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Identification of Causes and Solutions for The Malfunction of Hydraulic Deck Crane No. 2 on Board MV. Habco Carina

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ABSTRACT

A deck crane is one of the auxiliary machines on board a ship that functions to support ship operational activities, particularly in the cargo loading and unloading process. Deck crane No. 2 on board MV. Habco Carina employs a hydraulic system, which utilizes the pressure and power of liquid fluid to produce mechanical movement. This study aims to identify the causes of the hydraulic system malfunction on deck crane No. 2 and to determine the appropriate handling solutions. The research method used is descriptive qualitative, in which data were collected through direct observation, interviews with ship officers, and documentation study. The results indicate that the deck crane malfunction was caused by two main factors: damage to the hydraulic motor due to internal component wear and the ineffectiveness of the Plan Maintenance System (PMS) implementation, resulting in a lack of periodic maintenance. The impact of this damage caused disruption to ship operations at port. The most effective solution is to replace the hydraulic motor with a new unit and to improve deck crane maintenance discipline in accordance with the PMS schedule. The most critical preventive maintenance action is to check the hydraulic oil level before each deck crane operation. This research is expected to serve as a reference and additional knowledge for readers who experience similar problems.

Keywords:

Deck Crane; Hydraulic System; Hydraulic Motor; Plan Maintenance System; MV. Habco Carina

1. INTRODUCTION

Maritime transportation is one of the transportation modes that plays a strategic role in supporting both national and international economies. Ships, as the primary means of maritime transportation, are equipped with various auxiliary equipment to support the smooth running of their operations [6]. One of the most vital pieces of auxiliary equipment in ship operations, particularly in the loading and unloading process, is the deck crane. According to Karyanto [2], a deck crane is a lifting apparatus installed on the ship's deck that functions to lift, move, and lower cargo to and from the ship.

Deck cranes generally use a hydraulic system

as their main drive. A hydraulic system is a power transmission system that utilizes pressurized liquid fluid, typically hydraulic oil, to transmit power and produce mechanical movement [1]. The advantage of hydraulic systems lies in their ability to generate substantial power with relatively compact components, making them highly suitable for application in lifting equipment on board ships [3]. However, hydraulic systems require routine and proper maintenance so that their components can operate optimally and have a long service life [14].

MV. Habco Carina is a cargo vessel owned by PT. Habco Trans Maritima, equipped with three units of deck cranes to support loading and unloading activities. During the author's sea training on board the vessel, a serious problem was discovered on deck crane No. 2, namely the malfunction of the hydraulic system which rendered the deck crane inoperable. This condition caused disruption to loading and unloading activities at port, potentially resulting in significant time losses and operational costs.

Based on preliminary observations, it was determined that the damage to the hydraulic system of deck crane No. 2 was caused by damage to the hydraulic motor and a lack of periodic maintenance in accordance with the established Plan Maintenance System (PMS) [11]. The hydraulic motor is a critical component in the deck crane's hydraulic system, functioning to convert hydraulic energy into mechanical energy in the form of rotational movement [8]. Damage to the hydraulic motor results in the failure of the entire deck crane system.

Maintenance is a fundamental aspect in ensuring the reliability of equipment on board ships. The International Safety Management (ISM) Code issued by the International Maritime Organization (IMO) requires every shipping company to establish documented maintenance procedures for all ship equipment [5]. The Plan Maintenance System (PMS) is a scheduled maintenance planning system designed to ensure that all ship equipment receives periodic and structured maintenance [7].

Based on the above description, the author is interested in conducting research entitled "Identification of Causes and Solutions for the Malfunction of Hydraulic Deck Crane No. 2 on Board MV. Habco Carina". This research is expected to contribute to the development of knowledge in the field of marine engineering, particularly regarding the maintenance of hydraulic systems in ship auxiliary machinery.

2. RESEARCH METHOD

Research Design

A deck crane is a lifting apparatus that is permanently installed on a ship's deck and is used to lift, move, and lower cargo [2]. Deck cranes are one of the most important pieces of auxiliary equipment in ship operations, particularly on cargo vessels that carry out loading and unloading activities at ports that do not have adequate shore crane facilities [13]. According to Indonesian National Standard (SNI) 04-6817.1-2002, cranes must meet technical requirements that include aspects of safety, structural strength, and reliable drive systems [13].

This research uses a descriptive qualitative method. According to Moleong [9], qualitative research is research that aims to understand the phenomena experienced by research subjects holistically through description in the form of words and language. The descriptive qualitative approach was chosen because this research aims to describe and analyze the actual condition of the hydraulic system damage on deck crane No. 2 aboard MV. Habco Carina based on data collected in the field [10].

This research was conducted during the author's sea training aboard MV. Habco Carina, owned by PT. Habco Trans Maritima, during the period of [02/2022] to [11/2022]. MV. Habco Carina operates in Indonesian domestic shipping routes.

Data Sources

The data sources in this research consist of two types:

1. Primary Data, namely data obtained directly from the primary source through direct observation of the condition of deck crane No. 2 and interviews with ship officers responsible for the maintenance and operation of the deck crane, including the Chief Officer, the Second Engineer, and the bosun.
2. Secondary Data, namely data obtained from documents related to this research, including: the PMS manual of MV. Habco Carina, the deck crane operation and maintenance instruction manual, damage and repair records, and relevant scientific literature.

Data Collection

Data collection in this research was carried out through three techniques:

1. Observation, namely direct observation of the condition of deck crane No. 2, hydraulic system components, and the repair process

carried out on board the ship. Observations were conducted in a structured manner using observation sheets that had been prepared in advance.

2. Interviews, namely direct question-and-answer activities with informants who possess competence and experience related to the problems being studied. Interviews were conducted in a semi-structured manner to allow informants to provide more in-depth and comprehensive information.
3. Documentation Study, namely data collection through the review of documents relevant to the research, such as the PMS manual, engine logbook, and deck crane repair reports [11].

Data Analysis

The collected data were analyzed using descriptive qualitative methods through several stages: (1) data reduction, the process of selecting and simplifying raw data obtained from the field; (2) data presentation, the arrangement of data in the form of narrative descriptions, tables, and figures for easy comprehension; and (3) conclusion drawing and verification, the process of drawing conclusions based on the presented data and re-verifying them with informants and supporting data [9].

Problem-Solving Framework

The problem-solving framework in this research was arranged through the following steps: (1) problem identification, identifying the symptoms and causes of the hydraulic system malfunction on deck crane No. 2; (2) data collection, gathering relevant primary and secondary data; (3) data analysis, analyzing the cause-and-effect relationships between component damage and maintenance ineffectiveness; (4) solution formulation, formulating handling and prevention measures; and (5) implementation and evaluation, implementing solutions and evaluating their effectiveness.

3. RESULTS AND DISCUSSIONS

General Description of MV. Habco Carina

MV. Habco Carina is a general cargo ship owned by PT. Habco Trans Maritima, operating on Indonesian domestic shipping routes. The vessel is equipped with three units of deck cranes, each with a specific lifting capacity to support loading and unloading activities. The ship's technical data are presented in Table 1.

Table 1. Technical Data of MV. Habco Carina

Ship Name	MV. Habco Carina
Ship Type	General Cargo Ship
Flag State	Indonesia
Company	PT. Habco Trans Maritima
Year of Build	2009
Gross Tonnage (GT)	32957 tons
Deadweight Tonnage (DWT)	57000 tons
Length Overall (LOA)	190 meters

Identification of Deck Crane No. 2 Damage

Based on the results of observations and interviews conducted, it was identified that deck crane No. 2 on board MV. Habco Carina experienced a functional malfunction characterized by several damage symptoms. These symptoms are presented in Table 2.

Table 2. Damage Symptoms of Deck Crane No. 2

No.	Damage Symptom	Description
1	Hydraulic oil leakage	Hydraulic oil leakage was found in the area of the hydraulic motor and pipe connections, resulting in a significant decrease in the oil level in the hydraulic tank.
2	Decreased operating speed	The hoisting, luffing, and slewing movements became extremely slow

		and unresponsive to operator commands.
3	Abnormal noise	Abnormal noise was heard from the hydraulic motor when the deck crane was operated, indicating wear of internal components.
4	Excessive vibration	Excessive vibration occurred throughout the deck crane structure, particularly in the area of the hydraulic motor and hydraulic pump.
5	Total operational failure	Deck crane No. 2 could not be operated at all because the hydraulic motor was unable to produce sufficient torque to drive the crane mechanism.

Source: Observation Results on Board MV. Habco Carina

Analysis of Causes of Damage

Based on the analysis of the collected data, two main factors were identified as the causes of the hydraulic system malfunction on deck crane No. 2 aboard MV. Habco Carina:

1. Hydraulic Motor Damage

Examination of the hydraulic motor of deck crane No. 2 revealed damage to the internal components of the motor. Inspection results found that the piston and swash plate of the hydraulic motor had experienced significant wear. This wear caused internal leakage, which resulted in a drastic decrease in the volumetric efficiency of the hydraulic motor [15]. Consequently, the hydraulic motor was unable to produce sufficient torque to drive the deck crane mechanism. Additionally, damage to the seals and bearings of the hydraulic motor was also found, causing external oil leakage [12].

Interview results with the Second Engineer confirmed that the hydraulic motor had been operating beyond the recommended working hours without an overhaul or replacement of critical components. This condition was exacerbated by the deterioration in hydraulic oil quality due to contamination by metal particles from worn components. A detailed analysis of the causes of hydraulic motor damage is presented in Table 3.

Table 3. Analysis of Hydraulic Motor Damage Causes

No.	Damaged Component	Cause of Damage	Impact
1	Piston and Swash Plate	Wear due to prolonged use and oil contamination	Internal leakage, decreased volumetric efficiency
2	Hydraulic Motor Seal	Material aging and excessive working pressure	External oil leakage
3	Hydraulic Motor Bearing	Lack of lubrication and particle contamination	Abnormal noise and excessive vibration
4	Valve Plate	Erosion caused by contaminant particles in oil	Decreased motor output pressure

Source: Inspection Results and Interviews on Board MV. Habco Carina

2. Ineffectiveness of the Plan Maintenance System (PMS)

The second factor contributing to the damage of deck crane No. 2 was the ineffective implementation of the Plan Maintenance System (PMS). Based on the documentation study of the maintenance records of deck crane No. 2, it was found that several periodic maintenance items were not carried out in accordance with the established schedule [11]. Table 4 presents the comparison between the PMS maintenance schedule and its actual implementation.

Table 4. PMS Implementation Record for Deck Crane No. 2

No.	Maintenance Item	PMS Schedule	Actual	Remarks
1	Hydraulic oil level check	Daily	Not routine	Frequently missed
2	Mechanical component lubrication	Weekly	Bi-weekly	Delayed from schedule

3	Hydraulic hose inspection	Weekly	Monthly	Interval too infrequent
4	Oil filter replacement	Monthly	Every 3 months	Exceeded schedule limit
5	Safety device testing	Monthly	Not recorded	Undocumented
6	Hydraulic motor overhaul	Annually	Not performed	Overhaul schedule exceeded

Source: PMS Documents of MV. Habco Carina [11]

The data in Table 4 demonstrate a significant gap between the PMS maintenance schedule and its actual implementation. Non-compliance in executing periodic maintenance became a contributing factor that accelerated the occurrence of damage to the hydraulic motor and other hydraulic system components. An interview with the Chief Officer revealed that the limited number of crew members and the tight sailing schedule were the main obstacles in carrying out maintenance according to the PMS schedule.

Impact of Damage on Ship Operations

The malfunction of deck crane No. 2 had a significant negative impact on the operations of MV. Habco Carina. These impacts are presented in Table 5.

Table 5. Impact of Deck Crane No. 2 Damage on Ship Operations

No.	Impact Aspect	Description of Impact
1	Loading/Unloading Time	Loading and unloading time became longer because operations relied on only two functioning deck crane units, causing delays to the ship's schedule.
2	Operational Costs	Increased operational costs due to extended berth time at port and the need to hire a shore crane as a replacement.
3	Work Efficiency	The workload of the remaining two deck cranes increased, potentially accelerating wear and damage on the cranes still in operation.
4	Occupational Safety	The use of inadequate alternative lifting equipment increased the risk of occupational accidents during loading and unloading activities.
5	Company Reputation	Delays in the ship's schedule affected customer confidence in the reliability of the shipping company's services.

Source: Interview and Observation Results on Board MV. Habco Carina

Solutions for Damage Handling

Based on the analysis of causes and impacts of the damage described above, the following handling solutions were formulated to address the malfunction of deck crane No. 2:

1. Hydraulic Motor Replacement

The primary and most effective solution to address the damage to deck crane No. 2 is to replace the hydraulic motor with a new unit that meets the specifications recommended by the deck crane manufacturer [12]. Hydraulic motor replacement was chosen because the level of internal component wear was already extremely severe and did not allow for reconditioning. The hydraulic motor replacement process includes the following stages: (a) dismantling of the old hydraulic motor; (b) inspection and cleaning of the piping system and control valve; (c) installation of the new hydraulic motor; (d) filling and bleeding of the hydraulic system; and (e) testing and calibration [8].

2. Improvement of Maintenance Discipline in Accordance with PMS

To prevent the recurrence of similar damage, improvement in maintenance discipline according to the established PMS schedule is required [5]. The steps that need to be taken include: (a) reinforcement of each personnel's responsibility for PMS implementation; (b) creation of daily, weekly, and monthly maintenance checklists; (c) conducting toolbox meetings before each deck crane operation; (d) structured documentation of every maintenance activity; and (e) periodic evaluation of PMS effectiveness [7].

3. Priority Preventive Maintenance

The most critical preventive maintenance action that must be consistently carried out is checking the hydraulic oil level before each deck crane operation [14]. Hydraulic oil is a vital component in the hydraulic system that functions as a power transmission medium, component lubricant, and system coolant. Insufficient oil levels will cause pump cavitation, increased friction between

components, and overheating that ultimately leads to component damage [3]. In addition to level checks, hydraulic oil quality also needs to be monitored periodically through oil sample analysis to detect contamination and oil degradation at an early stage [15].

Evaluation of Solution Effectiveness

After the replacement of the hydraulic motor and improvement of maintenance discipline, deck crane No. 2 returned to normal operation. Table 6 presents the comparison of the condition of deck crane No. 2 before and after the corrective actions.

Table 6. Comparison of Deck Crane No. 2 Condition Before and After Corrective Actions

No.	Parameter	Before Corrective Action	After Corrective Action
1	Operational function	Non-functional (total failure)	Fully functional
2	Hoisting speed	Extremely slow / unresponsive	Meets standard specifications
3	Oil leakage	Significant leakage at motor and connections	No leakage detected
4	Operational noise	Abnormal noise (excessive)	Normal operational noise
5	Vibration level	Excessive vibration	Vibration within normal limits
6	PMS compliance	Many items not on schedule	Executed according to schedule

Source: Post-Corrective Observation Results on Board MV. Habco Carina

Table 6 demonstrates that the corrective solutions implemented successfully restored the function of deck crane No. 2 to optimal condition. The hydraulic motor replacement addressed the technical problems with the drive component, while the improvement of maintenance discipline ensured the long-term reliability of the equipment. This finding is consistent with the results of Prayitno [4], who emphasized the importance of a preventive maintenance approach in preventing recurring damage to hydraulic systems of ship auxiliary machinery

4. CONCLUSION

Based on the results of this research, the following conclusions can be drawn:

1. The malfunction of the hydraulic system of deck crane No. 2 on board MV. Habco Carina was caused by two main factors: damage to the hydraulic motor due to wear of internal components (piston, swash plate, seal, and bearing) and the ineffective implementation of the Plan Maintenance System (PMS), which resulted in a lack of periodic maintenance on the deck crane.
2. The damage to deck crane No. 2 had a significant impact on ship operations, including increased loading and unloading time, increased operational costs, decreased work efficiency, increased occupational safety risks, and decreased shipping company reputation.
3. The most effective solution to address this problem is to replace the hydraulic motor with a new unit in accordance with the manufacturer's specifications and to improve deck crane maintenance discipline in accordance with the established PMS schedule.
4. The most critical preventive maintenance action is to check the level and quality of hydraulic oil before each deck crane operation, in order to prevent the recurrence of similar damage in the future.

Recommendations that can be provided include that the shipping company should enhance supervision of PMS implementation, provide critical spare parts on board the ship, and conduct periodic training for crew members on the operation and maintenance of deck cranes and their hydraulic systems. This research is expected to serve as a reference and additional knowledge for readers and writers who experience similar problems.

REFERENCES

[1] Agency for the Assessment and Application of Technology, Introduction to Hydraulic Systems, Jakarta: BPPT Press, 2019.

[2] D. Karyanto, Maintenance and Repair of Hydraulic Systems on Ship Auxiliary Machinery, Semarang: Politeknik Ilmu Pelayaran Semarang, 2020.

[3] F. D. Petruzella, Hydraulic and Pneumatic Systems for Industrial Technology, New York: McGraw-Hill Education, 2018.

[4] H. Prayitno, "Analysis of Hydraulic System Damage on Deck Cranes Aboard Ships," Jurnal Teknik Perkapalan, vol. 8, no. 2, pp. 112–120, 2021.

[5] International Maritime Organization, International Safety Management (ISM) Code, London: IMO Publishing, 2018.

[6] International Maritime Organization, SOLAS: International Convention for the Safety of Life at Sea, London: IMO Publishing, 2020.

[7] Ministry of Transportation of the Republic of Indonesia, Ministerial Regulation No. PM 25 of 2020 on Waterway Transport Safety, Jakarta: Ministry of Transportation, 2020.

[8] M. Galal Rabie, Fluid Power Engineering, New York: McGraw-Hill, 2019.

[9] L. J. Moleong, Qualitative Research Methodology, Revised Edition, Bandung: Remaja Rosdakarya, 2018.

[10] P. Sugiyono, Quantitative, Qualitative, and R&D Research Methods, Bandung: Alfabeta, 2019.

[11] PT. Habco Trans Maritima, Plan Maintenance System Manual for MV. Habco Carina, Jakarta: Habco Trans Maritima, 2022.

[12] R. S. Khurmi and J. K. Gupta, A Textbook of Machine Design, New Delhi: S. Chand Publishing, 2019.

[13] Indonesian National Standard, SNI 04-6817.1-2002: Crane – General Requirements, Jakarta: National Standardization Agency, 2002.

[14] Suhardjono, Hydraulic Systems and Components, Surabaya: Institut Teknologi Sepuluh Nopember, 2020.

[15] T. J. Liang and S. Y. Tseng, "Analysis of Hydraulic Motor Performance in Marine Crane Applications," Journal of Marine Engineering and Technology, vol. 20, no. 3, pp. 178–189, 2021.