Damage Analysis of Hydraulic Bucket Cylinder on Excavator Komatsu CP-200 At PT. Wiratako Mitra Mulia

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I. Introduction

Indonesia is a developing country, one of which is in the field of construction, both building construction and transportation construction, such as office construction, bridge construction and road construction [1]. For this reason, the presence of heavy equipment in construction and manufacturing projects is very helpful and at the same time facilitates work that requires a large amount of energy and in a short period of time without using a lot of manpower. So that the work becomes faster and is able to meet the predetermined targets [2].

PT. Wiratako Mitra Mulia as one of the companies engaged in asphalt construction and road repair. At this time PT. Wiratako Mitra Mulia uses several heavy equipment to facilitate the work process, one of the heavy equipment used by PT. Wiratako Mitra Mulia is an excavator which is used for the process of dredging soil, moving materials and leveling the ground. From this, there are several obstacles or problems that occur in the excavator, such as damage to the bucket hydraulic cylinder, in which the bucket hydraulic cylinder has an oil leak, cylinder piston damage and seal leakage, therefore proper and scheduled maintenance is needed so that the damage that occurs to the hydraulic cylinder of the bucket excavator can be minimized so that the work process can run smoothly and do not experience any problems. Therefore, daily, weekly, monthly and yearly maintenance is required. For daily maintenance carried out every day by checking lubricants and performing services, for weekly maintenance inspections are carried out every 60 working hours. For monthly maintenance it is done every 250 working hours and for annual maintenance it is done every 2500 working hours.

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ABSTRACT

PT. Wiratako Mitra Mulia is a company engaged in asphalt construction and road repair. At this time PT. Wiratako Mitra Mulia uses several heavy equipment to facilitate the work process, one of the heavy equipment used by PT. Wiratako Mitra Mulia is an excavator which is used for the process of dredging soil, moving materials and leveling the ground. From this, there are several obstacles or problems that occur in the excavator, such as damage to the bucket hydraulic cylinder, in which the bucket hydraulic cylinder has an oil leak, cylinder piston damage and seal leakage, therefore proper and scheduled maintenance is needed so that the damage that occurs to the hydraulic cylinder of the bucket excavator can be minimized so that the work process can run smoothly and do not experience any problems. Therefore, daily, weekly, monthly and yearly maintenance is required. For daily maintenance carried out every day by checking lubricants and performing services, for weekly maintenance inspections are carried out every 60 working hours. For monthly maintenance it is done every 250 working hours and for annual maintenance it is done every 2500 working hours.
dredging soil, clearing land, lifting and moving materials, and leveling the ground. On the excavator, the movement process is assisted by equipment components using a hydraulic system consisting of several main components such as pump, engine, final drive, control valve, center join, boom, arm, and bucket [5].

Based on field observations and also from interviews with several operators and mechanics, there are a lot of damage, especially to the components in the hydraulic cylinder system, and this will hamper construction work [6]. In the process of repairing the hydraulic system to problems that often occur, such as a mismatch of component specifications based on existing standards, or inaccuracies in measuring spare parts, the material of the components is not based on the recommended or predetermined specifications [7].

Based on the results of the 4-month internship, the researcher conducted interviews with several technicians and operators at PT. Wiratako Mitra Mulia. From the results of observations and interviews found several problems that often occur in the excavator komatsu CP-200, including damage to the hydraulic bucket cylinder, therefore it is necessary to carry out maintenance on a scale to ensure that the excavator is in normal condition. Based on the problems above, it is necessary to analyze the damage to the hydraulic system periodically, so that the hydraulic excavator bucket cylinder remains in normal condition and the work process is not hampered [8].

II. Research Methods

In this study, researchers collected literacy and used research methods by conducting observations, surveys in the field at PT. Wiratako Mitra Mulia related to the excavator komatsu CP-200 heavy equipment. To get the desired results, the authors conducted research as well as interviewing, and conducting direct observations on the excavator komatsu CP-200 heavy equipment. this research was conducted for four months at PT. Wiratako Mitra Mulia starting from August 30, 2021 to December 20, 2022. The components of the hydraulic cylinder are shown in Figure 1. the specifications for the damaged equipment are as follows:

1. Specifications of the excavator komatsu CP-200 bucket cylinder:
   - cylinder capacity : 20 ton
   - stroke : 100mm
   - oil capacity : 311 ml
   - piston rod diameter : 45 mm
   - oil viscosity : 10 sae
   - inner diameter : 62.8 mm

   The calculation of the force acting on the hydraulic system can be calculated by the following equation.

   \[ F = P \times A \]

   Where:
   - \( F \) = is the force acting on the system hydraulic
   - \( P \) = is the pressure of the working fluid inside the hydraulic cylinder
   - \( A \) = is the effective area for work piston

2. Excavator komatsu CP-200 cylinder piston specifications:
   - piston rod diameter : 80 mm
   - piston diameter : 115 mm
   - piston material type : gray cast iron

3. Specifications o-seal cylinder excavator komatsu CP-200:
   - outside diameter : 293 mm
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III. Results and Discussion

Hydraulic system is a form of power transfer using a liquid medium that works according to pascal’s law [9]. One example of a hydraulic system that we often see is the hydraulic bucket cylinder on the excavator which functions to move the excavator bucket, as for the components in the hydraulic bucket cylinder system. Among others hydraulic pump, hydraulic hose, piston rod, piston, cylinder, seal, hydraulic oil are several other supporting components [8].

A. Damage Analysis

After making observations during an internship that lasted for 4 months at PT. Wiratako Mitra Mulia, the author found several problems that occurred in the hydraulic cylinder of the excavator komatsu CP-200, such as damage to the piston rod that was experiencing wear, the piston seals that have leaks and damage to the hydraulic hose system that leaks in the hydraulic fluid.

After doing the research, it was found that several problems occurred in the hydraulic cylinder of the excavator komatsu CP-200 bucket, as shown in Figure 2. Factors of the operator in operating the excavator.

The fishbone diagram for the hydraulic bucket cylinder damage is shown in Figure 3. Here are some problems that occur in the hydraulic bucket cylinder excavator komatsu CP-200 at PT. Wiratako Mitra Mulia:

1. Hydraulic system that often has problems, one of which is the oil for the hydraulic system is reduced (not according to standards), this can happen due to several reasons such as leaks in the cylinder hose or leaks in the cylinder seal.
2. Bucket cylinder components that are not in accordance with the standard or the material is damaged, such as scratching the piston rod and wear and tear that occurs on the piston head so that the hydraulic system in the excavator bucket experiences.

3. Operator negligence in operating the excavator komatsu CP-200 that does not carry out scheduled maintenance or the maintenance is not optimal.

4. Hydraulic cylinder jammed and scratched caused by mechanics not performing a hydraulic cylinder motion test so that they experience problems when operating in the field.

5. Hydraulic cylinder experienced an oil leak due to excessive load that occurs when the operator lifts the load.

6. The factor of negligence in checking the quality of the oil which is sometimes less than optimal which results in a less than optimal bucket performance system.

7. The factor that often occurs in hydraulic bucket cylinders is that the seal oring that is installed does not fit and causes the seal oring to be repeatedly damaged.

B. Due To Damage To The Hydraulic Bucket Cylinder

After doing research, it was found that several problems occurred in the hydraulic bucket cylinder of the excavator komatsu CP-200, such as:

1. Hydraulic bucket cylinder move slowly and do not have the strength to lift.

2. Hydraulic bucket cylinder moves slowly when it reaches a certain height.

3. Sometimes hydraulic bucket cylinder don't want to go up.

4. There is a friction sound that occurs around the hydraulic bucket cylinder.

5. Leaking part of the hydraulic system that allows other materials to enter during field work.

6. Leakage in the engine system that causes the combustion system to be imperfect and experience lubrication disturbances in the hydraulic bucket cylinder.

7. Excess load when lifting can result in bending of the cylindrical rod section.

8. Oil temperature that is not suitable and will result in damaged oring seals.

9. Reduced oil quality due to dirt and dust entering the oil cylinder.

10. Hydraulic cylinder it is easy to get stuck while operating in the field due to the weather that occurs in the field which causes the hydraulic cylinder to have abrasions on the rod.

C. Damage Handling

- Tools and Materials Used
  - tools used
  - moment wrench.
  - ring lock/pass
  - hammer

Figure 3. Fishbone Diagram of Hydraulic Bucket Cylinder Damage

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- shock lock
- screwdriver min.
- pliers.
- seal kid
- o ring
- grease/grease
- solar.

**Repair Step**
after the analysis is carried out, the following corrective steps are carried out:

- **Re-Seal Repair System**
  Figure 4. shows the re-seal turn. The system for changing the re-seal includes replacing all hydraulic cylinder seal kits damaged and it's time to replace it with a new one.

- **Re-Chrome Repair System**
  The re-chore repair system is shown in Figure 5, while the replacement of the re-choreme is only carried out on the smooth metal layer and has direct contact with the seal kit which has high elasticity, but has a weakness when it rubs against a rough surface.

The process of repairing bucket hydraulic cylinders that were damaged due to abrasions due to friction on the wiper rods.

**D. Preventive Maintenance and Corrective Hydraulic Bucket Maintenance on Excavator Komatsu CP-200**

**Preventive Maintenance**
The following is a description of the types of preventive maintenance on the hydraulic system components of the excavator komatsu CP-200 as shown in Table 1.

**Corrective Maintenance**

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Corrective type maintenance on the hydraulic system components of the excavator Komatsu CP-200 is shown in Table 2.

### Table 1. Preventive maintenance hydraulic system excavator Komatsu CP-200

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Description or Action</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>oil hydraulic filter</td>
<td>inspection of the oil hydraulic filter</td>
<td>100 working hours</td>
</tr>
<tr>
<td>2</td>
<td>pump</td>
<td>pump inspection for seal leaks</td>
<td>after every job</td>
</tr>
<tr>
<td>3</td>
<td>oil hydraulic</td>
<td>checking for hydraulic oil viscosity or replacing oil hydraulic</td>
<td>500 working hours</td>
</tr>
<tr>
<td>4</td>
<td>cylinder hydraulic boom</td>
<td>cylinder hydraulic boom performance inspection, and seal leakage</td>
<td>done doing work</td>
</tr>
<tr>
<td>5</td>
<td>cylinder hydraulic arm</td>
<td>cylinder arm performance inspection, and seal leaks</td>
<td>done doing work</td>
</tr>
<tr>
<td>6</td>
<td>cylinder hydraulic bucket</td>
<td>cylinder bucket performance inspection, seal leak checking</td>
<td>done doing work</td>
</tr>
<tr>
<td>7</td>
<td>coolant radiator</td>
<td>check radiator water</td>
<td>50 working hours</td>
</tr>
<tr>
<td>8</td>
<td>pump seal</td>
<td>check for leaks of seals on all pumped hose connections</td>
<td>completed operation and every 100 working hours</td>
</tr>
</tbody>
</table>

### Table 2. Corrective excavator Komatsu CP-200. hydraulic system component maintenance

<table>
<thead>
<tr>
<th>No</th>
<th>Component</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>planetary gear</td>
<td>planetary gear broken, caused by reduced oil in travel drive</td>
<td>change</td>
</tr>
<tr>
<td>2</td>
<td>spool</td>
<td>spool is abrasive</td>
<td>change</td>
</tr>
<tr>
<td>3</td>
<td>planetary gear</td>
<td>planetary gear broken, caused by reduced oil in the swing drive</td>
<td>change</td>
</tr>
<tr>
<td>4</td>
<td>seal</td>
<td>oil spilled from bucket, arm and boom cylinder tubes</td>
<td>change</td>
</tr>
<tr>
<td>5</td>
<td>hose</td>
<td>cracks in the hose caused by prolonged use and too high pressure.</td>
<td>change</td>
</tr>
<tr>
<td>6</td>
<td>stick cylinder</td>
<td>wiper seal tear and lip seal fatigue</td>
<td>reconditioning stick cylinder</td>
</tr>
<tr>
<td>7</td>
<td>oil pan</td>
<td>the oil pan gasket is hard or damaged so it leaks</td>
<td>patch the leaky side of the oil pan with silicon paste</td>
</tr>
<tr>
<td>8</td>
<td>swing gear</td>
<td>the rotary movement of the excavator is difficult, because the gear is damaged (worn) due to running out of oil</td>
<td>change</td>
</tr>
<tr>
<td>9</td>
<td>fuel lines</td>
<td>blockage in fuel circulation makes it difficult for the engine to run</td>
<td>replace the fuel hose</td>
</tr>
<tr>
<td>10</td>
<td>grease injector</td>
<td>grease lubrication on certain components is blocked</td>
<td>replace grease injector</td>
</tr>
</tbody>
</table>

### IV. Conclusion

Based on the results of the discussion above, it can be concluded that the damage that often occurs to the excavator Komatsu CP-200 is the bucket cylinder, namely, the cylinder bucket has problems such as, the hydraulic bucket cylinder does not want to go up, the hydraulic bucket cylinder moves slowly or slowly when certain heights and sometimes the bucket hydraulic system...
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does not work. After doing research on the problems that occur, it is found several causes of the damage, namely.

The oil or oil in the bucket hydraulic system is reduced or not according to the usual standard, this occurs because there is a leak in the hydraulic system such as the hydraulic hose and cylinder seal. as for the problem, it can also occur due to material factors that are damaged, such as scratches on the piston rod and wear and tear on the piston head. The other factors that cause damage to the hydraulic bucket cylinder are also caused by operator negligence, such as not checking the excavator before working.

Therefore it is necessary to carry out scheduled maintenance or checks such as daily, weekly, monthly, and annual checks, to ensure the condition of the bucket hydraulic cylinder.

References