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Research Paper

Analysis of Causes of Combustion Failure in Burner Incinerators at MT. JS INEOS INNOVATION

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Abstract

Abstraction-Incinerator is an auxiliary machine designed as the main combustion chamber to burn wasted oil after going through the heating process in a sludge incinerator tube. The use of the incinerator on the ship aims to burn the waste on the ship and also burn dirty oil. Based on the author's research, the operation of the incinerator on board is still not optimal due to the failure of the combustion in the incinerator burner. This study aims to find out the causes and efforts to solve the problems raised by researchers, namely combustion failure in the incinerator burner at MT. JS Ineos Innovation

This study used a descriptive qualitative method. By using fishbone analysis techniques, researchers identified the factors and efforts made related to combustion failure at the Incinerator burner at MT. JS Ineos Innovation. Source of data taken from primary and secondary data. Data collection was carried out by interviews, observation, documentation, and literature study which was carried out during the research.

Based on the research results, it can be concluded that combustion failure in the incinerator burner is caused by several factors, including a dirty burner nozzle, damaged steam valve, decreased steam supply from the steam service line, and jammed piston valve in the sludge dosing pump incinerator. Efforts made to overcome the occurrence of combustion failure at the incinerator burner are carrying out cleaning of the incinerator burner, carrying out maintenance or replacement of the steam valve, increasing the steam intensity from the steam service line to the inlet heater incinerator, and carrying out maintenance and repair of the piston valve in the sludge. dosing pump incinerator.

Keywords *incinerator, qualitative method, combustion failure*

INTRODUCTION

The growing fleet of commercial ships, both small and large, shows a potential threat to the marine ecosystem from shipping-related pollution (Trisaksono, 2017).

Based on Marpol 73/78 Annex V discusses the prevention of waste pollution from ships. Implementation of Marpol (marine pollution) and Solas (safety of life at sea) for the application of waste management on ships (M. Latief et al., 2018). Garbage is unwanted residual material after the end of a process (Dong, 2019). In this case, the solid waste referred to is all waste materials other than human excrement, urine, and liquid waste, which can be in the form of household kitchen waste, plastic, metal, glass, wood, and others. Liquid waste, what is meant is a liquid material that

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has been used and is not reused and disposed of in landfills. To prevent this pollution, there are 2 methods used, namely by storing it in port facilities and by burning it on ships. If the waste is accommodated at the port facility, it will require quite a large fee and require temporary storage while on board. If waste is processed on board, a tool called an incinerator is needed. An incinerator is a tool on a ship to burn waste lubricating oil, garbage, and other impurities that can be burned so that marine pollution can be avoided and handled by established handling procedures and conditions (Dong, 2021). The way it works is by utilizing the flow of steam from the boiler which is channeled into the heating tubes in the sludge incinerator tube. After heating in the Incinerator tube, the dirty oil will experience an increase in temperature to achieve the burning point of the dirty oil.

However, during the operation of the incinerator, problems or disturbances were found in the process of burning the dirty oil on board the MT. JS Ineos Innovation. Under normal conditions, the incinerator can work properly burning dirty oil without any combustion failure on the incinerator burner. But in the process of burning dirty oil that was carried out on the MT ship. JS Ineos Innovation has problems in the form of failure of combustion on the Incinerator burner which disrupts the process of burning dirty oil on board. The following are the research objectives that must be achieved:

1. To discuss what causes combustion failure in the Incinerator burner.
2. To overcome combustion failure on the Incinerator burner.

LITERATURE REVIEW

Definition of Analysis

In general, the definition of analysis is research on an event which includes (deeds, essays, etc.) to find out the actual conditions. In another context, analysis is an attempt to observe an event and describe its various constituent components to be studied in more depth. The definition of analysis according to Harahap (Azwar, 2019) is to describe or break apart into smaller parts.

Incinerators

The theoretical basis is the relevant theory that is used as the basis for providing temporary answers to the formulation of the problems that have been proposed, then used to explain the variables to be studied, and can be used to develop instruments in research (Azizah & Purwoko, 2019). Incineration is a solid waste treatment process by burning at temperatures over 800ºC to reduce combustible waste that can no longer be recycled, killing bacteria, viruses, and toxic chemicals (AS Latief, 2021). Incinerator studies as a gasification method to reduce waste (Susastrio et al., 2020).

Incinerator Working Principle

In the Incinerator system on board, the dirty oil or liquid waste will be accommodated in a waste oil tank, then the dirty oil will be transferred using a sludge pump to the sludge tank Incinerator. The dirty oil in the sludge tank incinerator will be heated with a steam heater to reach the burning point of the dirty oil. Then to burn the dirty oil can be done by starting with burning clean oil or diesel fuel first until the temperature reaches 870o C, then you can start burning the dirty oil by starting slowly. Until the combustion is complete use dirty oil.

Burning Process

Two methods can be used for combustion, namely incomplete combustion and complete combustion (Yunianto et al., 2018). Incomplete combustion is a combustion process that occurs when the fuel cannot be completely burned, which does not all turn into CO2 in the combustion process. Complete combustion is a combustion reaction that occurs when all the carbon reacts with oxygen to produce CO2. The gasification process can occur when volatile materials or converted carbon are released when heating the waste (Najib & Darsopuspito, 2021). 5 factors can affect the

combustion process, namely:
a. Dirty nozzle from the Incinerator burner
b. Damaged steam valve inlet heater Incinerator sludge tank
c. Low supply of steam from the steam service line
d. Jammed pneumatic piston valve on sludge dosing pump incinerator

Incinerator Components
a. Auxiliary Burner
b. Sludge Circulation Pump
c. Blower
d. Incinerator Sludge Tank

Research Framework

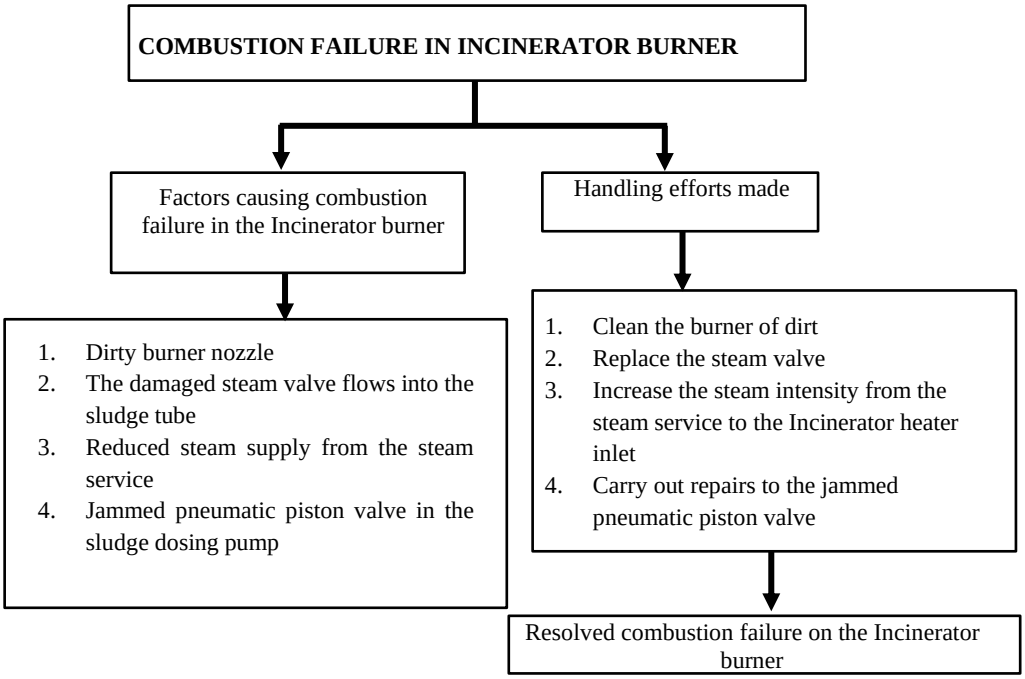

Figure 1. Research framework

METHODOLOGY
Time and Place of Research
a. Time of Research
This research was conducted from August [12] 2021 to August 18, 2022.
b. Place of Research
This research was conducted on MT JS. Ineos Innovation. MT. JS Ineos Innovation is an LNG (Liquefied Natural Gas) carrier owned by Xiangrui International Ship Lease Co. Ltd, and operated by Evergas Management A/S.

Sources and Research Data
a. Primary Data Source
Primary data can be said to be data collected directly from the individuals studied. The data for the preparation of this thesis were obtained through direct sources. Data collection through interviews and observations of people who are directly involved in matters related to this research.
b. Secondary Data
Secondary data is data that is collected first and reported by related parties who do not conduct research even though the data is original. In this case, the author looks for reference sources from the manual book on the ship

Method of Collecting Data

To obtain data, the way to collect data that the author uses is:

a. Observation Method (observation)
   Through these observational data, the authors systematically observed and recorded observation objects to obtain sufficient data from August 12 2021 to August 18, 2022. The observation location is MT. JS Ineos Innovation and Incinerators as observation objects.
b. Interview Method (interview)
   As a data collection technique, interviews were conducted with 2 informants, namely Mr. Perera Egodage H.K. as the fourth engineer and Mr. Arslan Ibrahim as the third engineer.
c. Literature Study Method (literature)
   Studi Literature study is the theory of a scientific discipline that needs to be continued with empirical testing. This is a technique for collecting data by conducting a review of books as a reference to support the process of compiling this thesis. The author classifies and describes them as below:
   1. Libraries.
   2. Ship documents or manual books.

Data Analysis Technique

Diagram Fishbone Analysis diagram is a method used to improve quality. This diagram is often called a cause-effect diagram or a cause-and-effect diagram that uses qualitative data or verbal (non-numerical) data.

a. Function Fishbone Diagrams
   The fishbone diagram has the basic function of identifying and organizing the causes that can arise from specific effects and then separating the root causes. Often one encounters many people who say "probable causes" and in the majority of cases have to test whether the causes for the hypothesis are real and whether reducing or increasing them can produce the expected results.
b. Advantages of Fishbone Analysis diagrams
   1. The advantage of a fishbone diagram is that it allows the development of sensitive analyses, preventing unnecessary observations of potential root causes that need to be resolved.
   2. The fishbone method is easy to use and makes it easy to understand a visual representation of the causes of the problem, the origin of the needs, to the categories of causes and problems that need to be addressed.
   3. A big picture of the possible causes of the problem or focus on the factors that influence the birth of a need (maslah) can be clearly described with a fishbone diagram.

FINDINGS AND DISCUSSION

Problem Analysis

The research focus is an outline of research observations so that the observation and analysis of research results are more directed. In this case, the researcher conducted research with a focus on analyzing the causes of combustion failure in the Incinerator burner.

Problem Discussion

From the results during sea practice on board the MT. JS Ineos Innovation where the discussion or topic in writing this thesis is based on experience while sailing on a ship with the following description.

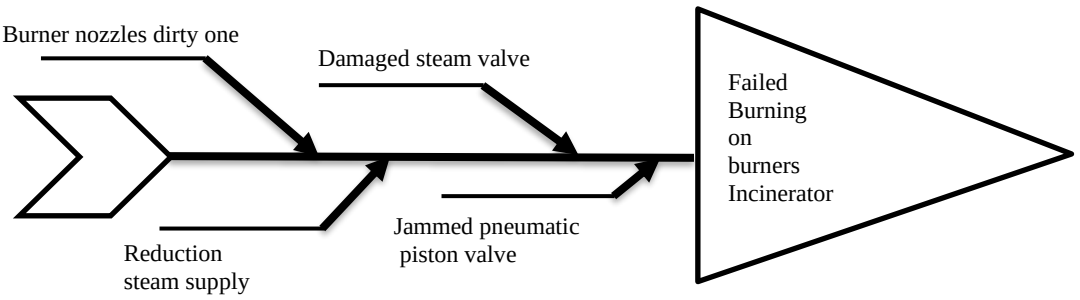

Figure 2. Diagram Fishbone
Source: Private document, 2022

a. Factors that cause burner combustion failure in the incinerator system.
Several factors cause reduced steam flow to the sludge tube in the incinerator system, including the following;

1) Dirty burner nozzles
From the results of the researchers' observations when carrying out marine work practices, the researchers obtained the effect factor of the cause of failure of the burner combustion in the incinerator system, namely the dirty nozzle burner. This can happen because of damage to the fuel filter so that in the process of filtering the fuel it is less than optimal which results in impurities entering the nozzle and hindering the rate of the fuel. This causes the spraying or fogging of diesel fuel or clean fuel oil to be less than optimal so that the process of burning fuel in the combustion tank fails. The following is a picture of the flow of clean fuel oil entering the incinerator burner through a strainer or filter.

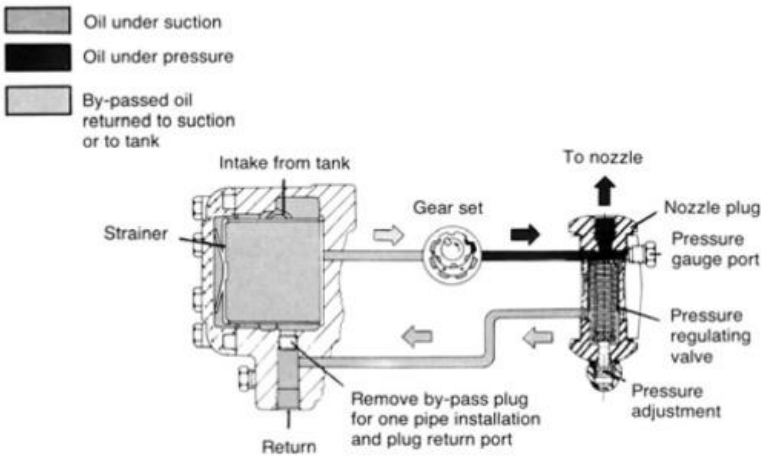

Figure 3. Burner diesel oil fuel pump
Source: manual book, 2022

2) Steam Valve Damage
In this case, the steam valve is a vital thing that functions as a regulator of steam entering the sludge incinerator tube so that if damage occurs it will inhibit the process of entering steam into the sludge tube so that the process of achieving the dirty oil fuel point is disrupted or less than optimal. So that when burning dirty oil in the combustion chamber or incinerator furnace, combustion failure can occur in the incinerator burner. The following is a picture of the broken steam valve taken by the researcher.

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Figure 4. Steam valve inlet heater sludge tank
Source: Private document, 2022

3) The steam supply from the steam service line is decreasing
This can happen because of a disturbance that causes the flow of steam or steam supply from the steam service line to the inlet heater sludge tank to decrease. When the ship is dismantling the generator shaft on April 17 to 18 2022 to be sent to the vendor, the ship takes longer than the predetermined schedule so that the ship experiences delays to the next destination country. On this basis, the company ordered the captain to only use 1 main engine with a speed of 9 knots, which normally is 16 knots. Then on April 21, 2022, when the ship was sailing the Chief Engineer only operated 1 main engine according to directions from the company. This causes the temperature of the main engine exhaust gas to drop so that the water vapor in the Economizer runs less optimally.

Event number	Date	Condition	Time	Location	Steaming time	Running Hours Counter						
						ME 1 TOTAL	ME 2 TOTAL	ME 1 onGAS	ME 2 onGAS	AE1	AE2	Bir
HELP	dd/mm/yy		hh:mm		Hrs	Hrs	Hrs	Hrs	Hrs	Hrs	Hrs	Hrs
2		3	4	5	6	7	8	9	10	11	12	13
77	18/Apr/2022	Noon	12:00	BE-ANT At Anchor - IIN060	4.8	37196.0	36844.0	25839.0	25611.0	13425.0	10634.0	5215.0
78	18/Apr/2022	STBY	23:12	BE-ANT At Anchor - IIN060	9.2	37197.0	36844.0	25839.0	25611.0	13426.0	10645.0	5223.0
79	18/Apr/2022	COSP	23:54	At Sea - IIN060	0.7	37197.0	36845.0	25839.0	25611.0	13426.0	10646.0	5223.0
80	19/Apr/2022	Noon	12:00	At Sea - IIN060	12.1	37209.0	36856.0	25850.0	25622.0	13427.0	10646.0	5223.0
81	20/Apr/2022	Noon	12:00	At Sea - IIN060	25.0	37234.0	36881.0	25875.0	25647.0	13427.0	10646.0	5223.0
82	21/Apr/2022	Noon	12:00	At Sea - IIN060	24.0	37258.0	36883.0	25897.0	25647.0	13427.0	10652.0	5223.0
83	22/Apr/2022	Noon	12:00	At Sea - IIN060	24.0	37282.0	36883.0	25921.0	25647.0	13427.0	10676.0	5223.0
84	23/Apr/2022	Noon	12:00	At Sea - IIN060	25.0	37307.0	36883.0	25946.0	25647.0	13428.0	10681.0	5223.0
85	24/Apr/2022	Noon	12:00	At Sea - IIN060	24.0	37331.0	36883.0	25970.0	25647.0	13428.0	10681.0	5223.0
86	25/Apr/2022	Noon	12:00	At Sea - IIN060	24.0	37355.0	36883.0	25994.0	25647.0	13428.0	10681.0	5223.0
87	26/Apr/2022	Noon	12:00	At Sea - IIN060	25.0	37380.0	36886.0	26015.0	25648.0	13431.0	10684.0	5223.0
88	27/Apr/2022	Noon	12:00	At Sea - IIN060	24.0	37404.0	36886.0	26039.0	25648.0	13436.0	10693.0	5223.0
89	28/Apr/2022	Noon	12:00	At Sea - IIN060	24.0	37428.0	36886.0	26063.0	25648.0	13446.0	10693.0	5223.0
90	29/Apr/2022	Noon	12:00	At Sea - IIN060	25.0	37453.0	36886.0	26088.0	25648.0	13446.0	10693.0	5223.0
91	30/Apr/2022	Noon	12:00	At Sea - IIN060	24.0	37477.0	36886.0	26112.0	25648.0	13447.0	10694.0	5223.0
92	1/May/2022	Noon	12:00	At Sea - IIN060	24.0	37501.0	36886.0	26136.0	25648.0	13447.0	10694.0	5223.0
93	2/May/2022	Noon	12:00	At Sea - IIN060	25.0	37526.0	36886.0	26161.0	25648.0	13447.0	10694.0	5223.0
94	3/May/2022	Noon	12:00	At Sea - IIN060	24.0	37550.0	36888.0	26183.0	25648.0	13447.0	10698.0	5223.0
95	4/May/2022	Noon	12:00	At Sea - IIN060	24.0	37574.0	36888.0	26207.0	25648.0	13447.0	10698.0	5223.0
96	5/May/2022	Noon	12:00	At Sea - IIN060	25.0	37599.0	36888.0	26232.0	25648.0	13447.0	10698.0	5223.0
97	6/May/2022	Noon	12:00	At Sea - IIN060	24.0	37623.0	36888.0	26256.0	25648.0	13447.0	10698.0	5223.0
98	7/May/2022	Noon	12:00	At Sea - IIN060	24.0	37647.0	36888.0	26280.0	25648.0	13447.0	10698.0	5223.0
99	8/May/2022	EOSP	12:00	At Sea - IIN060	24.0	37671.0	36888.0	26304.0	25648.0	13447.0	10698.0	5223.0
100	8/May/2022	FEW	14:00	US-HOU At anchorage - IIN060	2.0	37673.0	36890.0	26304.0	25648.0	13449.0	10698.0	5223.0
101	9/May/2022	Noon	12:00	US-HOU At anchorage - IIN060	22.0	37673.0	36890.0	26304.0	25648.0	13471.0	10698.0	5233.0
102	10/May/2022	Noon	12:00	US-HOU At anchorage - IIN060	24.0	37673.0	36890.0	26304.0	25648.0	13485.0	10708.0	5243.0
103	11/May/2022	Noon	12:00	US-HOU At anchorage - IIN060	24.0	37673.0	36890.0	26304.0	25648.0	13509.0	10708.0	5253.0

Figure 5. Noon Report
Source: Private document, 2022

4) Jammed pneumatic piston valve on sludge dosing pump incinerator

Based on the research conducted by the author when carrying out marine work practices, the researchers found the factors causing the failure of burner combustion in the Incinerator system, namely the jammed pneumatic piston valve at the sludge dosing pump Incinerator which resulted in disruption of the flow of dirty oil that would enter the burner incinerator failing combustion in the burner. Incinerator.

b. Efforts must be made to overcome the failure of combustion in the incinerator burner. That is:
   1) Carry out cleaning of the burner nozzle
   From the results of observations made by researchers on the causes of combustion failure on the Incinerator burner at MT. JS Ineos Innovation is a dirty nozzle burner that interferes with the process of releasing fuel from the nozzle to the combustion chamber. To overcome this, it is necessary to carry out maintenance according to the provisions in the manual book. The following is an overview of the burner fuel oil pump components.

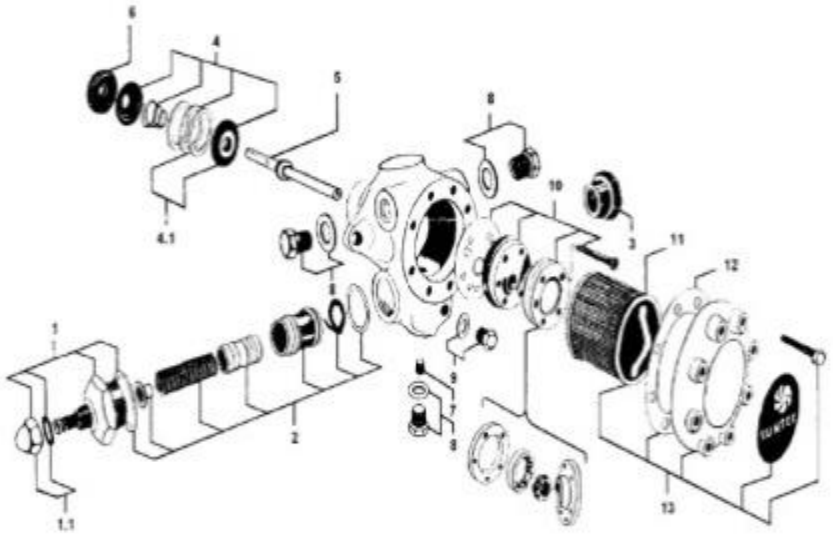

Figure 6. Burner fuel oil pump arrangement
Source: Manual book, 2022

   2) Replace the damaged steam valve in the incinerator system
   As a result of damage to the valve or valve of the incoming steam pipe, inhibits the process of entering the steam into the sludge tube so that the process of evaporation or heating of dirty oil is disturbed or not optimal. So it is necessary to carry out maintenance or replacement of the steam valve to be able to maintain the condition of the heating system so that it can operate optimally.

Figure 7. New steam valve
Source: Private Document, 2022

Some things to pay attention to are:

a) Cleaning pipes from rust
b) Replace the old steam valve with a new one
c) Replace the old O-Ring with a new one
d) Tighten each bolt and make sure there are no leaks

3) Increase the steam intensity from the steam service line to the Incinerator heater inlet
One of the causes of combustion failure in the burner is caused by a decrease in the steam supply from the steam service line. In the steam heating system, there are many paths for steam flow to the fuel oil tanks and also the LNG system, including the auxiliary machine system in the engine room, one of which is the Incinerator system. To overcome the decrease in heater temperature in the incinerator sludge tank, this can be done by adjusting the flow of the steam service pipeline by prioritizing the flow of steam to the incinerator sludge tank steam heater. Thus the problem of reduced steam intensity from the steam service line can be resolved. The following is a picture of the steam heating system leading to the Incinerator system.

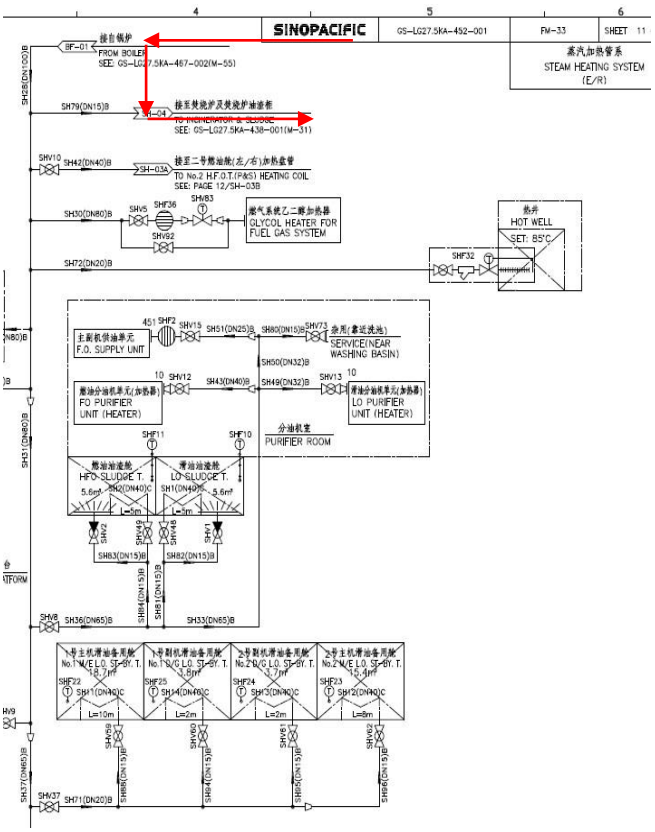

Figure 8. Steam heating system
Sumber : Manual book, 2022

4) Carry out repairs to a jammed pneumatic piston valve
The results of observations made by researchers to overcome piston congestion in the pneumatic piston valve by carrying out repairs or cleaning of the piston inside the pneumatic piston valve, so that the work of the pneumatic piston valve can work properly in controlling the flow of oil that will enter the burners. In this case, the ship's crew can do the cleaning by disassembling the valve and then cleaning the inside of the valve using clean diesel fuel to remove stubborn dirt in the cylinder or piston in the pneumatic valve.

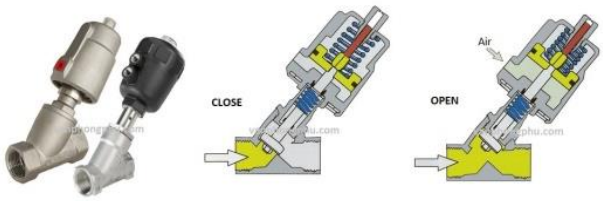

Figure 9. Pneumatic piston valve
Source: Manual book, 2022

CONCLUSION AND FURTHER RESEARCH

Conclusion

a. Factors that cause burner combustion failure in the incinerator system include the following:
   1) Dirty burner nozzle.
   2) Damage to the steam valve (valve) on the incoming steam pipe in the heating system.

3) Reduced steam supply from the steam service line.
4) Jammed pneumatic piston valve in sludge dosing pump incinerator.

b. Ways to do to overcome the occurrence of burner combustion failure in the incinerator system:
1) Carry out cleaning of the burner nozzle.
2) Replace the damaged steam valve in the incinerator system
3) Increase the steam intensity from the steam service line to the Incinerator heater inlet.
4) Carry out cleaning of the pneumatic piston valve.

Suggestion

a. It is better if each spare part installation is accompanied by a marker in the form of the date of installation with the aim that the running hours of the spare part will be monitored, so that spare parts that have almost reached the end of their useful life can be replaced immediately to minimize the occurrence of further disturbances.
b. It is advisable to carry out the watch in the engine room to check each parameter of the auxiliary machinery, especially the dirty oil temperature in the sludge tank incinerator.

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