mouth oil (°C)	40°C - 50°C
L.O Pressure	2.5 Go

b) Abnormal Operating Data (February 12, 2024)

Table 2.Operation data in abnormal state

Operating Conditions	400 psi (20% drop)
Hydraulic Pressure (psi)	40 seconds (decreased responsiveness)
Volume was hydraulic	48 liters (2 liters lost/week)
Sound and Vibration	Noisy sound, increased vibration
System Reliability	Downhill, more difficult to maneuver the ship
Mouth oil (°C)	45°C - 55°C
L.O Pressure	1.8 Bar

c) Operating data after overhaul (February 14, 2024) After repairs and replacement of seals and O-rings on February 14, 2024, the Steering Gear system was tested again. The results show that the system has returned to working optimally as it was

Table 3. Steering Gear after overhaul

Operating Conditions	After the Overhaul
Hydraulic Pressure (psi)	(psi) 500 psi
Rudder Movement Speed (sec)	30 seconds
Volume was hydraulic	50 liters
Sound and Vibration	No noisy noise, smooth system

System Reliability	100% operational, high precision
Mouth oil (°C)	40°C - 50°C
L.O Pressure	2.5 Bar

c. Research Data Analysis

Based on direct observation during the study, several major problems were found that caused hydraulic oil leakage in the Steering Gear system of the AHT Iron Tug ship. The data showed a decrease in hydraulic pressure of about 20% from normal pressure of 500 psi to 400 psi, while the responsiveness of the rudder weakened with the movement time increasing from 30 to 40 seconds. The volume of hydraulic oil decreases by about 2 liters per week, accompanied by increased noise and vibration, indicating a significant disruption to the system.

The main cause of the leak is damage to the seals and O-rings that function to keep the oil tightly closed in the system. Hydraulic pressure that exceeds operational limits, mechanical vibrations, and oil contamination with foreign particles all accelerate the deterioration of these components. In addition, the lack of regular inspections and maintenance causes wear and tear to go undetected, exacerbating leakage conditions and degrading overall system performance.

Another factor that contributes to worsening the condition is the use of spare parts that are not in accordance with the manufacturer's manual, such as seals and O-rings with non-standard materials, sizes, or quality. These mismatches cause components to wear out faster, leak easily, and reduce system efficiency, increasing the risk of maneuver failure and operational disruption.

To overcome these problems, it is necessary to replace the seals and O-rings regularly with quality materials according to factory specifications, regular inspections of wear-prone components, and strict supervision of the use of spare parts to meet standards. Technician and crew training and component replacement documentation are also important so that the maintenance of the Steering Gear system can be carried out optimally and prevent repeated breakdowns.

4. CONCLUSION

Based on the results of the analysis and observations during the implementation of the practice in Based on the results of research and field observations, the main cause of hydraulic oil leakage in the Steering Gear system

of the AHT Iron Tug ship is wear on the seals and O-rings due to high pressure, vibration, and lack of routine maintenance. In addition, the use of spare parts that do not comply with the manufacturer's manual exacerbates damage and the risk of system failure. This oil leak lowers hydraulic pressure, slows down the rudder's response, and threatens the safety of the vessel during operation.

The main recommended recommendations include the implementation of regular replacement of seals and O-rings with quality materials, thorough routine inspections of damage-prone components, and strict supervision of the use of spare parts in accordance with factory standards. Technical training for crews and technicians is also important in order to detect and address problems early. With the implementation of these preventive and corrective measures, the ship's Steering Gear system is expected to run optimally, improving reliability and operational safety on the high seas.

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