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# The Analysis of Overflow Occurrences in Fuel Oil Purifiers at MV Dahlia Merah

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***Abstract***

*A purifier is needed to maintain fuel quality and support ship engine performance. A purifier is a device that is a separator for oil from water and dirt based on its specific gravity. This research aims to determine the causes and impact of overflow on the fuel oil purifier. The data collection method used in this study is the observation method and discussion method with the crew or employees of PT. Kayu Lapis Indonesia as the ship owner, and literature study methods. This research uses a qualitative analysis method, namely by directly analyzing the problems in the fuel oil purifier. The research results concluded that the cause of overflow in the fuel oil purifier was due to a dirty bowl caused by a lack of cleaning and maintenance of the Main Cylinder, damage or wear to the Main Seal Ring and a dead end of the nozzle. The efforts made to overcome overflow in the fuel oil purifier are by blowing up manually, carrying out cleaning (overhaul) of the purifier bowl and walls, checking the fuel pressure entering the FO purifier, setting the temperature on the fuel heater, installing Play the Seal Ring correctly, maintain the nozzle and maintain the HFO purifier by the PMS & Instruction manual book.*

***Keywords****: Density, Overflow, and Purifier*

## INTRODUCTION

In general, the fuel received by ships may still contain water and sediment. Therefore, before being used to meet the needs of a diesel engine/main engine or auxiliary engine, it must first undergo various processes including deposition, heating, filtering and purification (Santosa et al., 2022). All these aim to obtain clean fuel free from water and sediment content. On ships driven by diesel motors, we pay attention to fuel usage and keep it clean because dirty fuel will affect the diesel motor (Wibowo & Astriawati, 2021). One effect that may occur due to the use of dirty fuel in diesel motors is the blockage of the injector holes in the motor (Wibowo et al., 2024). By blocking the fog holes, the combustion that occurs in the diesel motor could be better, so the operation of the ship experiences problems; for example, the number of revolutions/motor power becomes low (Kalghatgi, 2015).

Things like this can be avoided by using a tool called a Purifier. The purifier separates oil from water and dirt based on its specific gravity. In its work, the purifier provides fuel, which sometimes experiences various obstacles, including the purification that occurs when the purifier is less than perfect or is not working

correctly. Improper operation of the purifier can also result in the fuel produced still containing dirt and water. So, as a machinist, you are expected to be able to operate a purifier, and at the same time, you are required to know the process and maintain it properly and correctly. However, in its work, sometimes disturbances still occur, which affect the smooth operation of the ship.

Apart from that, a purifier is an auxiliary device whose function is to clean or separate oil, whether fuel or lubricating oil, from dirt, whether in the form of liquid or impurities, by providing centrifugal force to liquids of different specific gravities so that substances that have specific gravities the larger ones will be thrown out first. Purifiers are essential to the smooth operation of a ship. Because this tool separates oil and water, the fuel can contain water and dirt. A fuel cleaning system is implemented to avoid problems with the motor, boiler, and incinerator, starting when the fuel is in the double-bottom settling tank. At the same time, the lubricating oil starts when the fuel is in the settling and service tank (Adi, 2019).

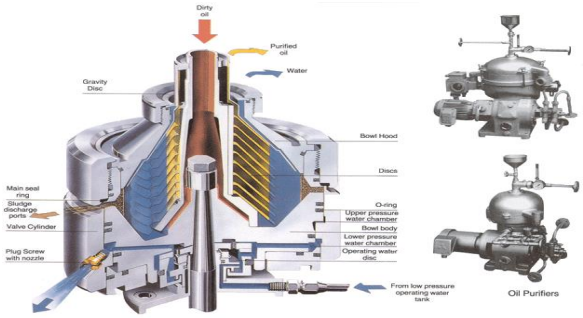


Figure 1. Purification of Fuel Oil in the purifier

The advantages of a purifier are that sludge can be separated easily and disposed of by blowing up. The mud removal movement is carried out quickly with a high cleaner, making the cleaning process much more efficient.

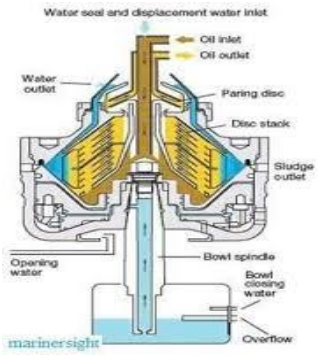


Figure 2. Separation Process with Bowl Arrangement

Type of Purifier. There are three types of purifiers according to the media that are separated, namely; **1**. The Fuel Oil Purifier, a highly efficient tool, is designed to separate fuel impurities, particularly fuel oil or black oil, using centrifugal force. It is always heated to a temperature of ± 70 ºC during each operation to prevent the

fuel from hardening, a process that occurs at a temperature of 40 ºC. This purifier's efficiency is further demonstrated by the fact that it must be blown once every ± 4 hours to prevent overflow (Marsudi & Palippui, 2020). **2**. A Diesel Oil Purifier is an auxiliary aircraft similar to the Fuel Oil Purifier, namely separating fuel, especially Diesel Oil, often called diesel, using centrifugal force. In operation, the Diesel Oil Purifier is more accessible than the Fuel Oil Purifier because the Diesel Oil Purifier is a liquid fuel that can be used directly at a specific room temperature. If heated using a heater, the fuel is unsuitable for the engine. This type of purifier does not always have to be blown because its working temperature is room temperature, except if the quality of the fuel contains much water, it must be blown at least twice in one filling to the service tank. **3**. The Lubricating Oil Purifier, a reliable tool, is designed to separate lubricating oil dirt on ship main engines (Pyo et al., 2014). Its working system circulates clean lubricating oil into the main engine charter using centrifugal force to separate it. This purifier's reliability is further demonstrated by its ability to work at a temperature of ± 60 º C, which allows it to effectively separate the mud and water, causing them to evaporate.

Purifier Working Principle. The working principle of a purifier is to separate oil from water, mud, and other impurities using centrifugal force based on its specific gravity so that particles with a greater specific gravity will be far away from the axis. In comparison, particles with a smaller specific gravity will always be closer to the axis. The purpose of separating oil by centrifugal rotation is: a) Sludge can be separated easily and removed by blow-up b) The mud removal movement is carried out quickly with better cleaning. c) The cleaning process is much more efficient and economical.

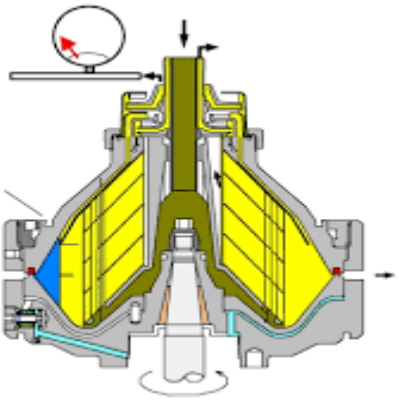

Figure 3. With Centrifugal Force

Purifier Components. There are several types of purifier components used in commercial ships; the picture below is a simple picture of the construction and central parts of the purifier.

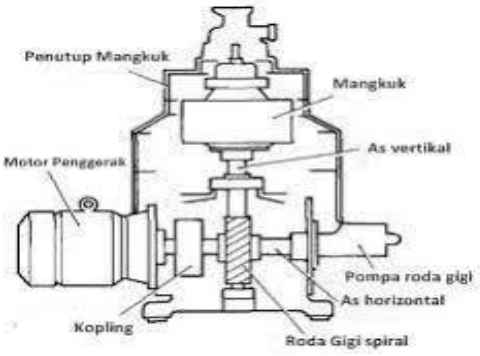


Figure 4. Fuel Oil Purifier Construction Sketch

The main parts of the purifier and their functions.

**1**. The Bowl. The bowl is a main part of the purifier, and it is shaped like a bowl and is made up of discs. These discs play a crucial role as a medium for separating liquid oil from dirt. In this process, the heavier particles are pushed out, while the oil, which carries lighter particles, is directed inward and flows out through the oil channel. The solid impurities form a mud-like substance on the bowl's walls, which can be cleaned at any time (Prasetyo, 2017).

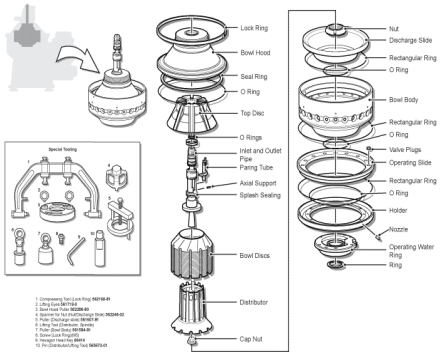


Figure 5. Bowl Cross Section

2. Electro Motor. An electromotor converts electrical energy into mechanical/rotational power, which is the purifier's main driving force, and it is connected to the horizontal shaft and vertical shaft to rotate the bowl and gear pump.

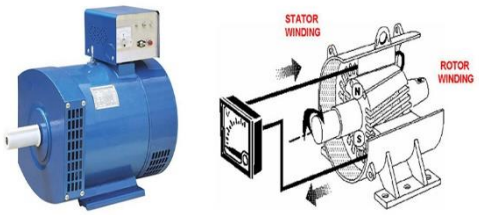


Figure 6. Electro Motor

3. Horizontal Shaft. The horizontal shaft is the shaft whose function is to transmit the motor/rotation power of the motor, which is connected to the gear pump and vertical shaft.

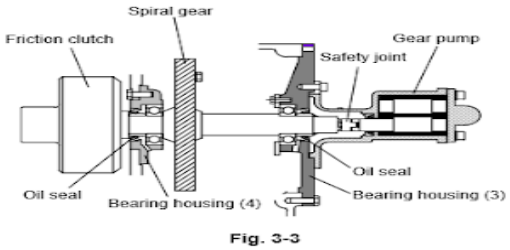


Figure 7. Horizontal Shaft

4. Vertical Shaft. The vertical shaft is the shaft that functions to rotate the bowl, which is connected to the horizontal shaft via a spiral gear. Figure 7. Alam Indah

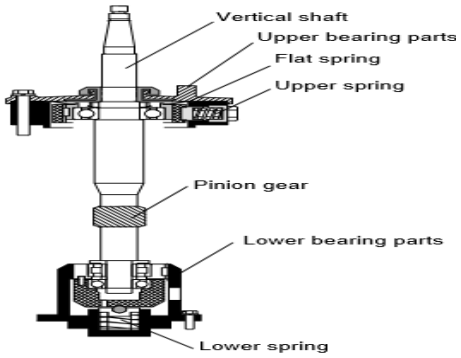


Figure 8. Vertical Shaft

5. Gear Pump. The gear pump is a pump used to transfer dirty oil to the purifier which is connected by a safety joint to the horizontal shaft.

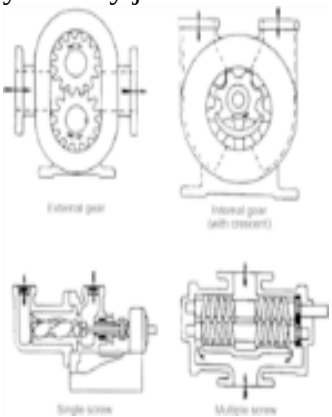

Figure 9. Gear Pump

6. Friction Clutch. A friction clutch is used to influence the motor's rotation if it exceeds the specified rotation limit (to prevent the motor from overloading).

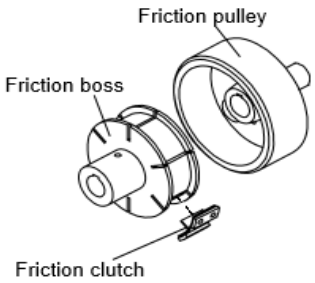


Figure 10. Friction Clutch

7. Brake. The brake functions as a brake or tool to temporarily stop the bowl's rotation if trouble occurs during the purification process or for specific reasons such as maintenance, inspection, etc.

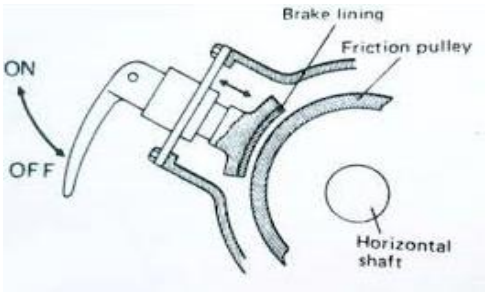


Figure 11. Brake

Purifier Operation and Shutdown Procedures. 1. Running the Fuel Oil Purifier, To support work on board the procedure for operating a fuel oil purifier, namely: a) Open the suction valve from the fuel oil settling tank and the valve before the purifier filter, b) Open the in and out valves of the steam heater purifier. c) Open the freshwater inlet purifier faucet. d) Blame it on the purifier. e) Wait for the purifier to rotate, normally or stable until it says "READY OPERATION" on the purifier panel f) Open the fill valve to the HFO service tank g) Set the HFO inlet temperature to 85°~to~95° h) Open the HFO inlet valve to the purifier i) Press the button on the purifier panel, "Program 1," to start the purifier process j) Set the OUT pressure of the purifier between 1.5 to 2kg k) Adjust the HFO inlet pressure if it is too large by opening the return valve.

2. Stop the Fuel Oil Purifier. The procedure or steps to stop the fuel oil purifier are as follows: a) Close the fuel inlet and outlet valves of the purifier. b) Turn off the fuel heater. c) Blow up using fresh water 2-3 times. d) The purifier will automatically slide first to remove any remaining dirt in the bowl before it stops. e) Stop the purifier motor. If the purifier is operating, there are four things you need to pay attention to, namely: 1) Fuel temperature 2) The pressure, both suction and purifier pressure and pressure from the purifier to the fuel tank. 5. Gear Pump.

The gear pump is a pump used to transfer dirty oil to the purifier which is connected by a safety joint to the horizontal shaft.

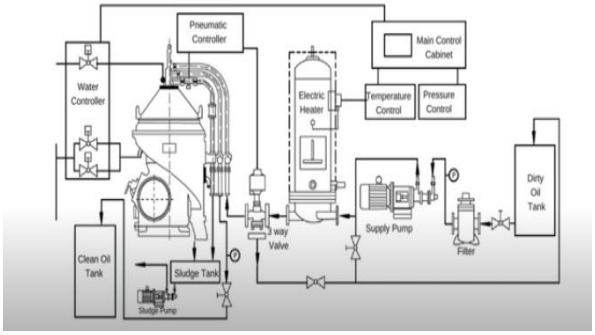


Figure 12. Diagram of fuel oil purifier system

## RESEARCH METHODS

The data collection methods used in this research are observation, interview, and library. Data was collected when the author carried out observations on board the MV Dahlia Merah and in-the-ground workshops against the FO Purifier. The discussion method was carried out by interviewing technicians on board ships and land workshops about problems that occurred with the FO Purifier. To further enhance the research, the author consulted several reputable sources from various literature, including [specific sources].

The data analysis method used in this research is qualitative data analysis. The writers carried out qualitative data analysis, namely a survey and direct analysis of the components and problems in the FO Purifier on board the ship and in the land workshop owned by PT. Kayu Lapis Indonesia.

## RESULTS AND DISCUSSION

Based on the problem data described above regarding overflow in the F.O. purifier, the following is a discussion and solution to the problem that can be described. In this study, the author explicitly explains the damage incident to the F.O. purifier auxiliary machine on board a ship owned by P.T. Kayu Lapis Indonesia and in this land workshop. The problems found when the author carried out sailing practice for one year were: a) Dirty Bowl. The bowl is dirty due to a lack of cleaning and maintenance of the Main Cylinder. The water and mud content in the fuel is separated based on centrifugal force. This is because water and mud are substances with a heavier specific gravity in the fuel, so the mud will be in the bowl, and if it has accumulated a lot, it has yet to be cleaned. This will result in a buildup of dirt on the distributor's neck. Therefore, fuel will flow out, often called overflow (Endro, 2015).

b) Damage or wear to the Main Seal Ring. Installation and age factors cause Damage or wear to the Main Seal Ring. Apart from that, the installation of a primary seal ring must be accompanied by accuracy and correct technique, and the central seal ring must be tightly installed. Part of the seal ring is twisted (rotating). This component is made from rubber material, which, over time, will become loose.

Suppose it has passed the maximum working limit (six months) automatically. In that case, the mechanical properties that the Main Seal Ring will cause will decrease, resulting in the Main Seal Ring no longer functioning as a seal. Fuel without time to separate from water and mud will come through the gaps between the bowl body and the main cylinder. As a result, fuel that is still clean also comes out through the sludge port or overflow. One of the causes of overflow is the presence of a dirty bowl. This is characterized by an abnormal purification process in the F.O. purifier, which results in clean fuel not coming out through the clean fuel output pipe, often called overflow (Nur, 2019).

c) The nozzle is dead due to crusts sticking to and covering the nozzle hole in the bowl body. This crust comes from the water used for pressing operations on the sliding bowl bottom during operation which is caused by the presence of lime contained in the water which clogs the hole in the nozzle. Lime comes from natural mineral content from the mountains. Because the water comes from the ground, the water content is still mixed with soil particles or other substances. The process of creating these crusts takes a long time due to a lack of cleaning and maintenance of the nozzle hole in the bowl body, causing it to clog and hinder the flow of water (closing water). Therefore, it is important to regularly maintain and clean the nozzle in the bowl closing operation process so that the Purifier can run normally (Wahyuddin, 2011). Regular nozzle maintenance and cleaning can prevent the formation of these crusts, ensuring the Purifier can run smoothly.

d) There is Damage to the bowl shaft bearing. Bearing Damage in purifiers is caused by several factors, including wear from the rolling ball on the bearing and wear due to corrosion. This is due to using low-quality spare parts, which accelerates material fatigue. However, a factor that is no less important is the human error when carrying out maintenance, repairs or overhouling and reassembling parts that are not correct and tilt occurs, so that when it rotates it becomes unstable and affects the working strength of the bearing (Tomi, 2020).

Figure 13. Purifier Bowl

e. Improper Installation of Gravity Disc. The function of the gravity disc here is to hold the water seal and determine or regulate the volume of lubricating oil output according to specific gravity or density so that the process of oil entering for purification and exiting the purifier is balanced. As a result, the purification process only takes place slowly because the fuel always spills (overflows) through the water outlet hole. The size of the gravity disc greatly influences the purifier's ability to separate fuel from water and dirt (mud). In the purifier, the incoming oil will rotate. This aims to regulate the throwing method so that liquids with a higher specific gravity will be thrown further away. In comparison, liquids with a lighter specific

gravity will be close to the axis of rotation. If the specific gravity of the fuel oil entering the purifier changes, then the centre line ratio (center line) must be changed. For this reason, each purifier needs to be installed with a ring in which the outer centre line of the water drainage canal can be changed. Moreover, this ring is a gravity disc that keeps oil and water fluids from uniting or mixing when the water and oil come out (Pongkessu, 2019).

Figure 14. Installation of FO purifier components

f.Incomplete Or Limited Spare Parts. On ships, the Fuel Oil Purifier often suffers from incomplete spare parts due to frequent damage. This issue can significantly disrupt the ship's operations, particularly when the bowl O'ring and main seal ring, which need to be replaced every time the bowl and disc are cleaned, are not available. However, this process of frequent replacement can lead to wasteful use of spare parts and depletion of supplies on board (Senda, P. J., Tona, T., & Lewar, J. M., 2021).

Figure. 15 Gravity Disc

g. Plates (Discs) and Bowls are often dirty. Frequently dirty plates (discs) in the bowl indicate that the fuel oil quality is decreasing. Even though the purifier is always blown down, that is, cleaning the bowl disc when the purifier is operated. The blowdown process is carried out automatically at intervals of every 2 hours, and sometimes, the Engineer does it manually when checking. Blowdown helps remove dirt and solid particles stuck to the bowl walls through a high-rotation centrifugal process. As a result, the purifier only works optimally because the disc is covered with very thick mud. The fuel must be adequately purified but will spill out (overflow) through the water outlet hole. This incident often occurs as a symptom that precedes an abnormality in the Fuel Oil Purifier. Fuel spills can also be caused by fuel temperatures that are too high, dirty bowls or discs, and lack of

operating water. In Fuel Oil Purifiers, the media used often overflows because the disc bowl is dirty and often gets clogged. As a result, the oil will escape and be wasted with dirt and water in the sludge tank.

Figure 16. Cleaning the Purifier Bowl

h. Maintenance System on Fuel Oil Purifier. Waiting for the damage to occur and implementing a maintenance planning system or PMS (Plan Maintenance System) could be more optimal. This is due to the need for more maintenance on the purifier bowl. Therefore, efforts made to improve the work of the Purifier include repairing damaged vertical shafts and replacing spiral gears, and then carrying out maintenance based on the PMS (plan maintenance system) and the instruction manual book (DIAZ, 2020).

## CONCLUSION

Based on the description and arguments above, and as a conclusion to this research, several important conclusions can be drawn, namely: 1. Factors that cause overflow in the Fuel Oil Purifier: a. Damage and wear to the primary seal ring. b. A need for more cleaning and Maintenance of the main cylinder b. Causes dirty bowls. There is Damage to the bowl shaft bearing. 2. Impacts that occur due to overflow in the Fuel Oil Purifier: a. Waste of fuel in vain. b. The performance of the HFO purifier could be more optimal. c. The level of fuel purification on board ships decreases. 3. Efforts to overcome overflow in the Fuel Oil Purifier: a. Do blow up manually. b. Carry out cleaning (overhaul) of the purifier bowl and walls. c. Check the fuel pressure entering the FO purifier. d. Set the temperature on the fuel heater. e. Install the Main Seal Ring correctly. f. Maintenance of the HFO purifier is done using the PMS & Instruction manual book.

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