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Research Paper

Ballast Pump Performance Optimization Strategy for Smooth Ship Operations in MV. DK 03

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Abstract

Suppose the operation of the ballast pump is not optimal. In that case, it will disrupt the ship's stability and be very detrimental to many parties, such as endangering the ship and crew, resulting in fatal losses, namely the ship's sinking. The research method used is qualitative to analyze strategies for optimizing ballast pump performance for smooth ship operations on MV.DK 03. Researchers used the SWOT method. Research objectives: a) to analyze ballast pump maintenance in ship operations, b) to analyze the impact of non-optimal ballast pumps. The results of the research concluded that the factors causing the non-optimal performance of the ballast pump were problems with damaged seals, lack of experience, and crew understanding of correct operating procedures. Disturbances in ship stability can result in unstable ships and delayed loading and unloading.

Keywords: *Optimization Strategy; Ballast Pump; SWOT*

INTRODUCTION

One of the important elements in the world of trade is sea transportation. Ships are the most important form of maritime transportation for local and international maritime trade. Compared to other transportation, ships are the best transportation choice considering the volume of cargo and the distance traveled because the use of buses creates more effective and efficient transportation activities (Jinca, IM 2019). In ship operations, the condition of the ship must be maintained when sailing or carrying out loading and unloading tasks so that it remains in a stable condition. Ship stability is the ship's ability to return to its original point after encountering external forces, whether sailing or stationary, such as wind and wave forces, when using a ballast pump system (Jia et al., 2020). The ballast pump system is a system that maintains the ship's stability to fill the ballast tank in the double bottom. This system uses seawater to be entered through the sea chest, then put into the ballast tank using a ballast pump, then the seawater in the ballast tank is transferred from one tank to another or removed from the ship via overboard discharge(Ye et al., 2022). Repairs and maintenance of ballast pumps need to be carried out to increase their performance and service life. Therefore, maintenance and repair work must be carried out in accordance with the instruction manual. Following the instructions in the manual regarding the repair and maintenance of ballast pumps can reduce the risk of damage to ballast pump components and improve ballast pump operations (Shu et al., 2022).In reality, little attention was paid to the lack of spare parts and substandard maintenance of ballast pumps. Here, researchers show a problem of pressure drop in the ballast pump during sea practice (prala). Therefore, this situation will cause an imbalance and smooth performance of the ship, which will hinder the ship's departure (delay time) and the loading and unloading process (Guo et al ., 2021). The aim of this research is: a) to find out how to maintain ballast pumps in ship operations, b) to find out what the impacts of ballast pumps that are not optimal are.

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LITERATURE REVIEW

According to Kimera & Nangolo (2020), ballast pump failure is associated with maintenance. It aims to carry out maintenance that can predict possible damage and provide warnings before problems occur. This approach uses machine learning as an alternative to using sensor technology. According to Halorik (2017), discussing the maintenance of ballast pumps and the effects that this has on ship stability, an indication of the cause of the drop in pump working pressure is the instability of the pump pressure, which causes ship instability because the ballast pump cannot meet the water supply into the ballast tank. Research conducted by Guney (2022) focused more on investigating the effectiveness of pneumatic systems in reducing the amount of sediment accumulation under different operating conditions and determining operating conditions for optimal smooth running of the ballast pump system. In this research, a comparison was made between previous research and current research. However, current research focuses more on the maintenance, impacts, and strategies carried out from internal and external factors that cause the non-optimal performance of ballast pumps. It has not been studied in previous research, so previous research is used as a reference in this research. This research focuses on the Ballast Pump Performance Optimization Strategy on MV.DK 03. In this research, a comparison was made between previous research and current research. However, current research focuses more on the maintenance, impacts, and strategies carried out from internal and external factors that cause the non-optimal performance of ballast pumps. It has not been studied in previous research, so previous research is used as a reference in this research. This research focuses on the Ballast Pump Performance Optimization Strategy on MV.DK 03. In this research, a comparison was made between previous research and research currently being conducted. However, current research focuses more on the maintenance, impacts, and strategies carried out from internal and external factors that cause the non-optimal performance of ballast pumps. It has not been studied in previous research, so previous research is used as a reference in this research. This research focuses on the Ballast Pump Performance Optimization Strategy on MV.DK 03. It has not been studied in previous research, so previous research is used as a reference in this research. This research focuses on the Ballast Pump Performance Optimization Strategy on MV.DK 03. It has not been studied in previous research, so previous research is used as a reference in this research. This research focuses on the Ballast Pump Performance Optimization Strategy on MV.DK 03.

The pump operates by creating a pressure difference between the inlet (suction) and the outlet (discharge) (Shu et al., 2022). The ballast pump uses a centrifugal pump because high pressure is required to transfer seawater into the ballast tank (Kimera & Nangolo, 2020). The working principle of the pump is to transfer ballast water by pressing the fluid. At the suction mouth, the pump element will reduce the pressure in the pump chamber so that there will be a pressure difference between the pump chamber and the surface of the fluid being sucked in. As a result, the fluid will flow into the pump room (Shu et al., 2022).

RESEARCH METHOD

The research method that can be carried out or used is the qualitative method. The existence of a method in research is also expected to be able to obtain data or information that is correct and accurate or a truth. In this research method, researchers used qualitative methods in conducting research on Ballast Pump Performance Optimization Strategies for smooth ship operations on MV. DK 03.

According to Anggito and Setiawan (2018), qualitative research basically has two objectives, namely: (1) to describe and explore and (2) to describe and explain.

According to Muhammad Ramdhan (2021), a research place is a location where research is conducted or information regarding the topic discussed in this research or the study process

carried out by researchers in order to collect valid data or information. Researchers carried out the research while carrying out the Sea Practice or Prala program on a bulk ship, or Bulk Carrier called MV. DK 03 belongs to the company PT. Karya Sumber Energy (KSE).

The data source in this research is needed to conduct research. According to Nazir (2014: 77), the data source is information or material from which the author obtained the data, whether from data, real objects, something abstract, or events that occurred at that time. Researchers carry out sea practices on ships. In this research, the data collection techniques used were observation and interviews. Observation is one way to obtain primary data. According to Kountur (2009: 182), primary data is data collected by researchers directly from the main source. Because not all information can be obtained from secondary data, if information is not available from secondary data, efforts are needed to obtain it from the main source, which is primary data. Observation activities are used to obtain information regarding strategies for optimizing ballast pump performance for smooth ship operations. In this research, researchers conducted unstructured interviews. Unstructured interviews are free interviews. Researchers do not use interview guides arranged systematically and completely for data collection (Moleong, 2014: 190). Here, the interviewer and those being interviewed talk casually, and questions can arise during the conversation. There is no strict list of questions to follow strictly. This interview guide only outlines the problems that will be asked. Researchers obtained initial data in the form of problems that occurred with the ballast pump on MV.DK 03.

A literature study is a method of collecting data sourced from reference book evidence. It aims to strengthen the theory from the theoretical discussion and data collected so that the state of the object observed and the theory is written in the reference book. Being more relevant and reasonable in this method will make it easier for researchers to understand more in general about ballast pump maintenance.

The study determines the analysis of internal and external strategic factors, namely processing strategic factors in internal and external environmental conditions, by giving weights and ratings to each strategic factor. The strategic factors used include strengths, weaknesses, opportunities, and threats. Internal factors are entered into a matrix called the IFAS factor matrix. External factors are included in a matrix called the EFAS factor matrix. Internal factors (IFAS) determine what factors support strengths and hinder weaknesses in the external environment (EFAS) by determining opportunities and threats and how to determine them.

Table 1. Internal And External Factors

	Strength (Strength)
1	Regular maintenance and checking of ballast
2	The crew who work on the ship work according to standard procedures
3	Knowledge of the machinist's job responsibilities on the ship
4	Good cooperation between machine crews (teamwork).
	Weakness
1	Lack of maintenance on board
2	Lack of cooperation between deck people and machines
3	Lack of safety meetings
4	Operations that exceed working hours
	Opportunities(Opportunity)
1	Availability of spare parts
2	Regular company supervision
3	Fast response in handling
4	Good communication from the company
	Threats(Threat)

1	Bad weather
2	Lack of spare parts and delays in spare parts
3	Environmental conditions that affect pump performance
4	Lack of supervision from the company

Data validity methods are an important aspect of supporting research. The data validity method that the researcher used was triangulation. The triangulation technique is a technique for testing the validity of research data by using something else or setting aside the main data to be used as a testing process and as comparative data against existing core data (Moleong, 2018: 330). The researcher uses the triangulation method by collecting data in the form of observations and interviewing several parties to get different points of view.

FINDINGS AND DISCUSSION

In carrying out the research process, the researcher made observations on board the ship while undergoing sea practice, often called prala. The research was carried out when the researcher carried out sea practice for approximately 12 months—starting from August 26, 2021, to August 27, 2022, on the MV ship. DK 03 belongs to the company PT. KSE (Karya Sumber Energy). The length of this ship is 189.83 m with a dead weight of 46,637 mt. It has five holds and is equipped with four cranes used for loading and unloading. The type of cargo loaded on the ship is in bulk. Therefore, setting up the ballast system is very important to maintain the ship's stability in order to smooth the loading and unloading process on board the ship.

In this research, the author discusses the ballast pump, an important mechanical device for maintaining the balance and smooth operation of the ship. Ballast pumps are used to fill or empty water from the ballast system of ships or other marine structures. A ballast system refers to fluids or materials introduced into a ship or marine structure to maintain balance, stability, and operational capability (Sayinli et al., 2022). Good stability is essential to the safety of the ship, its crew, and the cargo it carries. With adequate stability, the ship can prevent accidents such as capsizing or sinking (Elidolu et al., 2023).

Several factors that influence the performance of ballast pumps are leaks and damage to spare parts that have exceeded working hours or are subject to wear and tear, which can reduce pump performance. The pump's condition is also important, because a pump that is frequently damaged or disturbed can affect the performance of the ship's ballast. The cleanliness and quality of ballast water can also affect the performance of the ballast pump. Ballast water that is dirty, contains particles, or is polluted can cause the pump to become clogged or work harder, ultimately affecting pump performance (Bailey et al., 2022). This research was conducted on board the MV. DK 03. This is a bulk ship with an Indonesian flag belonging to the company PT Karya Sumber Energy. In collecting research data, The researcher plunges directly into the world of work while carrying out practical marine activities. Therefore, the researcher will discuss the facts and conditions directly experienced by the researcher when carrying out practical work on an MV ship. DK 03, research results carried out by researchers while on board the ship, namely regarding ballast pumps on MV ships. DK 03, as for the facts found and experienced by researchers when researching ships, researchers found several problems that occurred with ballast pumps, namely less than optimal pump performance when working. The results of research carried out by researchers while on board the ship were regarding ballast pumps on MV ships. Researchers found several problems that occurred with ballast pumps, namely, less than optimal pump performance when working. The results of research carried out by researchers while on board the ship were regarding ballast pumps on MV ships. DK 03, as for the facts found and experienced by researchers when conducting research on ships, researchers found several problems with ballast pumps, namely less than

optimal pump performance when working.

The pump studied in this research is a centrifugal pump with model SVA300 with a capacity of 850 m^3/h and an electric motor output of 90 kW (AC440V x 3 ϕ x 60 Hz) and on the MV.DK 03 ship, there are two ballast pumps. Ballast pumps have several main components, namely motors. Ballast pumps are equipped with motors that function to drive the pump and create fluid flow. These motors usually use electricity as a power source, although there are also ballast pumps that use other power sources such as diesel or hydraulics. The impeller or impeller rotor is a rotating component in the pump and is responsible for producing ballast water pressure and flow. Impellers are usually made from materials that are resistant to corrosion and wear, such as stainless steel or strong composite materials. The ballast pump pipe system is connected to the ship's ballast pipe system, which supplies ballast water to various ship ballast rooms. This pipe system usually consists of pipes with a suitable diameter to regulate ballast water flow efficiently (Babikir et al., 2019)..

On December 7, 2021, when the ship was carrying out the loading and unloading process in Balikpapan, Kalimantan, the pump experienced quite a serious problem, which resulted in the ballast tank being filled imperfectly and the loading and unloading process being disrupted, resulting in a delay time for filling the cargo, with a description of the facts and events of this ballast pump very influential on the smooth operation of the ship and the loading and unloading process(Othman et al., 2019). Therefore, when ballast pump number one is damaged, the ballast pump must be replaced with number two. When overhauling the number one ballast pump, various kinds of problems were found with the pump, including 1. Damaged pump shaft, 2. Damaged gland packing, 3. Corrosion that occurred on the foundation, 4. Lots of rubbish in the marine environment in the port area.

The results of interviews conducted by researchers with engineer IV regarding the factors that cause the ballast pump to work less than optimally were obtained due to lack of regularity in demand and delays in spare parts delivery. If the supply of spare parts on board the ship is lacking, then the maintenance and repair process will be disrupted and damage to the parts. Pump ballast, namely damage to the pump shaft, mechanical seal, and pump foundation. From the results of observations and identification of this incident, engineer IV and researchers took action in accordance with the ballast pump operating procedures from the instruction manual book and made improvements to the problems that occurred with the ballast pump, remembering that the shipping must be continued as soon as possible to the loading port for the loading and unloading process. on time.

Ballast pump maintenance is important to maintain optimal pump performance (Kimera., 2020). Based on the results of interviews conducted by researchers with Engineer IV, there is an explanation regarding ballast pump maintenance as follows. Ballast pump maintenance is carried out routinely and periodically in accordance with the PMS (Planning Management System) in the manual book, which includes checking the main components, namely the impeller, coupling, and bearing, as well as other supporting equipment, such as valves. Inspection of these components is carried out visually. Then, the bearing can be done using a tool, namely a thermogun, which functions to check the temperature of the bearing, which should not be more than 80°C. Apart from carrying out regular maintenance, we also carry out running tests to measure the internal wear of the pump and determine the pressure produced by the pump.

Based on the results of observations made by researchers on board the ship, several general steps were taken to maintain the ballast pump, namely by: a. Carrying out regular visual inspections, b. Checking pressure and flow, c. Clean the pump regularly, d. Check and clean the filter, e. Routine maintenance, f. Record treatment history. Apart from that, maintenance carried out on

the ballast pump circuit really needs attention because if maintenance is not carried out properly, it can disrupt the ship's operating system. Maintenance can be carried out as follows: a. Incidental Care, b. Planned Care.

Based on an interview with Engineer IV, the impact of non-optimal ballast pump performance is that it can disrupt the operation of the ship's stability because, basically, ballast is used to maintain ship stability by paying attention to the balance between the load being transported and the ship's ability to face disturbances such as strong winds or big waves. If the ballast pump does not work optimally, it will cause the ship to become unstable, and it is feared that it could compromise the ship's safety. Apart from that, the impact can reduce the efficiency of the cargo handling process on the ship, resulting in delays in the loading and unloading process, which can disrupt the ship's operational schedule.

Based on the results of observations made by researchers, the non-optimal performance of the ballast pump is caused by several factors, such as damage to the ballast pump components, so the impact of the damage is damage to the seal on the pump, damage to the seal on the pump can have a significant impact. The seal on the pump functions to prevent fluid leaks between the pump shaft and the connecting place. Fluid leaks caused by damage to the seal on the pump can result in the loss of the fluid being pumped, material losses, and increased operational costs. Uncontrolled fluid leaks can affect internal pump components such as bearings, motors, or gears. It can reduce the life of the pump and require expensive repairs or component replacement. Damaged seals also reduce pump efficiency. Fluid leaks also result in the loss of pressure and flow that the pump should produce. The pump has to work harder to achieve the same goal, resulting in higher energy consumption and decreased efficiency.

CONCLUSIONS

Regular and proper ballast pump maintenance is very important to maintain optimal pump performance. Some steps that can be taken include carrying out regular visual checks to ensure there are no leaks or damage, checking the pressure and flow of the pump regularly, cleaning the pump regularly from mud or scale that forms, checking and cleaning the pump filter, carrying out routine maintenance in accordance with manual book, as well as recording the ballast pump maintenance history. This step is taken so that the ballast pump continues to function properly, reduces the risk of damage, and extends the pump's service life.

The impact arising from the non-optimal performance of the ballast pump is due to several causal factors. Based on interviews with Engineer IV and the results of observations made by researchers, the causes are stability problems on the ship, damaged seals, lack of experience, and crew understanding of operating correct procedures. Disturbing the stability of the ship can result in an unstable ship, can disrupt the safety of the ship, as well as less efficient handling of cargo on the ship, such as delays in the loading and unloading process. Damaged seals can also cause fluid leaks from the pump, resulting in loss of pumped fluid, material loss, operational costs, and reduced pump efficiency.

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