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PREVENTIVE EFFORTS IN MAINTENANCE OF PROVISION PLANT REFRIGERATOR COMPONENTS TO MAINTAIN DURABILITY AND QUALITY OF FOOD INGREDIENTS IN LNG/C ENERGY FRONTIER

Firhan Arya Gani[1)], Jarot Delta Susanto[2)], Ir. Boedojo Wiwoho [3)]

Jl. Marunda Makmur No. 1 Cilincing, North Jakarta. Jakarta 14150

[*]Corresponding email: aryaganifirhan@gmail.com

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Abstract

The Quality and preservation of food supplies on board a vessel heavily depend on the performance of the refrigeration system, know as the refrigerator provision plant. This system functions to mantain proper storage temperatures,particulary for perishable animal- and plant based food items. This study aims to identify and analyze components to address issues such as unstable temperatures, frost buildup on evaporator pipes, and low suction pressure in the compressor. The research is based on practical experience aboard the LNG/C Energy Frontier, where problems such as coil pipe leakage and abnormal compressor shutdown due to low suction pressure were encountered. The findings are expected to contribute both theoretically and practically to the maintenance of ship refrigeration systems, thereby ensuring food quality and supporting crew welfare

Keywords : ***evaporator coil leakage, food preservation, preventive maintenance, refrigerator provision plant, suction pressure.***

1. INTRODUCTION

Indonesia as a maritime country has a high dependence on logistics and distribution systems at sea, including meeting the basic needs of ship crews such as food. On a voyage that lasts for weeks, the durability and quality of food becomes a vital aspect that affects the health and productivity of the crew. For this reason, the use of a cooling system such as the Refrigerator Provision Plant is the main solution in maintaining food storage temperatures that remain stable and according to standards. This system is designed to maintain the freshness of food, especially animal and plant foods that have limited shelf life.

However, the operation of the cooling system on board the ship does not always run without problems. Based on practical maritime experience aboard the LNG/C Energy Frontier, several technical problems were found, such as unstable cooling room temperatures, the formation of ice on the evaporator pipe, and the compressor suction pressure dropping drastically due to leaks in the capillary pipe. This problem has the potential to reduce the quality of food ingredients and can impact the overall welfare of the ship's crew. Therefore, preventive maintenance of the main components of the cooling system is crucial so that engine functionality remains optimal throughout the voyage.

This research aims to identify and analyze preventive steps in maintaining the Refrigerator Provision Plant, with a focus on preventing damage to components such as the evaporator coil and compressor. The approach used is descriptive qualitative based on direct observation, technical documentation, and interviews with the ship's technical crew. It is hoped that the research results can make a practical contribution to the operation of refrigeration machines in the shipping industry, as well as enrich maritime engineering studies in the context of maintenance of auxiliary equipment on board ships.

a. Preventive

According to the Big Indonesian Dictionary, "preventive" is an adjective which means preventing or preventative action. is an action to prevent undesirable things from happening.

b. Food Science

According to Yosfi (2020:4) Food science is basic science and engineering that studies the properties of food ingredients such as chemical, biochemical and physical properties. Food Science also has information that studies selection, preservation, management, packaging and distribution which affect consumption safety and nutritional value.

c. Cooling Process and Cooling Machines

According to Widayat and Rukmana (2019), the cooling process is an application of thermodynamic principles. Dewi and Fauziah (2020) emphasize that cooling machines work on the basic principle of heat transfer, namely absorbing heat from the space to be cooled and releasing it to the outside environment through circulating refrigerant.

d. Basic Theory of Corrosion

According to Ar Hakim (2012), rubber paint is damaged due to sunlight or exposure to chemicals, melting of steel-making furnace linings, attack of solid metal by liquid metal. In addition, according to Sedriks, et al. (2017), he believes that corrosion cannot be prevented but there are ways to reduce the risk of corrosion.

e. Compressor

The compressor's job is to suck in and press the cooling agent so that the coolant circulates inside the cooling machine unit. Meanwhile, the drive motor is responsible for rotating the compressor (Kurniawan, 2019).

f. Condenser

According to Whitman et al (2005), the condenser is the main component in the

cooling system which functions to release heat from the refrigerant so that the refrigerant can change from gas to liquid.

g. Maintenance and Repair Management

According to Wong (2015:22) maintenance management is an activity that includes planning, implementing and supervising maintenance activities to ensure that facilities and equipment remain functioning properly.

2. METHOD

This research focuses on preventive efforts in maintaining the Refrigerator Provision Plant components to maintain the durability and quality of food on board the Energy Frontier LNG/C ship, to analyze the extent of the influence of preventive maintenance on the performance of the cooling system in keeping the storage room temperature stable. The research was carried out using a qualitative descriptive approach based on observation data, technical documentation, and direct interviews with the ship's technical crew during the voyage.

2.1. Approach Method

The approach method used in this research is the qualitative research method.

2.2. Data collection technique

Data methods used by the author in the research:

a. Observation
b. Interview
c. Documentation

2.3. Population, Sample and Sampling Techniques

The population in this study are components of the Provision Refrigeration Plant, which is an auxiliary machine consisting of various machine components to maintain the durability and quality of food ingredients. The samples used in the research were leaks in the capillary pipe and low suction pressure in the compressor. The technique used by the author is Purposive Sampling Technique.

2.4. Data Analysis Techniques

Data was collected through observation, documentation and interview methods. Interviews were conducted with engineer III and the technical crew of the LNG/C Energy Frontier ship to obtain information regarding technical problems with the Refrigerator Provision Plant system, especially on the evaporator coil and compressor suction pressure. The data obtained was then analyzed descriptively qualitatively using a fishbone analysis approach to describe the causes and impacts of component damage on reducing cooling efficiency and the quality of food on board the ship.

3. RESULTS AND DISCUSSION

Results

This research found that damage to the Refrigerator Provision Plant components, especially the evaporator coil and compressor suction pressure, had a significant influence on reducing the performance of the cooling system on the Energy Frontier LNG/C ship. Based on the results of observations and interviews, it was discovered that the temperature of the food storage room did not reach the specified standards due to the formation of frost and leaks in the capillary pipe. Analysis using a fishbone diagram shows that the main causal factors come from a lubrication system that is not optimal, refrigerant leaks, and a lack of regular maintenance on engine components.

These findings confirm that consistent preventive maintenance determines the effectiveness of the cooling system in maintaining ideal storage temperatures for food ingredients. Respondents, in this case the ship's technical crew, generally gave a positive assessment of the function of the cooling machine when routine maintenance was carried out according to the procedure manual book. However, they also noted limitations in early detection of refrigerant leaks and the

need for further training regarding defrosting procedures and replacement of critical components.

The results of this research show the importance of implementing a planned maintenance system based on standard operating procedures (SOP) to optimize the performance of cooling machines on board ships. With the support of routine monitoring, increasing the technical competence of the engine crew, as well as accurate documentation of damage, it is hoped that the quality of food ingredients can be maintained optimally during the voyage. This research can be a reference in the technical management of ship cooling systems as well as strengthening welfare and food safety aspects for crew while on duty.

Discussion

This research shows that damage to the Refrigerator Provision Plant components, especially the evaporator coil and compressor suction pressure, significantly affects the cooling effectiveness and durability of food on board Energy Frontier's LNG/C vessels. These findings emphasize the importance of the technical readiness of the cooling system and the quality of maintenance implementation in supporting the smooth operation of the ship. Indicators such as the stability of the refrigeration room temperature, compressor performance and the success of the defrosting process receive primary attention because they contribute directly to the suitability of food consumption during the voyage.

However, several aspects such as early detection of refrigerant leaks and the effectiveness of regular maintenance still show weaknesses that have an impact on optimizing the cooling system. This indicates that maintenance efforts do not just depend on the availability of components and tools, but also require strengthening daily inspection procedures, damage reporting, and coordination between machine operators and technical officers. Human resource aspects, such as the technical skills of the engine crew and understanding of the manual, are key factors in supporting overall cooling system performance.

The implications of these findings indicate that Refrigerator Provision Plant maintenance must be carried out comprehensively, by strengthening the synergy between spare parts availability, increasing the technical competence of human resources, and implementing a disciplined monitoring system. Cooling system management does not only rely on machine capabilities, but also on human accuracy and the accuracy of work procedures. In this way, the effectiveness of the cooling system on board the ship can continue to be improved in maintaining the quality of food ingredients and supporting the welfare of the crew during sailing.

3.1. Alternative Problem Solving

To overcome the problem of unstable refrigeration room temperatures and low suction pressure on the compressor, one alternative solution to the problem that can be implemented is implementing a strict and regular preventive maintenance schedule. This procedure includes a visual inspection of all refrigerant pipelines, checking compressor working pressure, cleaning evaporator components, and testing the leak detection system. With regularly scheduled maintenance, potential problems such as capillary tube leaks and the formation of ice on the evaporator can be minimized before they cause more serious damage.

In addition, it is necessary to implement a well-documented technical recording system so that any damage findings and corrective actions can be traced and analyzed historically. This approach allows engine crews to make technical decisions based on previous data, rather than just momentary experience. On the other hand, continuous training of technical crews is also an important step, especially in terms of handling refrigerants and using appropriate leak detection equipment. By increasing personnel competency and strengthening a structured maintenance system, the effectiveness of the

cooling system can be optimally maintained in supporting food durability during long voyages.

If possible, the provision of auxiliary equipment such as a refrigerant leak detector, defrost timer, as well as capillary pipe and cooling oil reserves is also recommended to ensure readiness to face emergency conditions. These measures not only prevent further damage, but also maintain the safety of the crew and support overall operational efficiency on board the ship.

3.2. Problem Solving

Solving problems with cooling system damage, especially leaks in the evaporator coil and low suction pressure in the compressor, is carried out through the implementation of comprehensive preventive maintenance measures. One of the main steps is replacing damaged capillary tubes and evaporator components according to the specifications in the instruction manual book. This process is accompanied by draining (pump down system) and refilling the appropriate refrigerant, to ensure the system working pressure returns to normal. Applying the correct defrosting method is also carried out to overcome frost which hinders the circulation of cold air in the cooling room.

In addition to technical measures, the solution is also focused on optimizing daily inspection procedures as well as documentation of cooling system conditions. The person responsible for the machine regularly records the storage room temperature, working pressure and physical condition of the components, which is useful for detecting signs of damage early. In addition, internal training for technical crews is carried out so that they are able to identify and handle operational abnormalities quickly and accurately. With an integrated approach between technical measures, documentation and strengthening personnel competency, the refrigeration system can function optimally and support the availability of quality food during the voyage.

4. CONCLUSION

This research concludes that preventive efforts in maintaining the Refrigerator Provision Plant components have a significant influence on the effectiveness of the cooling system in maintaining the durability and quality of food on board the Energy Frontier LNG/C ship. Based on findings in the field, preventive actions such as replacing capillary pipes, refilling refrigerant, and implementing defrosting methods have proven to play an important role in stabilizing the temperature of the cooling room and optimizing compressor work. Timely maintenance, supported by operational procedures according to the manual, is the main factor in maintaining optimal cooling system performance during shipping.

Although in general the cooling system can function well after maintenance, several technical problems are still found such as delays in detecting refrigerant leaks and repeated suction pressure mismatches. This shows that maintenance effectiveness depends not only on component replacement, but also on the crew's technical skills and a structured and disciplined engine condition monitoring system. Limited understanding of measuring instruments and lack of maintenance documentation are also challenges that need to be overcome.

Therefore, strategies for improving cooling system performance need to be directed not only at equipment maintenance, but also at strengthening the crew's technical competence, implementing a routine inspection system, as well as providing supporting equipment such as leak detectors and automatic pressure indicators. In this way, the cooling system can function consistently, support the storage of food that is fit for consumption, and ultimately improve the welfare of the ship's crew in the long term.

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