



Unreachable Temperature in the Food Storage Room at MV. Pan Flower

Andy Wahyu Hermanto¹, Pritha Kurniasih¹, Tommy Wicahyo Setiawan¹

¹Politeknik Ilmu Pelayaran Semarang, Indonesia

Received: Aug 15, 2023

Revised: Sept 10, 2023

Accepted: Sept 25, 2023

Online: Sept 30, 2023

Abstract

Refrigerator machines on board have an essential role in the process of storing foodstuffs so they last. The availability of fresh foodstuffs and the crew's comfort are essential on long voyages. Therefore, it is vital to check the condition of the components in the refrigerator engine. Thus, this study aimed to determine the factors, impacts, and efforts that need to be taken when there is an increase in the food storage space on board. The research method used in this study is qualitative, with the SHELL analysis method. The data sources for this study came from observations, literature studies, and interviews, while the researchers carried out sea practice from 10 June 2021 to 11 June 2022 on the MV. Pan Flower. The results showed that several factors were causing the rise in temperature in the food storage room, including non-compliance in carrying out the Plan Maintenance System, damage to the expansion valve components, dust-contaminated refrigerant cycles, too much dirt in the condenser, and a lack of communication between the crew. The impact of this damage is the disruption of refrigerator performance, the evaporator performance is not optimal, the temperature rises, the condenser performance is not optimal, and the occurrence of overtime to deal with the problem. Efforts are made to prevent such damage by maintaining according to the Plan Maintenance System, spraying the evaporator side, cleaning the condenser, checking the dryer filter, and always carrying out toolbox meetings. Thus, the operation of the cooling machine can be carried out correctly and reduce the risk of incidents that could endanger the ship and crew.

Keywords *expansion valve, refrigerator machine, qualitative method, SHELL analysis technique*

INTRODUCTION

The ship is a place to live for all crew members. The company has ensured that all the necessities of daily life while on the ship are met. As long as the sea work agreement lasts, the company is responsible for the fitness and health of all crew members. One factor affecting their health and fitness condition is the availability of suitable and nutritious food as a source of nutrition. The availability of food ingredients on board must be guaranteed in the storage process so that the quality of the food is always well maintained. Food ingredients on board consist of wet ingredients and dry ingredients. Wet materials refer to materials that have a higher water content and have not undergone a heating process. Meanwhile, dry matter is material that does not contain water. In the maritime environment, foodstuffs are stored in unique rooms equipped with auxiliary devices such as cooling machines to maintain quality.

A refrigeration engine is an auxiliary machinery designed to take heat from a cold source and do as

Copyright Holder:

© Andy, Pritha, Tommy (2023)

Corresponding author's email: tjahjono.a@gmail.com; pritha@pip-semarang.ac.id; setiawantommy48@gmail.com

This Article is Licensed Under:



little work as possible. The evaporator is one of the main components that have an essential role in the performance of the refrigeration machine. Its primary role is to take heat from inside the room. By entering the refrigerant and utilizing the help of a fan to circulate air, heat exchange in the evaporator can be increased, thereby increasing the efficiency of its performance. The more efficient heat exchange occurs, the better the evaporator performance. In addition, this can also reduce the work demands on the compressor (Yusal, 2017).

Ships can sail long distances and for a long time. Food supplies of good quality and in sufficient quantities for the crew became very important in the voyage. In every voyage, the availability of food and the welfare of the ship's crew has a significant role. Researchers consider the cooling machine important in maintaining the freshness of food ingredients and creating comfort for the ship's crew. To meet the needs of food ingredients during shipping, it is essential to maintain their quality during storage, so tools are needed to support this. Every ship must be equipped with a cooling machine that meets operational standards. Food ingredients such as vegetables and fruit must be kept fresh without wilting or shrinking, and the taste must be maintained. Meanwhile, meat and fish that are still suitable for consumption must remain in a condition that is not mushy, does not rot, and can freeze when stored. Refrigerator machines must meet the storage temperature of meat and fish between -14°C to -17°C for vegetables and fruit, namely 4°C .

The cooling machine requires good maintenance to reach the desired temperature. The treatment involves the main and supporting components, including the compressor, condenser, oil separator, filter dryer, expansion valve, evaporator, refrigerant line system, and electrical control system. These parts must be maintained according to the Plan Maintenance System (PMS). In addition, engineers must visually pay attention to the condition of the refrigerator engine every shift. If they find something abnormal, take action immediately to prevent severe damage. If there is damage, it will be detrimental to the crew and the company. While the researchers carried out sailing for one year plus one day from 10 June 2021 to 11 June 2022, the ship experienced various engine problems ranging from minor to severe damage. In the end, the researcher got experience and learned when the refrigerator engine experienced a problem that did not reach the temperature in the food storage room.

Based on an incident researchers experienced in October 2021 while sailing from Seattle, America, to Zhousan, China, the chef complained about the poor quality of the ingredients after being stored in the storage cupboard. To ensure everything is in a safe condition, the third engineer checks the temperature on the refrigerator engine panel. There is a high temperature in each food storage cabinet, and what is checking the volume of refrigerant in the system, spraying icing on the evaporator, cleaning the condenser, to replacing the filter dryer. Based on this background, the researcher chose "Unreachable Temperature in the Food Storage Room at MV. Pan Flower."

This study aims to determine the cause of the temperature rise in the food storage room and the impact of the temperature increase, as well as determine strategies to prevent temperature rise in the storage room.

LITERATURE REVIEW

Refrigeration is a method used to keep product temperatures lower than ambient temperature. Temperature is achieved by transferring heat from the product that has been produced to the surrounding environment (Ziliwu, 2020). The refrigerator machine consists of primary and additional components that maintain the quality of food ingredients in the Refrigerated Chamber.

Some components are the compressor, condenser, evaporator, dryer, expansion valve, oil separator, and solenoid valve. In addition, there are several control devices, such as high/low-pressure switches, water failure switches, safety valves, and temperature control switches which function to regulate the overall performance of the refrigerator system.

Maintenance is a series of actions taken to maintain and care for a machine and make repairs to reach a condition that functions appropriately. The higher the machine hours in a production system, the more significant the maintenance management role in the system (Hamim Rachman, et al 2017).

Storage of food ingredients aims to regulate and maintain the condition of food ingredients so they do not spoil quickly. After the food ingredients that meet the standards are received, they will be immediately stored in a warehouse or cold room. To avoid spoilage caused by microorganisms, foodstuffs need to be stored in locations according to their type classification.

S.No.	Type of storage	Foods to be stored	Temperature	Characteristics of storage place
1	Dry storage	Cereals, canned foods, flour, sugar, shortenings, spices, certain fruits and vegetables like bananas, onions and potatoes.	21°C	<ul style="list-style-type: none"> • Should be clean • Adequate ventilation with sufficient air circulation • Low humidity
2	Refrigerator storage	Fresh, cooked or partially cooked foods (milk, meat, vegetables)	0-7°C	<ul style="list-style-type: none"> • Regular cleaning of condenser coil should be done • Do not open the door frequently
3	Frozen storage	Meat, Ice cream, Butter, Cheese, Milk	-18°C	<ul style="list-style-type: none"> • Accumulation of ice should be cleared frequently • Proper air circulation is preferable.

Figure 1. Food storage classification

This research framework aims to develop research contexts and concepts to clarify aspects such as the research context, the methodology used, and the use of theory.

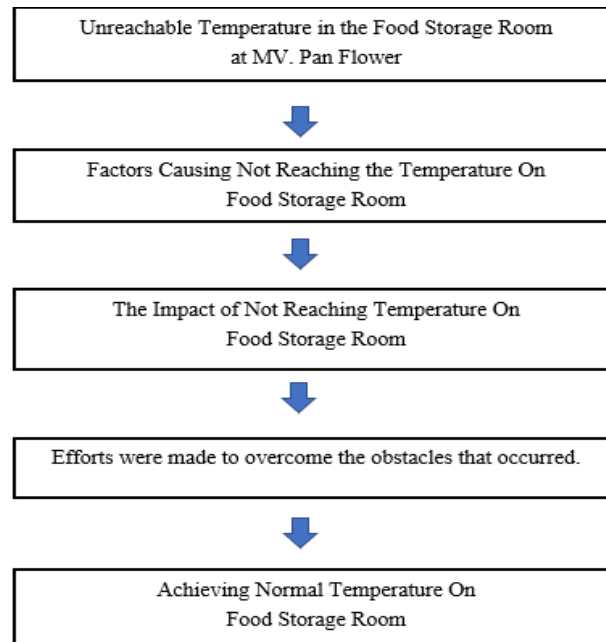


Figure 2. Research framework

METHODOLOGY

Research Method

This research was conducted during sea practice on the MV. Pan Flower from 10 June 2021 to 11 June 2022. This ship is managed by the company PT. Jasindo Duta Segara. Sources of data obtained in this study are primary data and secondary data. Primary data was obtained from interviews and direct observation of the research object. In comparison, the secondary data was obtained from the log book and the cooling machine instruction book manual.

The methods used to collect data in this study are observation, interviews, documentation, and literature study. Observations were made about the refrigerator engine experiencing an abnormal condition, increasing temperature. The interview was conducted with the chief engineer and third engineer at MV. Pan Flower. The documentation is obtained from the results of the work, as well as the literature study is carried out regarding the refrigeration machine manual book so that theory can be connected to the problem.

In qualitative research, the data collection tools are human informants (researchers themselves), and non-human tools (questionnaires, observation guidelines, interview guidelines, and literature study guidelines and documentation guidelines) can be used, but their function is limited. The data analysis technique used in the preparation of this research is the Software, Hardware, Environment, and Liveware (SHEL) method. In qualitative research, testing data validity includes various aspects, such as credibility, transferability, dependability, and confirmability. Through testing the validity of this data, data in qualitative research can be accounted for as part of valid scientific research.

FINDINGS AND DISCUSSION

Researchers made observations of the object of observation, namely the AC refrigerator on the MV ship. Pan Flower. The cooling machine cycle has several stages, including compression, expansion, and heat absorption. The compression stage occurs when the compressor compresses the refrigerant. The expansion stage occurs when the expansion valve circulates refrigerant in the evaporator and during the compressor suction step. The heat absorption stage occurs during the condensation process in the condenser and evaporation in the evaporator. When all these stages are combined in one system, it produces a cooling process.

The problem of needing the optimal performance of the refrigerator engine, which increases the

temperature in the food storage room, can cause losses. Researchers used these constraints to formulate the problem of the problem under study regarding the causes of the rise in the temperature of the cold room so that the room does not reach average temperatures for cooling food ingredients.



Figure 3. The cold room temperature panel has increased in temperature

Factors that cause a temperature rise in refrigerated food storage rooms are discussed using the SHEL analysis approach, which includes software, hardware, environment, and liveware components and is supported by interviews with the chief engineer & third engineer (interview attachment) and a literature study.

The factors causing not achieving the temperature in the food storage room are as follows: a). Implementation of irregular maintenance schedules, b). Running hours of cooling machines are not suitable, c). Impaired expansion valve performance, d). The emergence of frost on the evaporator, e). Accumulation of dust on the filter dryer, f). Dirt and mud in sea water entering the ship's sea chest can cause blockages and interfere with the condensation process, g). Cooperation or communication is one of the causal factors in this problem. When the ship's crew can communicate well, they can solve work problems efficiently.

RUNNING HOURS REF. PROVISION MACH.					
BULAN 2020	R/P No.1	TOTAL	R/P No.2	TOTAL	
SEPTEMBER	209,2	209,2	150,4	209,2	
OKTOBER	150,8	237,3	207,8	375,8	
NOVEMBER	211,4	450,8	X	NIL	
DECEMBER	450,5	720,4	X	NIL	

Figure 3 Running Hours Ref. Provision Mach.



Figure 4 Dirt and shells in condenser



Figure 5 Evaporator is blocked by ice

The impact of the factors causing the temperature not to be reached in the food storage room are as follows: a). The work done needs to be measurable and planned. When work is not properly planned, there is a risk of delay in completing tasks or projects, b). Component wears on each component of the refrigerator engine. Each refrigerator engine has a maximum limit recommended by the manufacturer, c). The performance of the refrigerator engine is disrupted due to the non-maximum performance of the refrigerator engine components, d). The formation of a layer of ice on the evaporator can block the flow of air that should pass through the evaporator. This layer of ice forms when condensed water vapor in the air condenses on the cold surface of the evaporator, e). Blockages in the condenser pipes hurt the condensation process, f). The performance of the filter dryer is not optimal, g). Lack of coordination in carrying out work orders can make alignment between crews in achieving common goals easier.



Figure 6 Exp. valve is blocked by ice



Figure 7 Dirty dryer filters

The efforts against the factor of not achieving the temperature in the food storage room are as follows: a). Carry out the Plan Maintenance System (PMS) regularly and plan. In addition, record inspection, maintenance, and repair activities and the results of work performed, b). Check the dryer filter, refrigerant line pipe, and ensure no ice crust or dirt is blocking the flow, c). The problem of cleanliness in a dirty cooler room can be solved by cleaning it when the refrigerator is turned off, d). Regularly evaluate team performance and identify areas where teamwork can be improved.

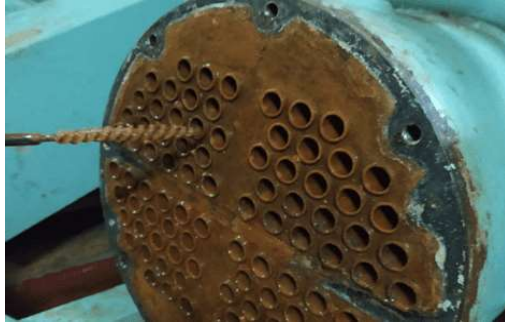


Figure 8 Cleaning condensor side



Figure 9 Renew filter dryer



Figure 10 Cleaning evaporator side



Figure 11 Toolbox meeting

CONCLUSION AND FURTHER RESEARCH

Based on data analysis using the SHELL technique, as well as the discussion in the previous chapter, the researcher can conclude the formulation of the problem from not achieving temperature in the food storage room, the impact of causal factors, and the influence of efforts to maintain food cooling machines in MV. Pan Flower, as follows: a). The causes of not achieving the temperature in the food storage room are the accumulation of ice flowers attached in large quantities to the evaporator and the condition of the expansion valve, which has been damaged due to exceeding working hours, b). The impact caused by the factor of not achieving the temperature in the food storage room is increasing the temperature in the refrigerated chamber so that the food material's shelf life does not last long and will result in losses for the company, c). Efforts to overcome these causative factors are to manually defrost all components that have accumulated ice, especially on the evaporator, and then to overcome the cause of not reaching the temperature in the storage room is to replacing new parts so that the refrigerant circulation process with the evaporator can run normally.

REFERENCES

- Appandi, I. (2020). *Mengenal Buku Panduan*. Diakses Pada 15 Mei 2023, dari <https://www.kompasiana.com/idrisapandi/5f930415d541df356c63f602/mengenal-buku-panduan-pedoman>
- Burhanuddin, A. (2013). *Landasan Teori, Kerangka Teori, Kerangka Pikir dan Hipotesis Dalam Metode Penelitian*. Diakses Pada 4 Mei 2023, dari <https://afidburhanuddin.wordpress.com/2013/05/21/landasan-teori-kerangka-pikir-dan-hipotesis-dalam-metode-penelitian/>
- Faputri, A.F. (2016). *Desain Evaporator dan Pengujian Kondisi Operasi Optimal Pada Desain Peralatan*. Jurnal Teknik Patra Akademika Vol. 7 No. 2. Diakses Pada 17 Mei 2023, dari <https://www.jurnal.pap.ac.id/index.php/JTPA/article/view/15/11>
- Febriyan, R., Cahyono, B.D. (2023). *Pemeliharaan Pada Mesin Moulding Unimat 22 A di PT. Sejin Lestari Furniture*. Jurnal Teknik Mesin, Industri, Elektro dan Informatika Vol. 2 No. 1. Diakses Pada 20 Mei 2023, dari <https://ejurnal.politeknikpratama.ac.id/index.php/jtmei/article/view/1521/1505>
- Firdausa, AS. (2022). *Pengertian Sistem Kontrol, Jenis dan Contohnya*. Diakses Pada 4 Mei 2023, dari

- <https://www.kompas.com/skola/read/2022/06/27/150000669/pengertian-sistem-kontrol-jenis-dan-contohnya>.
- Ghani, Muhammad, A. (2022). *Pengaruh Perawatan Mesin Pendingin Dalam Menunjang Performa dan Kesegaran Bahan Makanan di MV. Intan Baruna*. Skripsi. Semarang: Politeknik Ilmu Pelayaran.
- Hapsari, A.P. (2016). *Perbedaan Komunikasi Interpersonal Antara Mahasiswa Etnis Jawa Dengan Mahasiswa Etnis Tionghoa di Unika Soegijapranata Semarang*. Unika Repository. Diakses Pada 14 Mei 2023, dari <http://repository.unika.ac.id>
- Harjuansyah, Y. (2017). *Analisis Penyebab Turunnya Temperatur Pada Ruang Pendingin Makanan di MT. Bauhinia*. Jurnal Dinamika Bahari Vol. 7 No. 2. Diakses Pada 20 Mei 2023, dari <https://ejournal.pip-semarang.ac.id/index.php/jdb/article/view/53/19>
- Haryadi, S. (2020). *Analisa Pengaruh Pemeliharaan Terhadap Kinerja Sistem Pendingin Refrigerasi Kapal*. Jurnal Sains Teknologi Transportasi Maritim Vol. 2 No. 1. Diakses Pada 26 Mei 2023, dari <https://jurnal.akmicirebon.ac.id/index.php/akmi/article/view/16/15>
- Heriyadi. (2018). *Peran Teori Dalam Studi Komunikasi*. Jurnal UIN Mataram Vol. 16 No. 1. Diakses Pada 19 Mei 2023, dari <https://journal.uinmataram.ac.id/index.php/tasamuh/article/view/547/256>
- Islam, A.A.F. (2021). *Analisis Human Error Pada Sistem Permesinan Kapal Dengan Metode AHP dan SHELL*. Universitas Hasanuddin Repository. Diakses Pada 15 Mei 2023, dari http://repository.unhas.ac.id/id/eprint/18992/2/D33114302_skripsi_Bab%201-2.pdf
- Jauhari, L. (2014). *Bagian-Bagian Mesin Pendingin, Refrigasi*. Diakses pada 2 Mei 2023, dari <https://www.maritimeworld.web.id>
- Lesmana, Galih, R. (2021). *Analisis Dampak Kerusakan Expansion Valve pada Mesin AC di MV. MIMOSA III*. Skripsi. Semarang: Politeknik Ilmu Pelayaran.
- Peramutya, A.D. (2020). *Pengaruh Terganggunya Sirkulasi Freon Terhadap Mesin Pendingin di KMP Lakaan*. E-Journal Marine Inside Vol. 2 No. 2. Diakses Pada 25 Mei 2023, dari <https://ejournal.poltekel-banten.ac.id/index.php/ejmi/article/view/22/53>
- Pramiyati, T. (2017). *Peran Data Primer Pada Pembentukan Skema Konseptual Yang Faktual*. Jurnal Simetris Vo. 8 No. 2. Diakses Pada 8 Juni 2023, dari <https://jurnal.umk.ac.id/index.php/simet/article/view/1574/1121>
- Pratama, R.A. (2019). *Peningkatan Kerja Pada Air Conditioner Dalam Menjaga Suhu Ruang Akomodasi di MV. Glovis Daylight*. Jurnal Dinamika Bahari Vol. 10 No.1. Diakses Pada 20 Mei 2023, dari <https://ejournal.pip-semarang.ac.id/index.php/jdb/article/view/119/75>
- Qotrun, A. (2021). *Penelitian Kualitatif: Pengertian, Ciri-Ciri, Tujuan, Jenis, dan Prosedurnya*. Diakses Pada 11 Mei 2023, dari <https://www.gramedia.com/literasi/penelitian-kualitatif/>
- Rahmad, A. (2019). *Gangguan Pada Refrigerator Muatan Ikan di Kapal Nelayan Utomo Tambah Mulyo*. Unimar Amni Semarang Repository. Diakses Pada 3 Mei 2023, dari <http://repository.unimar-amni.ac.id/1657>
- Riadi, M. (2019). *Karakteristik, Jenis dan Prosedur Penelitian Kualitatif*. Diakses Pada 11 Mei 2023, dari <https://www.kajianpustaka.com/2019/04/karakteristik-jenis-dan-prosedur-penelitian-kualitatif.html>
- Riadi, M. (2020). *Populasi dan Sampel Penelitian*. Diakses Pada 11 Mei 2023, dari <https://www.kajianpustaka.com/2020/11/populasi-dan-sampel-penelitian.html>
- Ridhuan, K., Angga, I.G. (2014). *Pengaruh Media Pendingin Air Pada Kondensor Terhadap Kemampuan Kerja Mesin Pendingin*. Jurusan Teknik Mesin Fakultas Teknik Universitas Muhammadiyah Metro Vol. 3 No. 2. Diakses Pada 16 Mei 2023, dari <http://ojs.ummmetro.ac.id/index.php/turbo/article/view/11/10>
- Salmaa. (2022). *Manfaat Penelitian: Pengertian, Karakteristik, Fungsi dan Contoh*. Diakses Pada 3 Mei 2023, dari https://penerbitdepublish.com/manfaat-penelitian/#2_Sugiyono_2011
- STX. (2001). *Provision Refrigerating Plant, Operation Manual Book*. Hi Air Korea Co., Ltd.
- Suryaman, Y. (2018). *Optimalisasi Kinerja Mesin Pendingin Guna Menjaga Kualitas Bahan Makanan di Atas Kapal MT. Pujawati*. Jurnal Dinamika Bahari Vol. 9 No.1. Diakses Pada 5 Mei 2023, dari <https://ejournal.pip-semarang.ac.id/index.php/jdb/article/view/84/50>
- Syafnidawaty. (2020). *Observasi*. Diakses Pada 12 Mei 2023, dari <https://raharja.ac.id/2020/11/10/observasi/>

- Wahidmurni. (2017). *Pemaparan Metode Penelitian Kualitatif*. UIN Malang Repository. Diakses Pada 9 Juni 2023, dari <http://repository.uin-malang.ac.id/1984/2/1984.pdf>
- Yusanto, Y. (2020). *Ragam Pendekatan Penelitian Kualitatif*. Journal of Scientific Communication Vol. 1 No. 1. Diakses Pada 8 Juni 2023, dari <https://jurnal.untirta.ac.id/index.php/jsc/article/view/7764/5253>
- Zakky. (2018). *Pengertian Instrumen Penelitian Menurut Para Ahli dan Secara Umum*. Diakses Pada 15 Mei 2023, dari <https://www.zonareferensi.com/pengertian-instrumen-penelitian/>