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Analysis Of The Causes Of Cracks In The Cylinder Liner That Cause Non-Optimal Performance Of The Yuchai Yc 6a170c Generator Engine On Board Mv Lagun Mas

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Abstract: The liner cylinder is an important part of the yuchai yc 6a170c diesel engine which is a tube where the piston works and moves up and down to stimulate air and transfer heat into kinetic power. To obtain optimal engine power, efforts are made not to crack or leak in the liner cylinders of the yuchai yc6a170c generator engine. Factors causing the cracking of the liner cylinder such as the lack of a good cooling system on the liner cylinder so that the liner cylinder experiences a temperature increase caused by friction from the piston so that it can cause cracks. However, this should be reduced by regular maintenance and periodic checks of the pumps and raw materials used in the yuchai yc6a170c liner cylinders on the MV Lagun Mas ship. The **method** used in this research uses descriptive qualitative researchmethods. The research report will contain excerpts of data to provide an overview of the report presentation, the data comes from interview manuscripts, field notes, photos, personal documents, notes or memos and other official documents. The **results** of this study show that the importance of carrying out periodic maintenance on oil pumps and seawater pumps so that cooling on the liner cylinders can run optimally.

Keyword: Cylinder liner, crack, cooling system

INTRODUCTION

Applied science and technology must be improved in this era of globalization, which can support human activities in their activities. Along with advanced technology and to welcome the era of free trade in the international world, transportation equipment is needed as a means of trade activities, both national and international trade.

Ships are one of the right choices as the most effective and efficient means of transportation in large volumes. The ship must be equipped with various auxiliary machinery to support the smooth operation of the ship. There are many auxiliary machinery on board, so it has an important function to help the main engine to operate properly.

The generator engine is a machine used to produce electrical energy from a source of heat energy generated in the combustion chamber in a diesel engine so that mechanical energy can be

converted into electrical energy by utilizing an electromagnetic field. In the working principle of auxiliary machinery is divided into two types, including 4 stroke diesel engines and 2 stroke diesel engines. In a 4 stroke diesel engine has several components including cylinder head, cylinder liner, crankshaf, camshaf, piston and other components. In the components that often experience cracks, namely the cylinder liner. The cylinder liner is an important part of a diesel engine which is a tube where the piston works and moves up and down to compress air and convert heat power into kinetic power. To obtain the greatest possible engine power, no leaks are sought in the gases burned between the piston and the cylinder, and also the friction of the piston. Damage to the cylinder liner occurs due to thermal loads and vibrations caused by the operating conditions of the diesel engine. Cracks in the cylinder liner are also caused by the quality of the material used not meeting the requirements as a diesel engine cylinder liner material. The cylinder liner material is gray cast iron with low carbon and silicon content but has a high phosphorus content, this condition causes the resistance of the cylinder liner material to high temperatures to be low or decreased so that it can cause the cylinder liner to crack easily at high temperatures (hot shortness).

At high engine temperatures, the viscosity of the oil tends to decrease and the oil experiences volume expansion, on the other hand, when the engine temperature is low, the viscosity of the oil tends to increase, and the oil experiences volume shrinkage. Oil changes volume when there is a change in temperature. The volume of a substance is related to the density of the substance. If volume depends on temperature, then density also depends on temperature. From some of the factors above, it will have an impact on the performance of the Yuchai Yc6a170c generator engine on the MV Lagun Mas ship, so this condition will make the Yuchai Yc6a170c generator engine unable to operate optimally. Optimization is a measure that causes the achievement of goals so as to achieve the best value available from several functions given in a context.

The work of the generator engine that is not optimal will certainly hamper the smooth operation on board, if there is a crack in the cylinder liner, the gases that will be compressed in the cylinder tube are not perfectly compressed, so that the power generated from combustion in the cylinder liner is not perfect, cracks in the cylinder liner can result in cooling not running optimally so that the impact of cracks or can cause piston rupture due to the pressure generated by the piston movement from TMA to TMB.

Literature Review

Crack : According to KBBI Cracking is a cracked condition, which forms lines or scratches on a hard object such as metal as a result of decreasing hardness and resistance by deformation. According to Winarno (2014: 87), deformation is a change in the arrangement of forms carried out intentionally or unintentionally on a workpiece.

Working Principle of 4 stroke Diesel Motor : According to Ahmad Narto (2017: 83), the working principle of diesel motors is based on two different processes, namely the 4-stroke process which requires two full revolutions of the crankshaft to produce 1 power. While 2 tak which only requires one full rotation of the crankshaft to produce 1 power. In the 4-stroke diesel engine is included in the process of internal combustion (internal combustion engine) dominant number of cylinders even. The working process of a 4 stroke diesel motor is divided into two turns of the crankshaft and four times the piston stroke from top dead point to bottom dead point, namely the suction, compression, effort and exhaust steps.

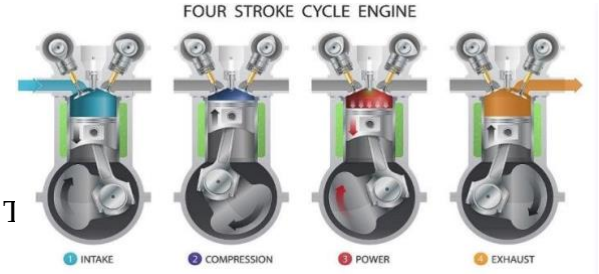


Figure 1 Diesel Engine 4 Stroke
Sumber.(https://www.speedwork.id/perbedaan_sistem_kerja_motor_2_tak_dan_motor_4tak.html

a. suction step : The piston or piston moves from TDC to BDC with the intake valve open and the exhaust valve closed.
b. Compression stroke : The piston moves from BDC to TDC with the intake and exhaust valves closed to compress fuel and air to produce an explosion of combustion or power.
c. Work steps : The piston moves from TDC to BDC with all valves still closed due to the impact of the explosion or the force of compression.
d. Discard step : The piston moves from BDC to TDC with the exhaust valve open and the piston pushes out the remaining combustion air and repeats itself continuously.

Diesel Engine Components : According to Sitindahon (2016), talking about diesel engine components (diesel engine parts) is an understanding of the operation or usefulness of various parts useful for a full understanding of the entire diesel engine. Each part or unit has its own specific function to perform and works together with other parts to form a diesel engine. Various companies producing diesel engines have different technologies in making diesel engines. Each company also has identical characteristics. But basically all diesel engines have the same working principle. The main parts of a diesel engine are:

a. Cylinder Head : The cylinder head is the part that is in the uppermost position, namely the place where the valves work. Maintenance by often cleaning the valve where air enters and where exhaust gas is released, another way is to check regularly on cooling water so that the cylinder head does not crack.
b. *Cylinder liner :* Cylinder liner is where fuel combustion occurs and where power is generated. The inside of the cylinder liner is formed with a layer (liner) or sleeve or sleve, the diameter in the cylinder is called the hole (bore).
c. Torak (Piston) : The end of the cylinder workspace is closed by a piston that continues to the power shaft (crankshaft) generated by the combustion of fuel. The piston ring (piston ring) lubricated with engine oil produces a gas tight seal between the piston and the cylinder lining. The distance the piston travels from one end of the cylinder to the other is called the piston stroke.
d. Batang Engkol (*Connecting Rod*) : Connecting rod is a rod that has a different end of the part, a large part of one end called the small end of the crankshaft rod, paired with a wrist pen (wirst pin) or piston pen (piston pin) located inside the piston. The large end has a bearing for the crank pen. The crankshaft converts and continues the reciprocating motion of the piston into continuous rotation.

Combustion and Cooling System

a. Fuel Spraying Method
   According to Fanie.D.N.C (2017) in diesel motors, spraying fuel into the combustion chamber begins when the piston or piston approaches TMA through a very small hole in the nozzle.
   The better the fuel fogging, the more perfect the combustion will be, in the combustion chamber in addition to the high temperature and maximum pressure due to combustion. If the fuel mixture with air is not appropriate, the combustion process does not occur perfectly.
b. Combustion in the Cylinder
   Fuel is injected into the combustion chamber (cylinder) in the form of a fine mist, then becomes vapor and mixes with the surrounding air. the evaporation process continues as long as the temperature around the combustion chamber is sufficient. So the vaporization process takes place gradually. Likewise with the mixing process with air. So when there is a good fuel mixture, the fuel ignition process can take place properly. In-cylinder combustion occurs in stages where the initial stage of combustion occurs at a relatively

low combustion chamber temperature and the rate of combustion gradually becomes faster. This happens because the combustion chamber temperature is getting higher.

c. Cylinder cooling

At the top of the cylinder is the hottest part and some of the heat of the combustion gases is transferred directly to the cooling fluid. At the bottom of the cylinder, heat is transferred to the cooling fluid indirectly through the piston and piston rings. If the coolant does not operate normally, the temperature of each part of the cylinder will increase in temperature. This situation will cause damage to the combustion chamber wall due to thermal stress or damage to the valves at the top of the piston and congestion in the piston ring.

The temperature in the combustion chamber will be accepted by the cylinder wall, if it does not immediately get good cooling continuously, then the parts exposed to heat will experience expansion so that the cylinder coating will lose resistance and will cause expansion which has a worse impact on the cylinder.

The way that this does not happen, it can be done coating the cylinder on the surrounding or around the outside of the cylinder with a cooling room that is continuously during the combustion of cooling water.

The purpose of the cooling is: Prevention of the formation of charcoal substances from lubricating oil in the piston spring cavity which results in jamming of the spring. Cooling can reduce the impact of corrosion / erosion caused by high temperatures. If there is a difference in cooling temperature that is too low, the stresses will cause cracks in the cylinder coating, but this has been prevented by taking into account the thickness of the cylinder coating and metal structure.

Lubrication system : According to Ahmad. N. (2019) lubrication system is a chemical substance that is generally a liquid given between two moving objects to reduce friction, lubrication serves as a protective layer that separates the two surfaces in contact. The auxiliary engine system consists of many moving parts and rubs against each other. If this is not addressed then within a few minutes the engine will experience an increase in temperature. In accordance with the physical properties of the metal the motor will heat and then break and cause sparks and the worst possibility that will occur is a fire on board. In order to prevent fires caused by friction on moving engine parts, it can be done by providing lubrication, namely giving a layer of oil or oil film between two surfaces that experience friction. Thus the friction that occurs in moving components can be minimized.

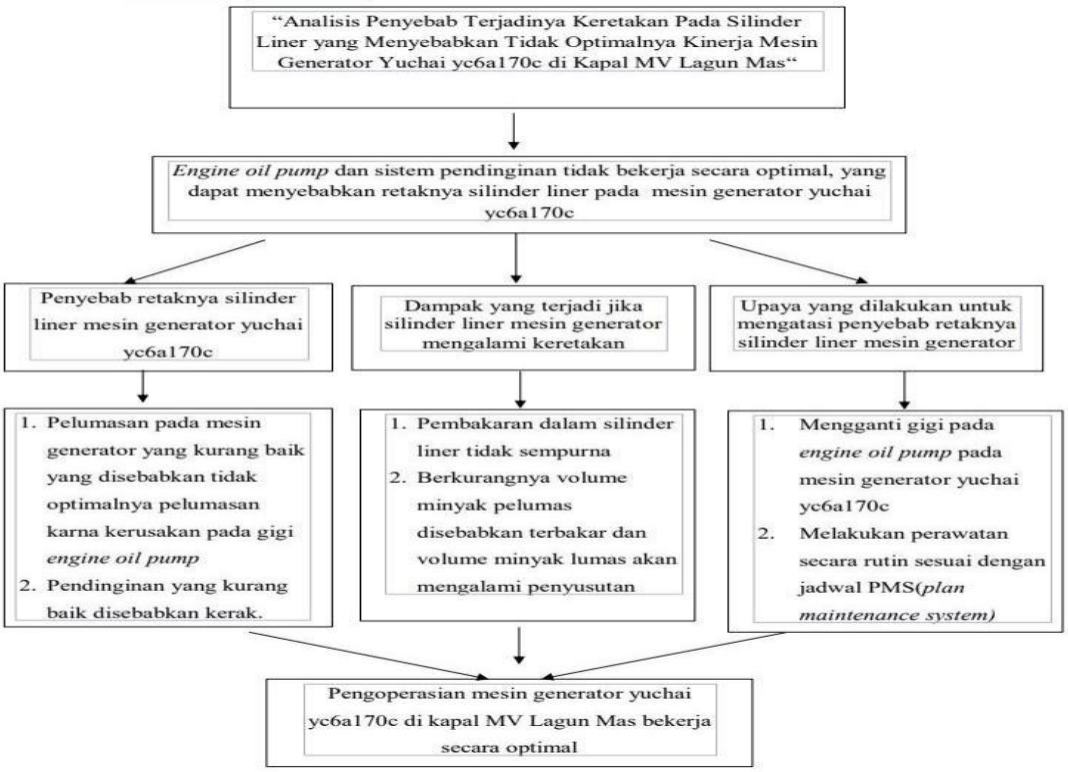
a. Lubrication Purpose : In some parts of the motor that move one against the other given lubricating material. (P.Van maanen, Diesel Motor ship volume The purpose of lubrication is: 1. Limitation of friction and friction wear. 2. Channeling of frictional heat. 3. Surface protection of corrosion materials. 4. Flushing of impurity materials. 5. Sound suppression. 6. Serves as a tight cover. 7. Surface treatment.

b. Lubrication Type : Lubrication systems in diesel motors or auxiliary engines are needed especially in parts that require lubrication, namely in gear bearings, cylinder walls, and others. Lubricating oil must be distributed to these parts. There are 3 lubrication systems, namely:

Splash Lubrication System : In this splash lubrication system, utilizing the rotation of the crankshaft to splash oil to the parts of the engine that require lubrication. In this splash lubrication system, the crankshaft at the bottom resembles a spoon, so that when the crankshaft rotates, the oil in the charter will be carried away and splashed by the crankshaft.

Press Lubrication System : In this press lubrication system, lubricant or oil will be circulated to all parts of the engine by an oil pump. The oil pump in this lubrication system functions to pump or press oil, so that the oil can circulate to all parts of the engine so that all parts of the engine get lubrication.

Combination Lubrication System : The combination lubrication system has two system units, namely the splash lubrication system and the press lubrication system, in the crank space there is a spoon that will splash engine oil to the parts that need lubrication and will be assisted by a press lubrication system that helps press lubricants into areas that are not reached from the reach of the splash system so that all parts that need lubrication will get oil evenly.



METHOD

According to Sugiyono. (2017), research methods are basically a scientific way to get data with specific purposes and uses. Based on this, there are four keywords that need to be considered, namely scientific methods, data, goals and uses. So that researchers use qualitative research methods to find data, collect data, process data and analyze data from the results of the study. This type of research is a case study, because this research uses qualitative research and includes case study researchers, the results of this study are descriptive analysis, namely in the form of written or spoken words of observed behavior, especially related to analyzing the causes of cracks in the cylinder liner which cause not optimal performance of the yuchai yc6a170c generator engine on the MV lagun Mas ship

RESULTS AND DISCUSSION

Based on previous research by Satiman (2019), he revealed that the factors that affect cylinder liner cracking include an imperfect lubrication system, errors in the cooling system, mechanism damage or poor material quality. Based on research by Bagus Sadewa (2018), he revealed that cylinder liner cracks are caused by poor cooling factors. The system cooling pump and damage by the pass valva/thermostat and the use of quality spare parts are not up to standard. In this discussion, the researcher will discuss the main problems that occur on the MV Lagun Mas ship, so that data is obtained regarding the formulation of problems made by researchers before practicing sea practice. In this discussion the researcher will explain what factors cause cracks in the cylinder liner of the yuchai yc6a170c generator engine on board the mv lagun mas.

The lubrication system on the generator engine is very necessary, especially in parts that require lubrication, lubricating oil must be distributed to moving parts so that if the lubrication does not run normally for a few minutes the engine will experience an increase in temperature. In accordance with the physical properties of metal the motor will crack and break. Therefore, the condition of the oil and oil pump on the generator engine must be paid attention to, here's how to install the generator lo attack pump gearpump on the yuchai engine; (1) Make sure the oil is empty from the charter, (2) Remove all fastening bolts on the gear housing part to facilitate the process of removing other parts, (3) Remove the fastening bolts on the carter on the yuchai yc6a170c generator engine. (4) Remove the fastening bolts on the generator engine oil pump gear.(5) Remove the spi pen on the oil pump gear (6) Remove the oil pump gear from the generator engine body. (7) Install the oil pump gear that matches the standard type from the manual book and spare parts. (8) Replace the spi pen and nut on the gear (9) Fasten the bolts on the oil pump gear with a ring wrench (10) Replace the generator engine oil charter (11) Replace the fastening bolts on the gear housing part so that the installation pays attention to the packing and tightness in between the generator engine body so that there is no leakage (12) Open one of the nepel bolts pay attention to the oil pressure that comes out of the bolt

How to change the charter oil when the generator engine when it is according to the schedule on the PMS (planning maintanance system) on the ISM CODE. Unscrew the fastening bolt on the valve to release the oil, Remove dirty oil from inside the charter, When it feels clean by rinsing the inside of the body with new oil, reinstall the bolt on the valve carter, Put new oil into the genertaor engine crankcase, Pay attention to the oil volume by checking the sounding wire of the crankcase, When it is sufficient, close the oil entry cover again.

CONCLUSION

Based on the results of research and discussion of the problems that the author has described, the authors can draw the following conclusions:

1. Routine checks on the oil pump gear that is not in accordance with the PMS (plannde maintanace system) in the generator engine can result in the circulation of lubrication in the engine not running properly so that wear occurs on moving parts so that it can result in temperature differences in rubbing parts such as cylinder liners so that it can cause cracks and leaks in the cylinder liner. Leaks caused by cracks in the cylinder liner will cause non-optimal performance of the generator engine due to leaks in the combustion chamber so that compression is not perfect and the power produced by the engine is not optimal.
2. Damage to the lubricant pump gear in the generator engine can be caused by wear on the pump gear, when the pump operates the lubricant on the gear does not flow normally resulting in friction between the teeth on the pump and causing erosion of the pump. The friction caused when the pump operates can cause heat so that it is easy to experience surface erosion and over time there will be a reduction in the size of the generator engine lubricating pump gear.

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