



ANALYSIS OF SLOW FREON CONDENSATION ON THE CONDENSOR OF FOOD COOLING MACHINES TO SUPPORT THE SUSTAINABILITY OF DAILY ACTIVITIES ON THE MV. BOGA INDAH SHIP

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Abstract: One of the most vital supports related to welfare and health is the Refrigeration Machine to ensure the quality and quantity of food ingredients. For meat and fish that is still good is the meat and fish are not mushy, not rotten and when stored can freeze completely and if necessary crystallize. In order for foodstuffs to remain good, they need a storage temperature of $\pm 2^{\circ}\text{C}$. For the storage of meat and fish we need a storage temperature of $\pm 15^{\circ}\text{C}$. The less than optimal working of the cooling machine is influenced by various factors, both internal factors such as the number of hours the machine works. For external factors, this is closely related to the lack of maintenance on the cooling machine. In the research that the author did, there were several factors that were very influential in the smooth operation of the food cooling machine. The presence of frost on the evaporator pipes is a problem that most often occurs in the work of the evaporator. This happens when the pipe surface temperature is lower than 00 (freezing temperature of water). Next is the lack of good condensation process. The suggestions given in this problem are: Immediately close the cooling room door when entering or leaving the cooling room and monitoring and periodical maintenance of the amount of freon through the guessing glass and lubricating oil contained in the compressor. So that the freon condensation process is perfect and can meet the cooling needs, then do the condenser maintenance properly. For normal conditions once a month and if in an emergency condition can be cleaned and checked as soon as possible.

Keywords: refrigeration machine, maintenance, refrigerator, Freon, ice flower, evaporato

INTRODUCTION

One of the aircraft that is no less important in supporting the smooth operation of the ship is the cooling engine, especially food coolers. Where food is the main requirement on board to improve the performance of all crew members (ABK). These foodstuffs consist of wet foodstuffs and dry foodstuffs. In this case, wet food ingredients such as: meat, fish, vegetables,

and fruits need special handling. Where the food material has a durability that is not too long. In order to keep food ingredients fresh and fit for consumption, more appropriate handling is through the cooling process in the cooling engine room.

In order for the food preservative machine to work normally, proper handling and maintenance is needed, if this has been done then the refrigeration machine can operate normally and there will be no fatal damage to the food refrigeration machine system.

The main parts of the refrigeration system include: compressor, condenser, expansion valve and evaporator. On ships using Freon R. 22 as a cooling medium.

METHOD

Research is a series of scientific activities in order to solve a problem. Research results are never intended as a direct solution to the problems at hand, because research is part of a larger problem solving effort. According to Azwar (1997:1), the function of research is to find explanations and answers to problems and provide alternatives for possibilities that can be used for problem solving.

According to Sugiyono (2007:2), the research method is a scientific method used to obtain data with a specific purpose. The scientific method means that the activity is based on the scientific method, namely rational, empirical, and systematic. Rational means research activities are carried out in ways that make sense so that they are affordable by human reasoning. Empirical means that the methods used can be observed by the human senses, so that other people can observe and know the methods used. Systematic means that the process used in the research uses certain logical steps. So it can be concluded that research is a scientific method used to find an explanation of a problem.

According to Prof. Dr. Sugiyono (2010:80) Population is a generalization area consisting of: objects/subjects that have certain qualities and characteristics determined by researchers to be studied and then drawn conclusions.

The relationship that exists between the research subject and the research population is that the population is the whole rather than what is the research subject. Here the author will write that oxygen is the subject of research, while oxygen levels are the population used in the study.

In addition to the subject and population, another thing that is related is the sample. Prof. Dr. Sugiyono in his book (2010:81) writes that the sample is part of the number and characteristics possessed by the population. The usefulness of the three is very necessary in collecting data for a study.

The purpose of sampling is to collect as much information as possible from various sources and construction. Thus the aim is not to focus on the differences which will later be developed into generalizations. The aim is to break down the particularities that exist into the unique concoction of contexts. The second purpose of sampling is to extract information that will form

the basis of the design and emerging theory. Therefore, in qualitative research there is no random sample, but a purposive sample.

Approach method

The approach method is a method used to explain the problems that occur by linking several concepts to find solutions to problem solving, dirty air filters, which result in defrost in the food cooling system on the ship, so that the temperature in the food cooler engine will rise and cause abnormal alarm in the food refrigeration system. Below are some of the concepts used to conduct research, including:

a. Case study

Research conducted by the author while working on the ship regarding the problems that occur in this case study will mention the problems that occur when the ship is on a voyage.

- 1) Lack of maintenance on food refrigeration support systems such as compressors
- 2) Lack of knowledge in the maintenance of the food refrigeration system on board the MV. BOGA INDAH

b. Problem solving

Some of the problems above occur according to research that has been working on ships that in every problem there must be a cause and effect that will occur. Therefore, to find solutions to problem solving must be in accordance with the facts that occurred, among others, as follows:

- 1) Replace / clean the air filter of the food cooler according to working hours.
- 2) The engineer must read the manual book on the maintenance of the food refrigeration machinery on board.
- 3) Before the company raises the driver on the ship, the experience and knowledge of the engineer must be thoroughly tested by doing job training so that they know what action to take if a problem occurs on the ship, especially in the food cooler engine to support the operation of the engine on the ship. .

c. Qualitative description

In an explanation of the problem there is a description or description of how the problem started and what causes the problem to arise. As has been made in the problem that occurs that the majority of problems

Data collection technique

Complete, objective, and accountable data and information are very necessary so that they can be processed and presented into a truly objective picture and view. In processing empirical data, the theory needed to compile this thesis can be collected properly, so the authors use data collection techniques, which include the following:

a. Observation

Method of Observation (Observation) Observation is a technique of collecting data through an observation, accompanied by notes on the state or behavior of the target object. People who make observations are called observers and those who are observed are called observers. Easily observation is often referred to as the observation method. In short, the observation method is a way of collecting data by recording carefully and systematically. Observation activities should not be seen as a job to be played by researchers. In this case

the authors carry out observations in the MV. BOGA INDAH, regarding the identification of condenser work, knowing the factors causing the decrease in the room temperature of foodstuffs, and the maintenance efforts made to normalize the temperature

b. Interview

Interview method (interview) According to Sugiyono (2009:231) Interview is used as a data collection technique, if the researcher wants to conduct a preliminary study to find problems that must be investigated. Interviews are also used to provide evidence in seeking discussion of the problem.

The main objectives of the interview are:

- a. Interviews can be used to obtain information about the object under study.
- b. Interview is one method of collecting data directly about an object.
- c. Interviews are useful for collecting data and answers that the author does not know and understand about the object of research.

In this method, the author directly asked the Head of the Engine Room and the 3rd Machinist at MV.BOGA INDAH about the identification of the work of the condenser on the decrease in the room temperature of foodstuffs, and the maintenance efforts made to return to normal.

c. Documentation study

According to Indrawan and Yaniawati (2014:139) Data collection techniques through documentation studies are defined as efforts to obtain data and information in the form of written notes or stored images relating to the problem being studied. Documents are facts and data stored in various materials in the form of documentation.

d. Literature review

According to Setiawan, 2016 that literature study is an activity to collect information that is relevant to the topic or problem that is the object of research. This information can be obtained from books, scientific works, theses, dissertations, encyclopedias, internet, and other sources. By conducting a literature study, researchers can take advantage of all the information and thoughts that are relevant to their research. In this case, the literature study carried out by the author is to collect information from interviews with ship engineers and manual books on board, books on refrigerant plant systems, scientific papers on refrigeration machines, and accredited journals.

According to Fatimah (2016: 27), SWOT analysis is a form of situation analysis by systematically identifying various factors on strengths, weaknesses, opportunities (opportunities), and threats (threats) from the environment to formulate strategies to be taken. From the meaning of SWOT, it will be explained one by one, namely:

1. Strength, which is the strength factors possessed, so that the working conditions of the condenser can be maintained in good condition in order to keep the room temperature of the food ingredients normal.
2. Weakness, namely all factors that are not beneficial or detrimental to the work of the condenser in order to maintain a normal temperature.
3. Opportunities, namely various environmental situations that can be utilized so that the room temperature of food ingredients is always normal as desired.

4. Threats, namely things that can add to weaknesses and arise from elements outside the scope of the discussed area and affect the decrease in the room temperature of food ingredients.

By looking at the factors of strength (Strengths), weaknesses (Weakness), opportunities (Opportunities) and threats (Threats) it will be seen how the solution to overcome the factors - what factors cause the decrease in the room temperature of foodstuffs.

SWOT analysis can be applied by analyzing and sorting out various things that affect the four factors, then applying them in a SWOT matrix image, where the application is how strengths are able to take advantage of existing opportunities, how to overcome weaknesses (weaknesses) that prevent the advantages (advantages) from existing opportunities (opportunities), then how the strengths (strengths) are able to face the threats (threats) that exist, and finally how to overcome the weaknesses (weaknesses) that can make the threats (threats) become real or create a new threat.

The method can be described as follows:

- a) Internal Factors: Strengths (Strengths) Weaknesses (Weaknesses)
- b) External Factors : Opportunities Threats
- c) SO Strategy: This is a situation that benefits the ship, has opportunities and strengths so that it can take advantage of existing opportunities. The strategy that must be carried out in this case is to support the policies of the ship and company.
- d) ST Strategy: In this situation the company faces various threats, but still has internal strength. The strategy that must be applied in this condition is to use strength to take advantage of long-term opportunities by means of a diversification strategy.
- e) WO Strategy: In this situation the ship faces enormous opportunities, but also faces internal constraints or weaknesses. The focus of the strategy in this situation is to minimize internal problems so as to maximize the performance of the main engine.
- f) WT Strategy: This is an unfavorable situation, so the company must face various internal threats and weaknesses.

RESULTS AND DISCUSSION

On the ship, the cooling engine is a very vital tool for its existence. With a refrigeration machine, the food you have can be stored properly. The cooling engine is one of the auxiliary aircraft that works based on the principles of thermodynamics and heat transfer.

In the refrigeration cycle there is a process of compression, expansion and absorption of heat. The compression process occurs when Freon is compressed by the compressor. The expansion process occurs when the expansion valve ejects Freon to be evaporated in the evaporator and also occurs in the compressor suction stroke. The heat absorption process occurs in the condensation process in the condenser and evaporation in the evaporator. By combining several of these processes in one system, it can be used as a cooling device. From the above process, the evaporation process in the evaporator is used for cooling a room. When Freon in the evaporator evaporates, it absorbs heat around the evaporator capillary tube, so the area around the evaporator becomes cooler. Because the evaporation process in the evaporator

occurs continuously and very quickly, the conditions around the evaporator become colder. With the presence of a blower that is installed near the evaporator, the cold air is blown throughout the cooling room so that the cooler room becomes colder.

In field operations, the cooling machine on board does not always work optimally. If this happens continuously, it will be very detrimental to all crew members and the company. The less than optimal working of the cooling machine is influenced by many factors, both internal factors such as the number of working hours of the machine, wear and tear and also changes in the material structure. For external factors, this is closely related to the skills of the machinist in caring for and overcoming every disturbance and damage that occurs.

When the author did practice for one year aboard the MV. BOGA INDAH. the author found something odd related to the maintenance of the cooling machine. The author found this problem when he did his duty as an assistant to the second machinist, namely the senior machinist on the writer's ship. When doing the watch, the alarm suddenly sounded, it turned out to be an alarm from the cooling machine, after the author checked the cooling machine accompanied by a watch oiler as an assistant from the watch engineer, we found that the cooling machine was stopped, and the author observed that the temperature was still showing reasonable limit is to cool vegetables 6°C and meat coolers -15°C this the author reports to the machinist on duty, then he did a reset on one of the buttons on the cooling panel and finally the cooler was running normally again. This happened repeatedly as long as the author followed the ship's practice, but the first engineer just reset the engine cooler without investigating the cause of the alarm on the engine cooler. Until the peak that occurred, namely on July 11, 2019 there was damage to the cooling machine, the cooling machine could no longer function normally even though it had been reset many times, until finally KKM ordered the second engineer to check the cooling machine and it was found that the condition of the cooler was damaged and its condition not very good.

Unstable temperature in the food storage room

The existence of a leak in the Freon circulation system in the food refrigeration machine installation system results in an unstable temperature in the food refrigeration room and threatens to spoil or reduce the quality of the food ingredients in the food refrigeration room, so the engineer is responsible for this food refrigeration machine. checking especially matters relating to the installation of food refrigeration machines.

Freon is a very important medium in the engine cooling system. With the Freon the heat transfer process can take place. Basically, Freon in its nature system is eternal. Because Freon is only circulated from low pressure to high pressure and so on. To support the smooth operation of the cooling machine and the maximum cooling temperature can be achieved, the amount of Freon that exists must also have sufficient cooling capacity. However, along with continuous operation, sometimes the amount of Freon in the system can be reduced. Reduction of Freon from the system occurs due to a leak.

Indications of Freon Leakage:

- 1) The occurrence of a decrease in the level of Freon in the guess glass.

- 2) Compressor outlet pressure is very low.
- 3) Compressor suction pressure is too high (Can't reach the vacuum)
- 4) Hot refrigeration room temperature
- 5) Compressor operates continuously (can't turn off automatically)
- 6) Compressor amperage drops, because the load drops due to the lack of Freon present in the system.

Leaks at low pressure are leaks that occur in the area after the expansion valve, the evaporator to the suction side of the compressor. The area of low pressure is in the pressure range of 1.2 kg/cm² to 0.2 kg/cm². If the suction pressure from the compressor has reached below 1 atm (1 kg/cm²), then this will cause air to be able to enter the Freon system. In the operation of the refrigeration machine, one of the conditions if the cooling in the cooling room is to be optimal, there is no air entering the system. Because air cannot be compressed, it will cause air bubbles to form in the capillary tube. In addition, if the air is pressed at high pressure and then participates in the condensation process it will cause water to occur.

Leakage in the High Pressure Area is where the pressure is between 8 kg/cm² to 19 kg/cm². This area starts from the compression side of the compressor, condenser to the expansion valve. If a leak occurs in this area, it will cause the Freon to run out. Because the Freon pressure from the leak is greater than the atmospheric pressure which is only 1 kg/cm². If this continues to happen it will cause the Freon in the system to run out.

Perform soldering and replacement on leaky nipple joints

- a. Unstable temperature in the food storage room can occur if there is a leak in the Freon circulation system, leakage in the Freon circulation should not occur because this will cause a decrease in the performance of the refrigeration machine and will cause waste in the use of Freon and unstable temperature in the food cooling system.

To overcome this, it can be done by disassembling the leaky nipple and connection and then soldering the leaking pipe parts.

Advantages:

- 1) By replacing the leaking nipples and soldering the leaking pipes, this will save maintenance costs, because doing this doesn't have to be expensive.
- 2) Leaks can be immediately resolved because by using this technique the time required is not much, because the process is very easy and efficient.

Weaknesses:

- 1) Cannot be repaired if there is damage or leakage that occurs is quite extensive
- 2) It takes time to find the points of leakage.

- b. The occurrence of leaks in the Freon circulation system can also be overcome by replacing all the leaking pipes thereby providing certainty that no pipes from the Freon system will leak because all parts of the pipes have been replaced by using pipes. the new one.

Advantages:

- 1) By replacing all the pipes with new ones, you can be sure that there will be no more Freon leaks.
- 2) It doesn't take much time to find the points of leakage.

Weaknesses:

- 1) It costs more extra because it requires a lot of new pipes to replace the old pipes.
- 2) It cannot be carried out if the ship is on a long voyage, because the cooling engine must be off for quite a long time.

The occurrence of thickening of the ice flower on the evaporator pipes

The occurrence of thickening or lumps of ice flowers on the surface of the evaporator pipes is the most common problem in the work of the evaporator. This will appear if the pipe surface temperature is lower than 00C (freezing point temperature of water).

On this occasion the Chief Engineer MV. BOGA INDAH stated that the thickening of the ice flower on the evaporator pipes was due to the frequent opening of the refrigerator door for a long time where the outside air whose temperature was higher than the temperature inside the food ingredients cooler was free to enter the food ingredients cooler.

The thickening of the frost was immediately followed up by the machinist in charge of this food refrigeration machine by defrosting the frost adhering to the evaporator pipes after receiving direct orders from the chief engineer.

On board the MV. BOGA INDAH the food ingredients cooler room consists of a meat room, vegetable room, waiting room or lobby. Freon in the evaporator changes its state from liquid to gas by taking the heat around it, so that the food ingredients cooling room is equipped with a fan motor so that there is a strong and even circulation of cold air to all parts of the food ingredients cooler. The hot air in the food cooler room is sucked in by the fan motor and then flowed by the evaporator. The air becomes cooler by the fan motor, the air is pushed back into the entire room where the food is stored where the air is pushed through the evaporator. In the food refrigerator, the outside air entering into must not be excessive or must be limited entry. If the outside air is too much, the entry of air containing water vapor contained in the outside air will condense and form layers of ice on the walls, especially on the evaporation pipes of the evaporator. As it is known that it contains water vapor when the air is cold to 00C then the water vapor it contains will melt and form layers of ice flowers. This layer of ice is a barrier to heat propagation, so that the heat in the food refrigeration chamber cannot be completely absorbed by the freon. The air entering the food cooler causes the temperature in the refrigerator to rise or become hot. If the ice thickness in the evaporator is above 2.5 mm, it will interfere with the cooling process in the food cooler so that the desired temperature is not reached. As for the signs of the evaporator in the food stuffs refrigeration room that there has been a thick layer of frost, the compressor is running continuously but the cold temperature is not reached, and it is checked directly on the evaporator and will be seen if there is thickening of the frost.

From the explanation above, it is found that the cause of the emergence of layers of ice in the evaporator pipes is air, both air circulating in the cooling room and air from outside entering the food cooling room (gand room).

The onboard cooling machine, especially the food cooling machine, is one of the most important equipment and plays a very important role in the smooth operation of a ship.

The role of the food cooling machine plays a very important role because all crew on board need food ingredients during the voyage to obtain energy that will be used in carrying out various activities on board.

All crew on board the ship need food during the voyage to obtain energy that will be used to carry out various activities on board. If the food cooler engine is damaged, it will disrupt the food needs of all crew members on board so that it interferes with the activities of all crew members in carrying out their daily activities which will eventually cause huge losses to the company, namely the ship will experience delays to arrive at the port of destination so that there can be complaints from the charterer, the company will incur a lot of extra costs for repairs, as well as extra costs for replacing new food ingredients. And for the crew themselves, they experience losses that can be obtained, namely by consuming food that is not fit to eat and will result in a decline in their health so that the daily activities of the crew on board the ship also decrease. Therefore, from the installation of the food refrigeration machine on board the ship must be given the best possible care in accordance with the manual instructions on a regular basis to anticipate and overcome the occurrence of disturbances in the food refrigeration machine on board which must be given the best possible care in accordance with manual instructions on a regular basis to anticipate the occurrence of disturbances in the food cooling machine while on the cruise.

Defrosting the food storage room

a. Turning off the system and opening the door to let outside air flow into the food cooler is one example of melting the ice that sticks to the evaporator pipes.

Pros:

- 1) Does not use a lot of electricity to do defrosting
- 2) It's easier to do, and can be done by every crew on board with the permission of the chief engineer

Disadvantages:

- 1) However, this method will take a long time which will result in the temperature inside the food cooler being almost the same as the air outside the food cooler.
- 2) foodstuffs will experience an increase in temperature because the door is always open

b. Through electric heating (heater) which is applied to the evaporator pipes, it can melt the ice that has accumulated on the evaporator pipes.

Advantages:

- 1) This method is very good because the process of melting the ice flower lumps in the evaporator pipes is very fast and practical,
- 2) This method does not require a long time compared to the way to just open the door of the food cooler using an auxiliary blower and let the outside air freely enter the food cooler.

Disadvantages:

- 1) Uses a lot of electricity to operate an electric heater (heater) compared to opening a food storage door

- 2) The process of operating the electric heater cannot be carried out by every crew on board, the operation must be supervised by the engineer on board the ship.

CONCLUSION

The conclusion of the research and discussion of the problems that have been described in the previous chapter is that there is a leak in the Freon circulation installation which results in unstable temperature in the food refrigeration room, thickening of the ice flower in the evaporator pipes, is the lack of care and attention to the installation of this air conditioning machine. by the crew themselves. Conclusions are obtained and arranged systematically according to the sequence of problems encountered during maintenance and repairs as well as when looking for causes of lack of care.

The temperature in the food storage room is unstable

The unstable temperature in the food storage room is caused by a leak in the Freon circulation system due to lack of maintenance on the Freon circulation installation in the food cooling room system, which can make the performance of the food cooler machine decrease.

Occurrence of frost buildup on the evaporator pipes

The buildup of frost on the evaporator coil is caused by not carrying out the procedures or procedures for entering the food ingredients cooler properly and not checking the tightness of the refrigerator door where outside air freely enters the food ingredients cooler.

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