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HIGH PRESSURE PUMP DAMAGE ANALYSIS MPK MTU 16 V 4000 M 90 SERIES ON KRI PARCHIM CLASS USING SWOT METHOD

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ABSTRACT

Hasan Basri-382 Indonesian warhip (KRI) use MTU 16 V 4000 M 90 diesel engine with common rail technology that uses a High Pressure Fuel Pump. The pump has a vital function because it provides fuel up to a pressure of 1400 bars on the common rail. The problem is that there is pump compilation or damage (leakage), then the fuel pressure at the High Pressure Pump input drops and risks the output pressure of the fuel High Pressure Pump towards the common rail, where the pressure drops dramatically, so that the fuel pressure is below 4 bar or fuel pressure inside the common rail below 700 bar Engine Control Unit (ECU) accepts the engine to stop the engine. The price of the pump is too expensive. In addition, this pump cannot be repaired or in other words it must be replaced by the new one. Based on the pump for life, it must be replaced every 4500 hours or in once W5 maintenanc period. But this lifetime schedule has never been approved. Therefore, it is expected to cause damage to the pump so prevention efforts can be made. In addition, the author has also used the SWOT method to find the best strategy in finding solutions to the problems of this High Pressure Pump. And of course, these strategies are used for advice at the end of this settlement.

Keywords*: Common Rail, Damage, High Pressure Pump, Parchim Class, and SWOT Method.*

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1. INTRODUCTION

KRI Hasan Basri with a hull number 382 made at the VEB shipyard Penee Werft GmbH Wolgast East Germany on November 10, 1982. This ship is one of the types of ships Parchim. The name of this ship when it was first launched was "Gustrow-223", but after being bought by the Indonesian government, Refit was held including demilitarization, modernization and changes to the initial design. Then on April 22, 1993 was inaugurated as KRI Hasan Basri-382 and is currently at the juxtaposition of the Eskorta Ship Unit of the Republic of Indonesia Fleet Command III. At the start of the launch the ship used a drive in the form of a M 504 A – 3 ER, star-type diesel engine, 7 Cyle Block, Zvezda St. Petersburg in 1981. However, along with its development a rejuvenation of the ship propulsion system was carried out in 2004, namely the propulsion system new form of MTU 16 V 4000 M 90 Diesel engine, (Livret KRI Hasan Basri-382, 2008).

However, along with its development carried out rejuvenation in 2004 with MTU 16 V 4000 M 90 diesel engine with common rail technology that uses a High Pressure Fuel Pump. The pump has a vital function because it is able to supply fuel up to a pressure of 1400 bars on the common rail. The problem is that when there is a problem or the pump is damaged (leaking), the fuel pressure on the High Pressure Pump input drops and of course impacts the High Pressure Pump's output fuel pressure towards the common rail, where the pressure drops dramatically, so that the fuel pressure is below 4 bar or fuel pressure inside the common rail below 700 bar Engine Control Unit (ECU) instructs the engine to do an engine stop. The price of these pumps is very expensive. In addition, the pump cannot be repaired or in other words, it must be replaced if the pump is damaged. Based on the lifetime of the pump, it should be replaced every 4500 hours of play or onetime maintenance of W5. But in reality this lifetime has never been reached. Therefore, if you can find out the cause of the damage to the pump, preventive efforts can be made. In addition, the author has also used the SWOT method to find the best strategy in finding solutions to the problems of the High Pressure Pump. And of course these strategies the author uses as a suggestion at the end of this writing.

2. MATERIALS AND METHODOLOGY.

2.1 Size of datasets

In this study the authors obtained data from the results of observation directly on the KRI Hasan Basri-382. The author obtained data directly from the journal Motor Pokok (MPK) and the sick book MPK MTU 16 V 4000 M 90 on KRI Hasan Basri-382. In addition, the author also collected information from the KRI escort Hasan Basri – 382 as the user, the Eastern Region Material Compliance Unit (Satlaikmatim) as the expert choice and Technician of PT. Antakesuma Inti Raharja (PT. AIR) as the manufacturer of the engine itself. Another step taken by the author is testing the fuel content on the KRI Hasan Basri-382 at the Labinkimat Fuel and Lubricant (BBMP) Laboratory. In addition, the author also looks for supporting data sourced from book literature and the internet, as well as interviews from parties related to previous research. On the other hand, to complete this study the authors will also take data on the KRI Kelabang-826 as a comparison ship that also uses the 4000 series MTU engine.

2.2 ORF in nucleotide sequences

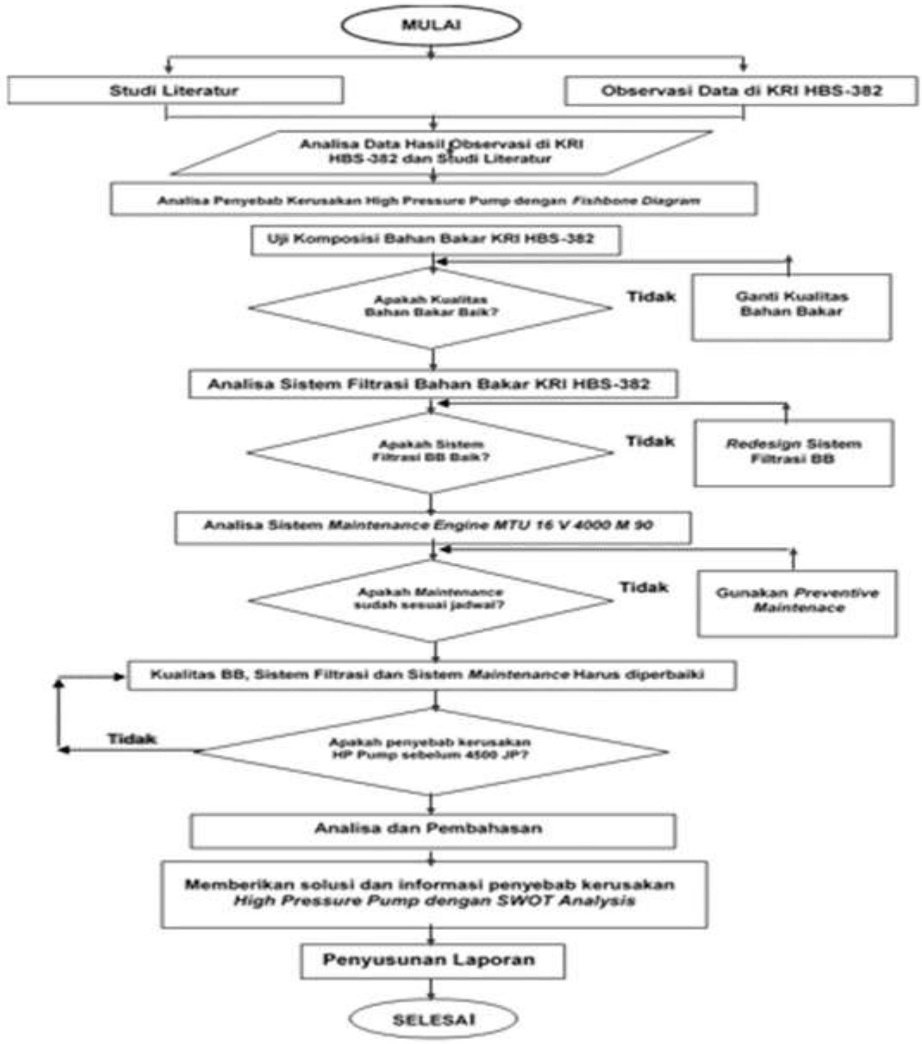

Fig.1 Flowchart Diagram

Flow Chart Description:

a. Carry out observations on KRI Hasan Basri-382. In this study the writer will begin by carrying out observations on KRI Hasan Basri-382. In this case the author will carry out data retrieval about the constraints that exist in the MPK MTU 16 V 4000 M 90 drive system, specifically related to the High Pressure Pump.

b. Analyze data from observations with literature studies. After completing the data collection and observation on KRI Hasan Basri-382, the panel will compare the existing data with the study of literature. In this case the writer will take literature from PT. AIR and several book sources and the internet.

c. Test the composition of the bahar material used by KRI Hasan Basri-382. In this study the author will also carry out a fuel composition test to determine the composition and content of the fuel on KRI Hasan Basri-382 at the Labinkimat Fuel and Lubricant (BBMP) Laboratory, Surabaya.

d. Analyzing the Fuel Filtration System on KRI HBS-382. After knowing the fuel content on the KRI HBS the author will also analyze the filtration system on the KRI HBS-382 to determine the condition of the fuel before entering the High Pressure Pump.

e. Analyzing MPK MTU Maintenance System 16 V 4000 M 90 on KRI Hasan Basri-382. After the author can find out the fuel content and fuel filtration system that exists, the writer will analyze the maintenance system on KRI Hasan Basri-382 to find out whether indeed the current maintenance system is implemented or not. What if the current maintenance system condition is on the Hasan Basri-382 KRI compared to the maintenance system on the Kelabang-826 KRI.

f. Providing solutions and information on High Press Pressure Pump damage with SWOT Analysis. After the author can find out the causes of damage to the High Pressure Pump, the author will provide a solution and information on how to maintain the life of the High Pressure can be used according to its useful life of 4500 Play Hours.

g. Preparation of reports. The author will present all the results of observations, data retrieval, literature studies, test the composition of fuels, opinions of experts, and other findings in the field in a report in the form of a thesis.

3. RESULT AND DISCUSSION.

Table 1. Engine MTU Maintenance Table

TIME BETWEEN OVERHAUL (TBO) ENGINE MTU SERIES								
No.	MTU Engine Type	Engine Running Hours/ Days Needed						
		W2	W3	W4	W5	Days Needed	W6	Days Needed
1	16V956TB81/91	250	500	1500	3000	90	9000	150
2	16V956TB92	250	500	1500	4500	90	18000	150
3	12V956TB82	250	1000	2000	6000	60	24000	120
4	16V595TE70L	500	1000	3000	6000	90	12000	150
5	20V538TB91	250	500	1500	3000	120	9000	180
6	12V493AZ80-GA31L	150	300	1500	3000	60	6000	120
7	12V396TC82-DB51L	250	500	1500	3000	45	9000	60
8	8V396SE84	250	300	1500	3000	45	9000	60
9	8V396TE54	250	500	2000	10000	30	30000	45
10	6V331TC80	250	500	1500	3000	30	9000	45
11	12V183TE52	250	1000	1000	3000	21	24000	30
12	10V183AA51	250	500	1000	3000	18	24000	28
13	8V183TE52	250	500	1000	3000	14	24000	21
14	6R099TA51V	250	500	1000	3000	7	24000	14
15	16V4000M90	250	750	2250	4500	60	9000	90
16	16V4000M73L	500	1000	3000	7500	60	15000	90
17	12V4000M71	500	1000	5000	7500	45	15000	60
18	8V4000M70	500	1000	2000	7500	30	15000	45
19	8V4000M53	500	1000	7500	13500	45	27000	60

Certainly different depending on the type of engine itself. Especially for the MTU 4000 series engine has two engine types based on the level of performance or the ability of the engine itself. The type is the medium duty engine with code engine 8, and the light duty engine with engine code 9. Especially for the MTU 16 V 4000 M 90 engine is included in the type of Marine Use Light Duty Engine which has a shorter time in the time or period of maintenance

It appears in the table above that the maintenance schedule in the 12 V 4000 M 71 engine has a maintenance period of almost twice the maintenance time of the 16 V 4000 M 90 engine. Likewise for W6 maintenance that takes 15000 Play Hours. Still related to the High Pressure Pump maintenance schedule, this component is included in the repair volume W5, where the volume of work for this component will be replaced by 1 unit. For the time specified for one W5 maintenance itself is 7500 Play Hours. But in reality in the field, until the maintenance time of W5, the High Pressure Pump condition on the KRI Kelabang-826 was still in good condition. Even in reality on the ground, the High Pressure Pump on the KRI Kelabang-826 can last up to 15000 Hours of Play or one W6 maintenance.

Table 2. Water Content Table

No.	Type of fuel Sample	Water Content (% Vol)
1.	Fuel sample from Bunker (Bunker Pertamina)	0,02
2.	Fuel sample from Pertamina Pipe System	Nil
3.	Fuel sample from Main Tank in KRI HBS-382	0,05
4.	Fuel sample from Daily Tank in KRI HBS-382	0,015

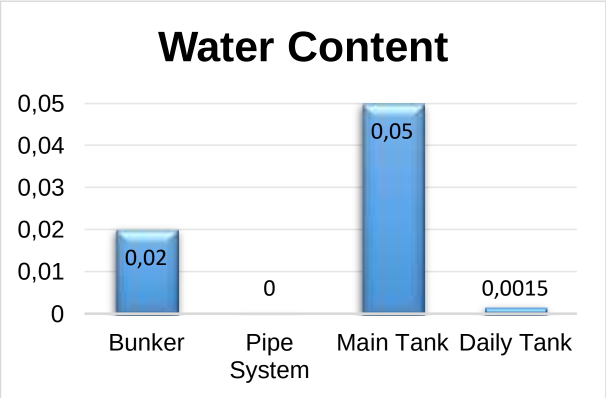

Fig.2 Water Content Chart

It seems that water content from main tank has highest level of water content. And the pipe system from Pertamina has the lowest level of water content. Water content in large quantities which if it has entered into the combustion chamber will cause damage to engine components such as pistons, piston rings or cylinder walls due to the nature of water that is uncompressible or incompressible which if forced will cause the effect of Water Hammer.

Table 3. Ash Content Table

No.	Type of fuel Sample	Ash Content (% Wt)
1.	Fuel sample from Bunker (Bunker Pertamina)	0,0024
2.	Fuel sample from Pertamina Pipe Sytem	0,0077
3.	Fuel sample from Main Tank in KRI HBS-382	0,0061
4.	Fuel sample from Daily Tank in KRI HBS-382	0,0090

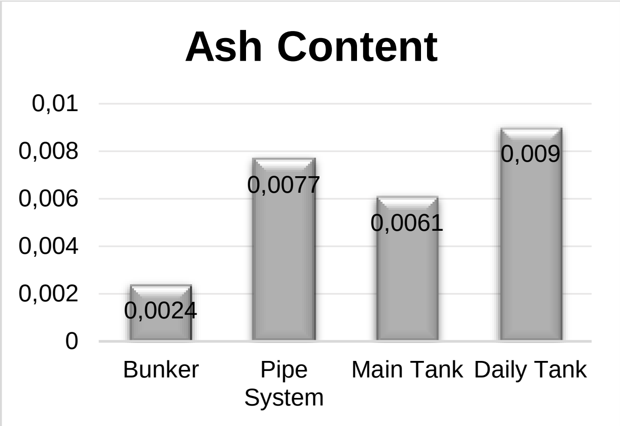

Fig.3 Ash Content Chart

Fuel quality and fuel filtration system on KRI Hasan Basri-382 are not good. This is evidenced by the results of fuel quality tests conducted at Labinkimat Laboratory of Lubricants and Oils (BMMP), Surabaya. Where from the test results it was found that the fuel in the staple tank and daily tank contained water content and sediment content which was high enough to damage the High Pressure Pump MTU 16 V 4000 M 90.

Table 4. Sedimentation Content Table

No.	Type of fuel Sample	Sedimentation Content (% Wt)
1.	Fuel sample from Bunker (Bunker Pertamina)	0,025
2.	Fuel sample from Pertamina Pipe System	0
3.	Fuel sample from Main Tank in KRI HBS-382	0,05
4.	Fuel sample from Daily Tank in KRI HBS-382	0,015

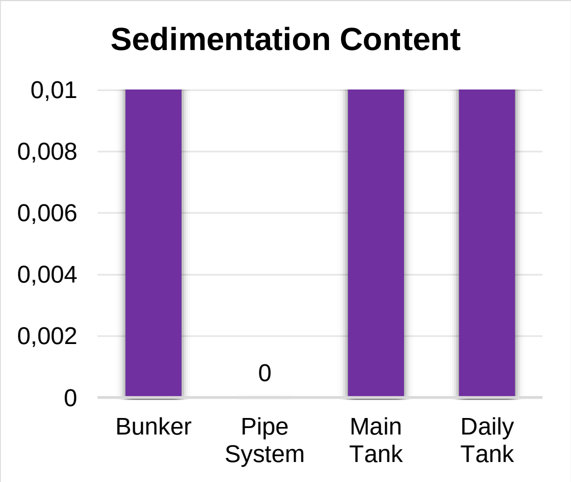

Fig.4 Sedimentation Content Chart

From the graph above, we can see that 3 samples namely, fuel samples from the barge, main tank and daily tank have very high sediment levels, even greater than the permitted limit. This is necessary because the fuel source from the barge which has high levels of sediment enters the fuel tank. Because this is constantly repeating so that sediment occurs at the bottom of the fuel tank, both the main tank and the daily tank.

Table 5. Table of IFAS and EFAS for HP Pump Error

	Internal Factors Analysis Summary (IFAS)			
No	***Strength***	Bobot	Skor	Bobot x Skor
1	Memiliki tekanan bahan bakar yang tinggi	0.16	4	0.64
2	Menghasilkan pembakaran yang mendekati sempurna	0.20	3	0.60
3	Menghasilkan power (tenaga) yang besar	0.14	4	0.56
	Weakness			
1	Bad fuel caused the error of HP Pump	0.17	4	0.68
2	The error of Hp Pump can stop the engine	0.16	3	0.48
3	HP Pump component is consumabl and remanufacture	0.17	3	0.51
		1.00		**0.13**
	External Factors Analysis Summary (EFAS)			
	Opportunity			
1	Choose good resource of fuel	0.14	4	0.56
2	Optimize the fuel filtration system on the ship	0.18	4	0.72
3	Maintenance sesuai jadwal dan spare part dari pabrikan	0.20	4	0.80
	Threat			
1	Bunker Fuel Fiiling System	0.21	2	0.42
2	Using ungenuine spare part	0.17	3	0.51
3	Uncorrect Maintenance System	0.10	2	0.20
		1.00		**0.95**

Based on the Internal and External Factor Analysis Summary Table, we can determine several possible strategies, namely:

a. SO (Strength-Opportunity) Strategy. This strategy is made based on the way of thinking to use all the power to seize and take advantage of maximum opportunities.

b. ST (Strength-Threat) Strategy. This strategy is a strategy in using the power possessed to overcome threats.

c. WO (Weakness-Opportunity) Strategy. This strategy is implemented based on the utilization of existing opportunities by minimizing existing weaknesses.

d. WT (Weakness-Threat) Strategy. This strategy is based on business activities to minimize existing weaknesses and avoid threats.

Common rail technology is a technology on engines that uses configurations / arrangements and components that are different from conventional fuel systems on other engines. One of the examples of engines that have implemented a common rail system is MTU. Where this system relies heavily on a high-pressure fuel pump that is able to provide a continuous supply of fuel at injection pressure to all injectors. In this common rail system does not require a component injector pump with a separate plunger which is driven by cam driven to produce fuel pressure to the entire injector. Where in timing and fuel capacity (fuel quantity) is set by the Engine Control Unit (ECU).

There are several problems that often occur in the MTU High Pressure Pump Engine 4000 series. These problems include shift gear drive (Armed Gear Position), damage to the ceramic bearing (Broken Ceramic Bearing) and leakage on the connection between the pump body (Body Leaking).

Affecting Factors:

a. Fuel Quality

b. Fuel Filtration System

c. Maintenance System

d. Operation Pattern of War Ship

Discussion of Damage to the KRI HBS-382 High Pressure Pump with the SWOT Method:

Carrying out maintenance according to schedule and factory-determined spare parts will greatly help extend the lifetime of the High Pressure Pump, as has been done by KRI Kelabang-826. On the other hand, dirty and contaminated fuel is a major weakness of the common rail system that uses High Pressure Pump as its main tool. Therefore, carrying out refueling through Pertamina Pipes is the best option that can be done to avoid damage to the High Pressure Pump.

Efforts Made:

a. Choose a good refueling source

b. Repair the fuel filtration system

c. Carry out tank cleaning regularly

d. Implement support for spare parts (filters) appropriately and optimally

e. Provide training and training on how to maintain a High Pressure Pump

4. CONCLUSION.

a. Fuel quality and fuel filtration system on KRI Hasan Basri-382 are not good. This is evidenced by the results of fuel quality tests conducted at Labinkimat Laboratory of Lubricants and Oils (BMMP), Surabaya. Where from the test results it was found that the fuel in the staple tank and daily tank contained water content and sediment content which was high enough to damage the High Pressure Pump MTU 16 V 4000 M 90.

b. Maintenance system for fuel filtration system at KRI Hasan Basri-382 has not been implemented properly based on maintenance instructions and use of genuine spare parts from the factory.

c. Damage to the MTU 16 V 4000 M 90 High Pressure Pump before reaching 4500 Play Hours is caused by:

1) Fuel quality is not good

2) Poor condition of fuel filtration system

3) Poor fuel maintenance system

d. MTU 16 V 4000 M 90 pump engine on KRI Hasan Basri – 382, including:

1) Carry out maintenance according to schedule and spare parts from the factory.

2) Improve the KRI hasan Basri-382 fuel filtration system.

3) Choose a good refueling source.

4) Providing training and training on how to maintain a High Pressure Pump.

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