Overheat Analysis on the Scania P380 Engine UsingFishbone Analysis Method

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Article

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Abstract: Engine Overheating is a condition where the engine temperature has increased above the working temperature. This analysis aims to analyze the damage, determine the factors causing the damage, identify corrective steps and prevent engine overheating. The inspection procedure is carried out by checking the cooling system's components, cylinder head, and cylinder block. Further analysis using a fishbone diagram to analyze the causes of engine overheating troubleshooting. Damage analysis results Engine overheating occurs because the thermostat is damaged, namely the thermostat valve which cannot open when the temperature reaches the standard temperature (71oC), and also due to damage to the cylinder gasket which cause bubbles due to compression leaks and mixing of radiator coolant and oil. Repair steps taken in the form of replacing damaged components with new ones. Preventive measures are taken by not using the unit on an over-running basis, checking coolant levels, carrying out daily checks properly and correctly, carrying out preventive maintenance regularly.

Keywords: engine overheating; cooling system; cylinder head; cylinder blok

1. Introduction

Scania dump truck is one of the units produced by a company from Sweden. The Scania company is a company that specifically manufactures trucks and buses. In use, this unit is devoted to transporting coal and also to transport stockpiled materials for mining areas that have completed excavation and extraction of coal. Dump trucks are one of the units that work most often to transport materials, because the work process is often carried out, the unit needs to be carried out routine maintenance. One of the maintenance carried out is engine maintenance.

Engine overheat is a condition where the engine temperature has increased above working temperature. The engine overheating problem greatly affects the engine performance and productivity of the unit. The main cause of engine overheating is an abnormal occurrence in the engine cooling system. Of course, this must be addressed immediately, and the main problem is sought so that it does not spread and trigger damage to other important components in the cooling system.

Analysis of damage to the engine is a step to determine a damage that will be experienced by the machine. Therefore every machine needs maintenance to ensure that the machine can be used. So many units operating in the world of work that the demand increases and the demand will decrease when the unit is no longer able to operate.

2. Materials and Methods

Method steps fishbone

Step 1: Agree on the problem statement

Agree on a problem statement. This problem statement is interpreted as "effect", or visually in fishbone as "fish head".

Step 2: Identify the categories

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From the main horizontal line, make a diagonal line that becomes the "branches". Each branch represents the "main cause" of the problem written. This cause is interpreted as "cause", or visually in fishbone as "fishbone".

The main cause categories organize the causes in such a way that they make sense of the situation. This cause is interpreted as "cause", or visually in fishbone as "fishbone".

Step 3: Finding potential causes by brainstorming

Each category has causes that need to be explained through a brainstorming session. When the reasons are put forward, determine together where these reasons should be placed in the fishbone diagram, i.e. determine under which category the idea should be placed

Because it is written with horizontal lines so that many small "bones" come out of the diagonal lines.

A cause can be written in several places if the cause relates to several categories exit under which category the idea is because the cause relates to several categories

Step 4: Assess and agree on the most likely causes

After each category is filled in, look for the most likely cause among all the causes and their sub-causes.

If there are causes that appear in more than one category, the possibility is an indication of the most likely cause that appears in more than one category.

Review the causes listed (the reasons that seem most likely) and ask, "Why is this the reason?"

Ask “Why ?” until the question can no longer be answered. When you get there, the main causes have been identified. Circle the causes that seem most likely on the fishbone diagram \

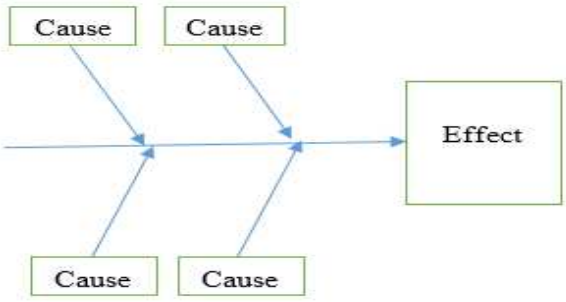

Figure 1. Making Fishbone Diagrams.

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Research Flow

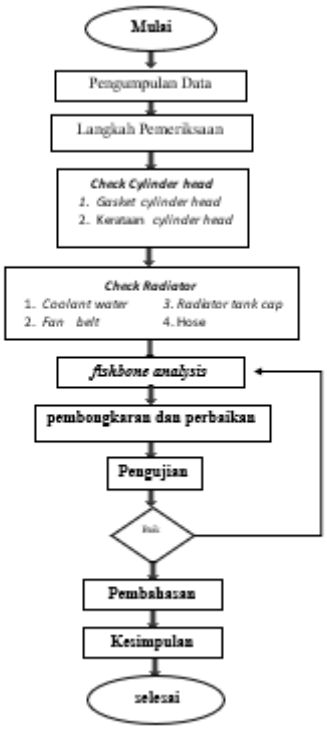

Figure 2. Research Flow Diagram.

3. Results and Discussion

In the process of checking the cylinder head, a visual inspection is carried out. In this inspection, it can be seen that in the gaps of the cylinder head and cylinder block there is seepage of cooling water coming out of the gaps. After this inspection, the step taken is to open the cylinder head to find out which component is causing the leak. After disassembling the cylinder head, it can be seen that the cylinder head gasket components have been damaged.

Figure 1. Damaged cylinder head gasket.

Check the flatness of the cylinder head to find out whether there is rust that appears on the surface of the cylinder and cylinder block. And on this inspection it can be seen that the surface of the cylinder and cylinder block has rust. Rust on the surface of the cylinder head and cylinder block can also affect the density when installing the cylinder head gasket.

In checking the water level in the cooling water/coolant water, a visual check is carried out to see if the radiator lacks cooling water. And the results of the inspection of the radiator lack of cooling water due to a leak in the cylinder head gasket.

In this inspection, the tightness of the fan belt is checked, and the result is that the tightness of the fan belt is still in good condition.

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In checking the radiator cap, check the radiator cap seal. To find out whether the seal is still in good condition or not, and the result is that the seal from the radiator cap is still in good condition

Examination of the radiator hose is carried out by a visual inspection to see on the radiator hose whether the radiator hose has cracks until the threads are visible so that it can cause leaks

Analysis using Fishbone Diagram

After checking the cylinder head and cylinder block, the next step is to do an analysis using a fishbone diagram to find out the cause of overheating. There are several steps in conducting an analysis using a fishbone diagram:

a) Agreed on problems that occur with the engine, any problems that occur [there is an engine is the engine has overheated. So, the problem that is agreed upon or that is used as an effect or visually in fishbone such as a fish head is "engine overheat"

b) The second step is to identify the categories that become branches in each of the main causes, while the categories that become the main causes or causes are:

Man, Material, Metodhe, Machine/Tools

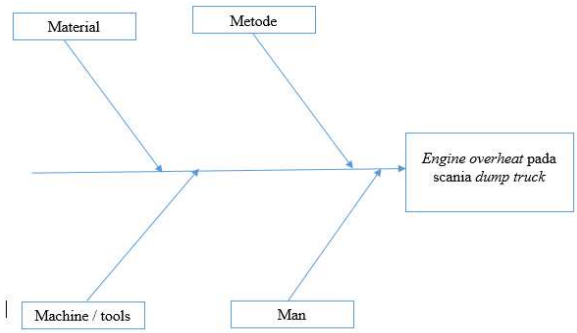

Figure 1. Steps to Make a Fishbone Diagram.

c) Step 3 is to find a potential cause by means of barriostroming

In this step, to list the causes from the category of causes, it is carried out through a brainstorming session. This barinstorming session is carried out to express ideas, where the ideas put forward will be explained, and some will fall later. This aims to determine the possible causes that can cause overheating of the engine. If the reasons have been stated, it must be determined where the ideas or ideas are placed according to the category. Because it is written with horizontal lines so that many small bones come out of the horizontal lines.

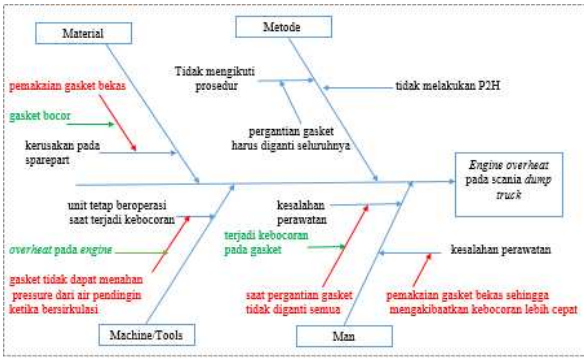

Figure 1. Potential Causes Fishbone Diagram.

c) Step 4 agree and examine the most likely causes After each category is filled in, look for the cause that is most likely to cause overheating of the Scania dump truck p380 engine

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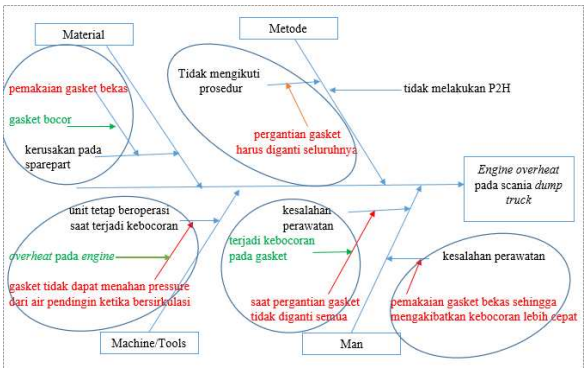

Figure 4. Possible causes of overheating agreed on the fishbone diagram.

Factors Causing Overheat using a fishbone diagram on the Scania Dump Truck Engine P380

From the fishbone diagram it can be seen that the cause of engine overheating is that the engine has a shortage of cooling water due to a leak in the cylinder head gasket, where a leak in the cylinder head gasket causes the leaky gasket to be unable to withstand the pressure from the cooling water when it circulates at the engine's ideal working temperature.

The factors that cause leaks in the cylinder head gasket are factors when carrying out maintenance on the engine. When carrying out maintenance, replacing the cylinder head gasket, the mechanic does not follow the company's procedures, in which the company's standard for replacing cylinder head gaskets is not allowed to replace only those that are damaged. But it is recommended to replace the entire cylinder head gasket.

To use used gaskets when changing engine cylinder head gaskets, this is highly not recommended because it will make used gaskets leak quickly and repair maintenance will always occur on the unit. This can also affect the company's productivity as a result of maintenance repairs that take a long time.

Table 1. Summary of discussion of fishbone diagrams.

Possible root cause	Discussion	Root cause
Manusia (Man)		
Maintenance error	When changing the gasket, the mechanic did not replace all the gaskets, resulting in a leak in the used gasket	Yes
Maintenance error	The use of used gaskets in the engine results in faster damage to used gaskets	Yes
Machine/Tools		
The unit remains operational in the event of a leak	Cooling water decreases quickly because the gasket cannot withstand the pressure from the cooling water when the cooling water circulates at the engine's ideal operating temperature. This causes the engine to overheat	Yes
Metodhe		
Not doing P2H	In the morning briefing the operator who will operate the unit will carry out daily checks and checks first	No
Not following procedures	In company procedures, when changing the gasket, a complete replacement of the cylinder head gasket must be carried out	Yes

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Material		
Damage to spare parts	The use of used gaskets causes the gasket to be damaged more quickly	Yes

Remedial steps

After the surface of the cylinder head and cylinder block is clean from rust. The next step is to install a new cylinder gasket. Before installing the gasket, first grease the cylinder head gasket using gasket glue such as a shellac gasket. This aims to glue all the material on the gasket.

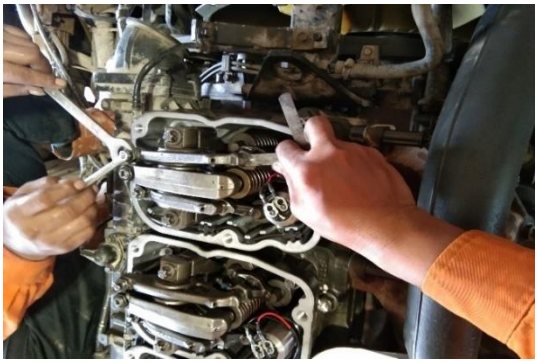

Figure 4. Penyetelan Valve Intake dan Exhaust.

After the cylinder head gasket is smeared, then install the gasket on the surface of the cylinder block first. After that, install the cylinder head and tighten all the bolts on the cylinder head. For tightening bolts on the cylinder head, each bolt tightness has its own value when tightened using a torque wrench.

In the process of tightening cylinder head bolts, it must be done in 4 steps. at each step the tightening of the bolts must be done crosswise. In the first stage of bolt tightness, use a torque wrench with a weight value of 60 Nm. In the second stage it is 150 Nm, in the third stage it is 250 Nm and in the 4th stage it rotates the bolt by 90 degrees.

Then tighten the injector bolts to a weight value of 70 Nm. Then tighten the upper rocker cover bolts with a weight value of 26 Nm. After tightening the bolts, the next step is to adjust the intake valve play and exhaust valve play. For the value of the intake valve play gap is 0.45 mm and for the exhaust valve play gap is 0.70 mm. Replace the cylinder head cover and the engine is ready for testing.

Conclusion

After examining the engine overheat that occurred in the Scania dump truck P380 unit, it can be concluded that the engine overheating occurred because there was a leak in the cylinder head gasket causing cooling water to come out of the cylinder head gasket. The reduction in cooling water is due to the cooling water that circulates when the engine's working temperature has pressure pumped from the water pump, where this pressure causes water to come out of the water jacket due to the head cylinder gasket not being able to withstand the pressure from the cooling water and from the results of analysis using fishbone diagram, overheating is caused by maintenance errors, in which the mechanic who does the maintenance does not completely replace the cylinder head gasket and this results in faster gasket leaks because some of the gaskets are replaced with new ones and some are used.

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