Optimization of Maintenance of Main Cooling Sea Water Pump for Improving the Ship Performance

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Abstract : The importance of the role of this seawater pump, so the treatment carried out must be in accordance with established standards. One of the important parameters that can indicate that the pump is not running well is the decrease in pump pressure, the pump pressure when working is kept stable so that the seawater supply that will be used to cool fresh water remains the required amount. This study uses qualitative methods to determine the performance of the main cooling sea water pump if no treatment is performed, during treatment and after treatment.

Keywords: Main Cooling Sea Water Pump, MV. Tanto Permai , Care

1. INTRODUCTION

Main Cooling Sea Water Pump is one of the auxiliary machines on the ship, serves to pump seawater used to cool fresh water on *cooler plate of* the auxiliary motor cooler plate [1]. The pump function is to convert mechanical power from a power source (drive) into kinetic energy (speed), where this power is useful for flowing fluids and overcoming obstacles that exist along the flow, because it is a system that serves to support the smooth operation of the ship [2][3]. Main cooling sea water pump that helps the main motor as the main mover of the ship must receive attention or care in a planned and sustainable manner [4], so that the ship is always at sea and can transport and move goods from one port to another and the machines always run smoothly and durable even in bad weather conditions [5][6].

Most ships now use diesel engines as their main driving force because *diesel engines* are more efficient than steam engines [7]. Ship machinery, especially the main engine needs to get serious attention from the Machinists on board. Especially when the main engine is operating then the moving components will experience heat. That heat is generated from the combustion of fuel in the cylinder [8]. With cooling, it aims to cool, prevent expansion, *overheating*, damage to metals and materials that will lead to changes in shape and decreased engine performance [9]. Incomplete cooling or circulation that does not work properly on the main engine can cause damage so that it

A. Yulianto et al. (eds.), *Proceedings of the International Conference of Inland Water and Ferries Transport Polytechnic of Palembang on Technology and Environment (IWPOSPA-TE 2025)*, Advances in Engineering Research 302,
https://doi.org/10.2991/978-94-6239-731-6_12

will shorten the working power of an engine. To cool the main engine can use closed cooling media that is fresh water or open cooling media that is using sea water [10].

The importance of the role of this seawater pump, the treatment carried out must be in accordance with established standards, one of the important parameters that can indicate that the pump is not running well is the decrease in pump pressure, the pump pressure when working is kept stable so that the seawater supply that will be used to cool fresh water remains the required amount.

2. METHODOLOGY

The type of research used in this study is a type of qualitative research. Qualitative research is a research that is descriptive, tends to use analysis, and shows processes and meanings more. The theoretical basis is used as a guide so that the focus of research is in accordance with the facts in the field..

This method can be used to understand and find the problem under study, the purpose is to get a true picture of the alignment between theory and practice in optimizing the maintenance of seawater cooling pumps on board. This study was conducted at MV. Tanto Permai for 12 months using the following data analysis methods :

a. Data Reduction
   Reducing data means summarizing, choosing the main things that focus on the important things that are looking for the theme and pattern.
b. Presentation Of Data
   The presentation of data is a set of information that has been arranged in an integrated and easy to understand manner that provides the possibility of drawing conclusions and taking an action
c. Data Collection
   Data collection by observation, in-depth interviews, and documentation or combined into three (*triangulation*)

3. DISCUSSION

The monitoring of performance of main cooling sea water pump di MV. Tanto Permai is conducted for 3 months, from January to March. Measurements were made at the time of Watch with 4 / E, namely 08.00-12.00/20.00-24.00 periodically every week to monitor the flow rate (flow rate) and output pressure (discharge pressure).

a. January (Before Treatment)
   In January 2025, when the main cooling sea water pump has not been maintained, the result of monitoring main cooling sea water pump as the following:

TABLE 1. PUMP PERFORMANCE IN JANUARY

Week-	discharge flow (m3 / h)	*Discharge pressure* (bar)	Description
1	114	2.3	mild drop (-5%)
2	112	2.2	performance drop (-7%)
3	110	2.1	significant drop (-9%)
4	109	2.0	below standard (-10%)

Source:Data Researchers

The results of observations in January obtained the following data:

1) *Fouling occurs* on the suction line and *impeller*
2) Pump vibration increased to 5.2 mm/s (safe limit < 4.5 mm / s)
3) Leaks in *the mechanical seal* began to appear

At this time there is a decrease in the pressure of the main cooling sea water pump decreases, a factor that causes a decrease in the pressure of sea water cooling the auxiliary engine in the MV. Tanto Permai, namely:

a. The Lack of *Mechanical Seal*
   Decreased pump pressure can be caused due to leakage in *the mechanical seal*.
b. The Blockage of *Filter Sea Chest*
   The decrease in the pressure of the seawater pump is caused by impurities, sea shells, or other impurities that enter the sea chest, causing a decrease in the pressure of the seawater pump. The efforts that can be done in this condition are to clean the sea chest filter and clean the pump impeller by bribing the pump cracks from the dirt sucked by the sea chest and into the pump impeller through the suction valve.
c. Presence of impurities
   The presence of old dirt on the Blades so that they experience wear and damage, causing a decrease in seawater pump pressure and seawater capacity produced is not maximal or less. The thing that can be done is by cleaning the Blades *impeller* of the pump impeller so that the pressure on the coolant pump remains normal. As well as a loud sound on the pump due to wear lubrication on *ball bearing* the pump ball bearing.

If the pressure of the seawater cooling pump that has decreased is allowed to continue, it will have a negative impact on the ship's auxiliary engine. The impacts include the following:

a. Engine temperature rise

Low seawater pressure can cause non-optimal coolant flow in the engine, so the engine temperature will increase. Increased engine temperature can cause damage to the engine and decreased engine efficiency.

b. Decreased performance *of the Impeller* on the pump.
The decreased pressure of the seawater pump is caused by a blockage in *the impeller* by dirt, taps or marine animals that enter through *the sea chest*, causing a decrease in the pressure of the seawater pump.

c. Overheating
If the seawater pressure continues to drop, the seawater will not be able to flow to *the cooler plate* quickly. This can cause the ship's auxiliary Motors to *overheat*, which can result in damage to the engine.

b. February (treatment and recovery period)
After observing, the condition and performance of the main cooling sea water pump, treatment and recovery were carried out in February.

TABLE 2. FEBRUARY PUMP PERFORMANCE

Week-	discharge flow (m3 / h)	*Discharge pressure* (bar)	specification
1	118	2.4	initial recovery (+8%)
2	123	2.5	return close to Standard
3	126	2.6	Normal
4	128	2.7	stable (+15%)

Source: Data Researchers

Main cooling sea water pump performance analysis after treatment and recovery as follows:

1) Pump efficiency increased from 68% to 80% after treatment.
2) Vibration dropped to 3.8 mm/s.
3) Flow rate is close to the factory standard (120-150 m3 / h)

Efforts can be made so that the pressure of seawater cooling the main engine can be optimal by doing, including:

a. Checking and changing *Mechanical seals* and other parts, such *as ball bearings* periodically.
b. Periodic checking and maintenance
Perform periodic checks and maintenance of the coolant pump and by providing *grease* to the *ball bearing* at least every 2 weeks so that the sound of the pump is not noisy and sounds smooth and check the pump clutch, *impeller position* and pump balance to work optimally.
c. *Impeller Replacement*

Perform *impeller replacement* on the coolant pump periodically. A damaged impeller can cause a decrease in pump performance and result in a reduced flow of seawater entering the engine.

d. Cleaning *Filter Sea Chest*
Cleaning drain valve sea chest and cooler sea water pump of auxiliary engine, then the next step is performing maintenance periodically by cleaning garbage and things that make the clogging *of the sea chest filter* and ensuring that it is not clogged in the pipes connected to the sea water pump.

c. Month Of March (Post-Treatment)
In March, observations were carried out again to observe the performance of the main cooling sea water pump after maintenance.

TABLE 3. PUMP PERFORMANCE IN MARCH

Week-	discharge flow (m3 / h)	*Discharge pressure* (bar)	specification
1	118	2.4	initial recovery (+8%)
2	123	2.5	return close to Standard
3	126	2.6	Normal
4	128	2.7	stable (+15%)

Source: Data Researchers.

Performance analysis of main cooling sea water pump after treatment as follows:
1) The average flowrate increased to 130 m3 / h.
2) The discharge pressure is stable in the range of 2.7-2.8 bar.
3) Pump efficiency increased to 82%.

Comparison of the performance of the main cooling sea water pump before treatment, during treatment and after treatment can be seen in the chart below.

a. Flow discharge (m3/h) before and after treatment

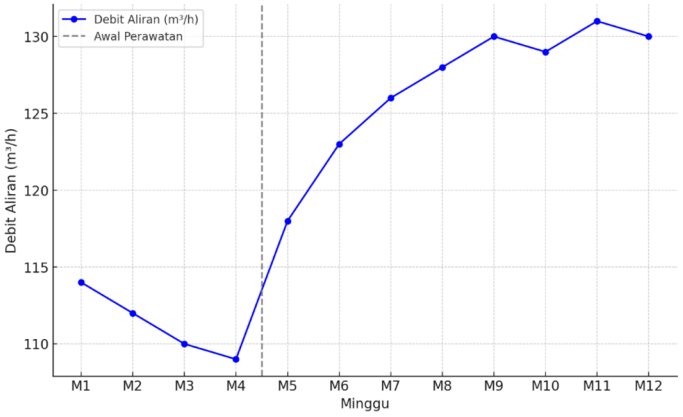

Figure 1. Flow discharge Chart

b. *Discharge pressure* (bar) before and after treatment

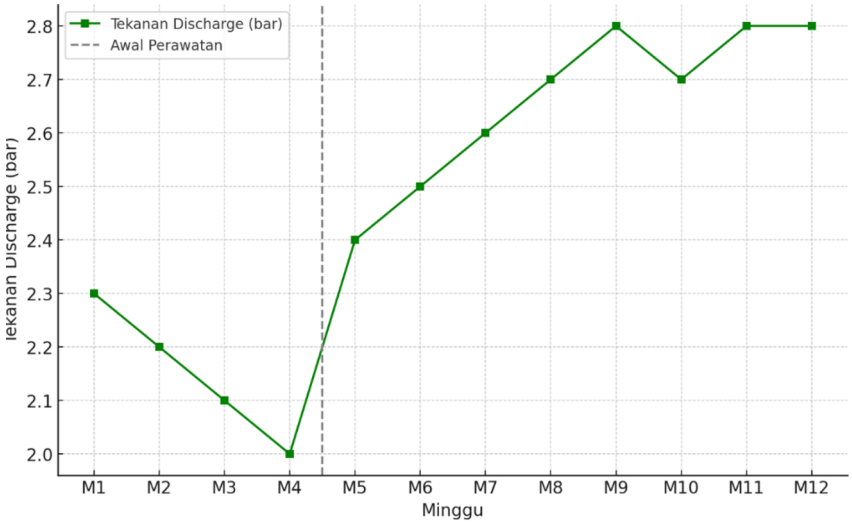

Figure 2. Pump Discharge Pressure Chart

c. Chart Analysis

1) Prior to maintenance in January, the performance of the main cooling sea water pump decreased significantly in January due to fouling, impeller erosion, and leakage in the seal.
2) After treatment in early February, the flow discharge increased by an average **of 18%** and the discharge pressure returned to the standard.
3) In March, the pump performance was stable with optimal efficiency **(82%)**and vibration within safe limits **(3.4 mm/s).**

Seawater cooling pump maintenance and repair management is very important to maintain the performance and longevity of the pump. The followings are the steps in seawater cooling pump maintenance and repair management:

a. Routine Maintenance
1) Periodic inspection: regular inspection of the pump is carried out, including visual inspection, sound inspection, and vibration. Check for leaks, damage to external parts, and make sure that there are no blockages.

2) Cleaning: seawater cooling pumps are often exposed to impurities such as mud, algae, and sea salt. Regular cleaning of the filter and internal parts is important to prevent a decrease in efficiency.
3) Lubrication: ensuring lubrication of bearings and other moving parts is carried out in accordance with the manufacturer's recommendations.
4) Replacement of parts, replacing worn components such as seals, gaskets, and *impellers* periodically to prevent further damage.

b. *Preventive Maintenance*
1) Calibration and adjustment: calibrate gauges and controls, and adjust pumps to manufacturer specifications to ensure optimum performance.
2) Cooling system check: check the entire cooling system, including pipelines and valves, to make sure there are no blockages or damage.

c. Corrective Treatment
1) Identify the problem: if there are signs of damage or decreased performance, identify the cause of the problem such as leakage, *impeller wear*, or damage to the motor.
2) Repair: repairs are made as needed, such as replacement of damaged components or repair of damaged systems. Make sure that all work is carried out in compliance with standard procedures and using quality parts.
3) Test run: after the repair, a test run is carried out to ensure that the pump is working properly and that there are no additional problems. Ensure pump performance is in accordance with specifications.

4. CONCLUSION

The conclusion that can be drawn from this study is the pressure drop of the seawater cooling pump on the auxiliary motor in the MV. Tanto Permai occurs due to lack of regular maintenance on the pump and a leak in the pump so that the pump pressure decreases. The impact that occurs when the pressure of the seawater cooling pump on the auxiliary engine of the ship MV. Tanto Permai is allowed to continue to decline is the *increasing of water temperature* in *fresh water coolers* that if it enters the auxiliary engine cooling system can damage its components. Efforts are made so that the pump pressure can return to optimal is to perform periodic maintenance on the pump such as replacement *of mechanical seals, ball bearings, impellers* and frequent checks and lubrication of *ball bearings* on a regular basis with a minimum of 2 weeks.

The sea chest filter is clogged by garbage, mud, and crusts causes sea water suction on the auxiliary engine cooling sea water pump is not optimal. The next step is to perform regular maintenance on *the sea chest* by cleaning garbage, sea animals, crusty mud and things that clog *the sea chest filter* regularly so that the flow of sea water that will enter the pump runs well and is not clogged.

Acknowledgement

Maintenance and repair management of seawater cooling pumps is critical to maintaining pump performance and longevity. Maintenance and repair management of seawater cooling pumps can be carried out by performing routine maintenance, preventive maintenance and corrective maintenance.

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