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Research Paper

# Causes of Leaks in the Main Engine Cooling Jacket MT. Mulia Karsa 2

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**Abstract**

Between the cylinder wall and the cylinder block is the cylinder block is an intermediary cooling device called the primary cooling jacket of the main engine system. Here, the cooling fluid is able to draw heat away from the cylinder wall and continue its circulation. Due to an issue with the jacket cooling of the primary engine system, ship operations had to be suspended for maintenance, prompting the current investigation. The study aims to pinpoint the reasons behind jacket cooling leakage in the main engine room and suggest viable countermeasures. Observation, interviews, and reviews of relevant literature are just a few methods used to gather information. The study took a descriptive, qualitative approach, using tools like SHEL and the fishbone diagram to analyze data. According to the results of this research, a lack of attention to the planning and maintenance system for the main engine, o-ring deterioration in the jacket cooling main engine system, corrosion of the cooling jacket, rust formation in the tank, suboptimal water preheating temperature, and a lack of maintenance all contribute to leaks in the main engine cooling system. Several variables contribute to the main engine's less-than-ideal cooling efficiency. The jacket cooling system damage system's o-ring or a leak in the jacket cooling system are two examples of these problems with the primary engine system. In addition, the primary engine cooler's cooling water jacket is subpar, and its circulation is subpar. In addition, the exhaust gas temperature from the main engine is inconsistent, and rising temperatures have not yet resulted in the engine's shutoff. The primary engine system performs maintenance at the specified intervals specified in the handbook to handle problems with jacket cooling leaks. O-ring and cooling jacket replacement, chemical dosing, water pH testing, and routine temperature checks are all part of the maintenance process.

**Keywords:** *Analysis; Leakage; Jacket cooling*

## INTRODUCTION

The movement of cargo is greatly aided by sea transportation. As we know, ships have become a medium of water transportation as a liaison between islands, countries, and continents with each other. Ships are built in large numbers and strive to be ready for use in meeting the growing demand. The entire system and components must be maintained to keep the diesel engine operating properly. One of them is the jacket cooling main engine system. The item is the main engine cooling jacket that cools the block as well as the cylinder walls. The cooling fluid flows towards this part, absorbing heat from the cylinder walls, and then there is constant circulation (Transportation of Goods by Ship, 2019).

Operating vessels require planned and maximum maintenance and repair to support the smooth operation of the ship in the short and long term. Shipowners and charterers do everything possible to ensure their fleets operate optimally. It makes it as viable as possible for the company.

In addition, the first machinist needs to maintain the jacket cooling system for the main engine according to the working hours specified in the operational manual (manual book instruction).

Good maintenance of the jacket cooling system for the main engine is the key to maintaining the performance and stability of the ship. Adequate training and technical knowledge for ship technicians and crew is essential to maintaining safety, avoiding operational disruptions, and


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reducing the risk of damage to the main engine. The author experimented to solve problems on the MT ship. MULIA KARSA 2 sailed through the creation of a scientific work entitled "Analysis of the Causes of Leakage in the Jacket Cooling System for the Main Engine at MT. Mulia Karsa 2." In operating the ship, it cannot be separated from engine maintenance, including engine cooling system maintenance.

Freshwater plays an important role on board. That is, smoothness is required in the operation of auxiliary aircraft. Among them are jacket cooling, main engine cooling, additional diesel engines, and cleaning agents.

According to Subekti et al. (2022), freshwater cooling systems really need maintenance on ships that travel long distances or spend days sailing at sea. When using clean water on board to treat cooling systems, there are two options: test the water quality and keep the temperature stable. To optimize cooling water entering the main engine and minimize leaks and engine damage in the primary engine cooling jacket, sometimes the cooling water temperature is a problem because the jacket cooling control is not able to work automatically. It is a serious problem for all engine crews because they are new to ships and are not used to dealing with these problems.

A planning maintenance system (PMS) is needed to maintain the condition and prevent damage or leakage of the primary engine's jacket cooling system. In the closed cooling system, good-quality water is used, e.g., H. Water has a pH of 8–10, and this water also does not contain corrosive substances that cause the engine to rust. When the author did the test, the pH of the water was below the normal limit of 6.5, which is a sign that the water has acidic properties.

Keeping the condition and level of main engine coolant damage to a minimum is the main goal of all maintenance carried out. For example, in the MT. MULIA KARSA routine, two times a week, fresh water will always be replaced. When researchers carried out sea practice (prala) at MT. MULIA KARSA 2, which is owned by the shipping company PT. SAMUDERA MULIA KARSA, the researchers explained that for a year (12 months), they damaged the main engine jacket cooling cover and caused leaks in the freshwater cooling system, even though the main engine jacket cooling system was still in good condition based on the Planning Maintenance System (PMS).

Therefore, researchers are interested in taking this problem and putting it in the form of a thesis entitled "Analysis of the Causes of Leaks in the Jacket Cooling Main Engine System at MT. Mulia Karsa 2." Based on the background above, the problem can be formulated as follows:

1. What factors affect the leakage of the Jacket Cooling Main Engine System on the MT. Mulia Karsa 2?
2. What are the actions taken to prevent leakage of the jacket cooling main engine system on the MT. Mulia Karsa 2?

## LITERATURE REVIEW

### Description of Theory

*Main engine*

The main engine is the one that drives the ship's propeller with a working system that converts potential heat energy into mechanical energy. The piston can compress the air in the cylinder, increasing the pressure and temperature. Furthermore, the fuel will be atomized in the combustion chamber, where combustion occurs in the ignition compression engine. Heat is generated by combustion in the main engine cylinder liner. Cooling is required to reduce the temperature of the main engine, as this heat source increases its temperature. Closed cooling is required, especially freshwater cooling (Jamiin, 2022). There are several main engine parts, namely jacket cooling and o-rings.

*Diesel engine*

Diesel engines or engines that trigger compression. This machine starts when fuel is sprayed into the air at a high temperature and pressure. A number of compression stages affect the performance of a diesel engine, including the degree of homogeneity of the fuel-air mixture, the size of the compression ratio, fuel capacity, and overall fuel properties. Based on Fadly & Pakan (2021) the steps for operating a diesel engine are based on 4-step and 2-step maneuvers.

*Cooling system*

Cooling is a technique for carrying out heat absorption. Heat is obtained from the combustion process in the cylinder, and the cooling system will work. Thus, when the engine is turned on, the engine will work at an optimal temperature and always work and operate at that temperature. The engine cooling system operates on the principles of convection, conduction, and radiation.

Heat conduction from the metal around the cylinder to the coolant through the cylinder head valves absorbs heat. The metal surface containing the cooling water transfers heat by the principle of convection comes into contact with the cooling water, and transfers heat, causing the water in the cooling bag in the cylinder block to become hot. As a result, a cooling system is needed to avoid engine damage. However, the temperature and various parts of the machine are maintained within certain limits to ensure that all parts of the machine are able to function optimally (Wisely Ziliwu et al., 2021).

*Heat exchanger*

According to Septian et al. (2021), a heat exchanger can transfer heat from two liquids at different temperatures without uniting one liquid with another. This method is used to transfer heat from a hot fluid to a cold fluid in a system. It generally functions as a heater or cooler.

The heat transfer that takes place in a heat exchanger usually consists of conductive heat transfer in the walls separating the two fluids and convective heat transfer between one fluid and the other. The different temperatures determine the amount of heat transfer between the two fluids in a phase in a heat exchanger. These phases differ throughout the cycle in the heat exchanger. To determine the average total temperature difference between the two fluids located in the hot feeder, the logarithmic mean temperature difference (LMTD) method can be used.

**Framework of Mind**

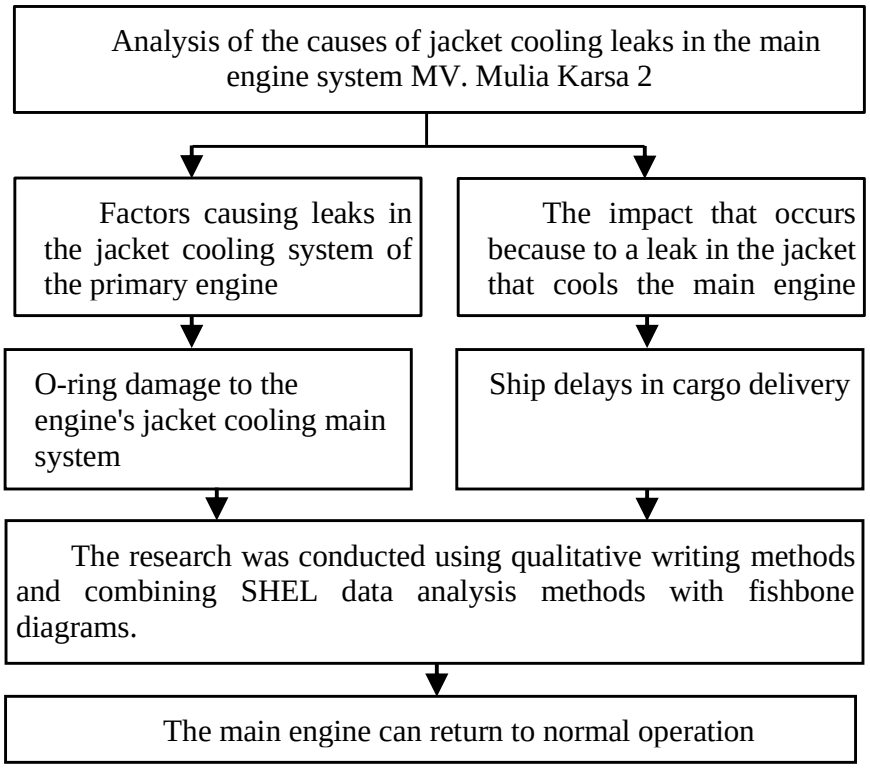


**Figure 1.** Research Framework

**RESEARCH METHOD**

This study employed a qualitative-descriptive research design.

**Time and Place of Research**

This research was conducted during sea practice (Prala) from 10 October 2021 to 30 October 2022 on the MT ship. Mualia Karsa 2, which is owned by PT. Samudera Mulia Karsa 2. This ship is a CPO (Crude Palm Oil) oil tanker.

**Sources of Sample Research Data**

The sources of data obtained there are both primary and secondary data in this study. Interviews and direct observation at MT Mulia Karsa 2. In comparison, secondary data is obtained from daily records and operational records.

**Method of data collecting**

This study's data collection techniques are observation and questionnaires, interviews, and a literature study. Observations were made about leaks in the primary engine's jacket cooling system. Interviews were conducted with the head of the machine room. At the same time, literature studies are obtained from reference manuals, scientific works, studies, books, theses, and others related to the object of research.

**Research Instruments**

In qualitative research, the data collection tool is the researcher himself; non-human tools (questionnaire, observation guide, interview guide, literature study guide, and documentation guide) can be used, but their function is limited.

**Techniques for Analyzing Qualitative Data**

The SHEL approach (software, hardware, environment, and liveware) and fishbone analysis were employed in the creation of this research.

**Data Validity Testing**

To test the data validity in qualitative research, triangulation is used. Using numerous data sources such as papers, archives, interview findings, and observation results, triangulation will determine the truth of specific information

**FINDINGS AND DISCUSSION**

Factors that affect the main engine system jacket cooling leaks are as follows:

**Lack of attention to planning maintenance system (PMS)**

Factors that cause leakage of the jacket cooling main engine system, namely maintenance and repairs carried out by the machinist not in accordance with the time interval specified in the manual book, for maintenance that must be carried out accordance to the handbook are to preserve the quality of cooling water, clean the expansion tank, and ensure this cooling water temperature remains stable, preventing the main engine from operating at performance.

Damage occurs as a result of failure to pay attention to the planned maintenance system (PMS) on the main engine, abnormality, and non-optimal operation of the main engine components. In addition, because the main engine components operate beyond their working hours, corrosion on the cooling jacket causes coolant leaks from the main engine. When a problem occurs with the main engine, the engineer performs maintenance and repairs because it is the same as the repair and maintenance of other equipment that must be prioritized.

**Damage to the primary engine cooling jacket o-ring system**

This low temperature and instability of the cooling water heating process cause the o-ring material in cooling of the primary engine cooling jacket system to change shape, making it vulnerable to injury and resulting in breaches when the cooling water circulates. When the main engine is operating, there is a discharge of circulating cooling water due to damage to the primary engine system's o-ring jacket cooling, which will result in gaps and inaccuracies in the distance between the cylinder liner and jacket cooling.

**Corrosion of the jacket cooling of the main engine system has occurred**

The occurrence of corrosion in the jacket cooling of the main engine system as a result of poor quality cooling water, which contains substances that cause rust, and the gradual erosion of material in the jacket cooling as a result of poor cooling water continues to circulate in the jacket cooling of the main engine system are factors that contribute to leaks. The corrosion of the jacket cooling expansion tank results in the corrosion of the jacket cooling damage to the primary engine system's o-ring jacket cooling. The interior of the cooling garment erodes as a result, enabling cold water to escape via microscopic holes.

**Rusty expansion tank jacket cooling main engine system**

Lack of tank maintenance and cleansing is also one of the causes of corrosion in the primary engine's jacket cooling system.

**Low main engine preheating cooling water temperature**.

The water temperature becomes unstable due to the low temperature of the cooling water

heating process. As a result, the o-ring on the main engine cooling sleeve system has become deformed, which is one of the causes of o-ring damage. Infrequent maintenance and cleansing of cooling water quality in the expansion tank is the result of suboptimal maintenance of the engine's primary cooling water. Corrosion scale and grime deposits are the cause of the poor quality of cooling water in the jacket cooling expansion tank of the primary engine system.

**Less optimal treatment of cooling water on the main engine**

Improper cooling water maintenance in the main engine reduces the quality of the cooling water, causing water circulating in the cooling system to harm the jacket cooling components of the main engine system.

Factors where the main engine jacket cooling system performance is not optimal:

1. Software
2. Hardware
3. Environment
4. Liveware

**CONCLUSIONS**

The following conclusions may be derived from the researchers' results and the debate that has been provided, as well as their relationship to each other, about the sources of leaks in the main engine's jacket cooling system at MT. Mulia Karsa 2, among others :

1. The main engine jacket cooling system can leak due to the following factors: a lack of planned maintenance system (PMS) on the main engine, damage to the main engine's o-ring jacket cooling system, corrosion of the cooling jacket, rusty expansion tanks, and low preheating temperatures. water.
2. Preventing leaks in the main engine's jacket cooling system. Replace new o-rings; provide appropriate chemical water cooling chemicals; always test water pH levels; routinely check cooling water temperature; and perform maintenance briefings and repairs. The machine's primary components, according to the instructions, will function.

Based on the research conclusions, the following suggestions can be conveyed by researchers to address the problems faced, among others:

1. Documenting maintenance and repairs in line with the Planning Maintenance System (PMS) instructions for the main engine book helps prevent repeat mishaps. The machinist must demand new o-ring spare parts to avoid delays in repairs if a problem arises. Adding chemical water cooling and monitoring the cooling water content maintains water quality. flowing in the cooling jacket to avoid eroding engine material.

   Overcoming the issue of the main engine cooling water's lack requires draining the cooling water, thoroughly cleaning the rust and dirt deposits, refilling the main engine jacket cooling system expansion tank, adding chemical water coolant as specified in the manual at regular intervals, and testing the pH level of the cooling water (fresh water) to ensure the quality of the cooling water in the expansion tank. These actions include of adding chemicals, checking the composition of the cooling water, and keeping the cooling water at a constant temperature.
2. In order to ensure that the ship's crew receives the necessary training to be professional and competent at work, the company must carry out training according to predetermined standards.

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