SIZING OF DUAL HYDRAULIC CYLINDER OF LIFTER SYSTEM FOR 6X6 OIL PALM FRUIT BUNCH TRANSPORTER VEHICLE

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ABSTRACT: The new design of lifter system for 6x6 oil palm fruit bunch transporter vehicle requires optimum specifications for it to operate effectively. Because of that, the aim of this study is sizing the hydraulic cylinder that is going to be used in the lifter system. It was carried out using theoretical analysis by focusing on determining the appropriate cylinder diameter. The analysis is based on the required power of the hydraulic cylinder when operating at maximum stroke of 0.5 m and maximum payload of 2200 kg. It was acquired by determining the maximum operating speed of the hydraulic cylinder. The result showed that cylinder diameter of 0.13 m required the minimum power among all the other specifications. It showed comparable performance as other bigger cylinder diameter such as 0.17 m. Dual cylinder configuration also showed better system's efficiency as compared to single cylinder configuration with the value of 70.83%. Based on that, double cylinder configuration with the diameter of 0.13 m was selected as the size of the new lifter system.

KEYWORDS: *Lifter System; Hydraulic Cylinder; 6x6 Transporter*

1.0 INTRODUCTION

Palm oil plantations require transportation vehicle to carry the oil palm fruit bunch from the farm to the processing plant. Because of that, there is always a demand to design new transportation vehicle in order to increase the effectiveness of the farm operation especially in Malaysia (Deraman et al., 2013). One of the new vehicle design is by utilizing 6x6 transporter vehicle that is equipped with steel bucket to carry the heavy load of oil palm fruit bunch.

It also requires lifter system in order to tilt the steel bucket during the unloading process (Shuib et al., 2009). This tilting procedure is commonly utilizing hydraulic cylinder due to its proven capability of producing or withstanding high forces (Borikar et al., 2012). In the case of designing this new 6x6 oil palm fruit bunch transporter vehicle, it is necessary to do proper sizing of this hydraulic system especially the cylinder diameter (Prakalp et al., 2017). It is important to ensure the system is able to carry the desired load with fast operating time and preferably by having the cylinder size that is available in the market.

Due to that reasons, the aim of this study is to determine the appropriate size of hydraulic cylinder to be utilized in the lifter system of the transporter vehicle.

2.0 RESEARCH METHODOLOGY

The initial phase of this study was determining the lifter operating parameters. It had been set based on the design configuration of the 6x6 transporter vehicle and the maximum payload. Details of the parameters are listed in Table 1 below.

Table 1 Lifter System Parameters

Parameter	Value
Load Capacity	2200 kg
Specific Gravity of Hydraulic Oil	0.87
Maximum Stroke	50 cm
Pressure Relief Valve	90 bar
Volume Flow Rate	85 lpm

Next, the size of the hydraulic cylinder was calculated theoretically, especially the cylinder diameter. It included two types of configurations, namely single cylinder and dual cylinder.

Cylinder velocities of achieving maximum stroke of 0.5 m during extending and retracting were calculated. Based on that, the required power of the cylinder in performing these operations were also determined. This aspect is important in obtaining the power source of the hydraulic system.

3.0 RESULTS AND DISCUSSION

Figure 1 below shows the relationship between cylinder diameter and cylinder power during maximum stroke. Based on this figure, higher cylinder power is produced during the retracting motion because of the higher speed of cylinder travel.

Because of that, the sizing of cylinder diameter is based on retracting motion. Cylinder power is showing linear trend from the cylinder diameter of 0.13 m until 0.17 m. By increasing the cylinder diameter bigger than 0.17 m shows significant increment of cylinder power. In selecting the cylinder diameter, low cylinder power is preferable. Due to that reason, cylinder diameter of 0.13 m is selected for this new lifter system because it shows comparable power as cylinder 0.17 m but still able to fulfil the desired system's performance.

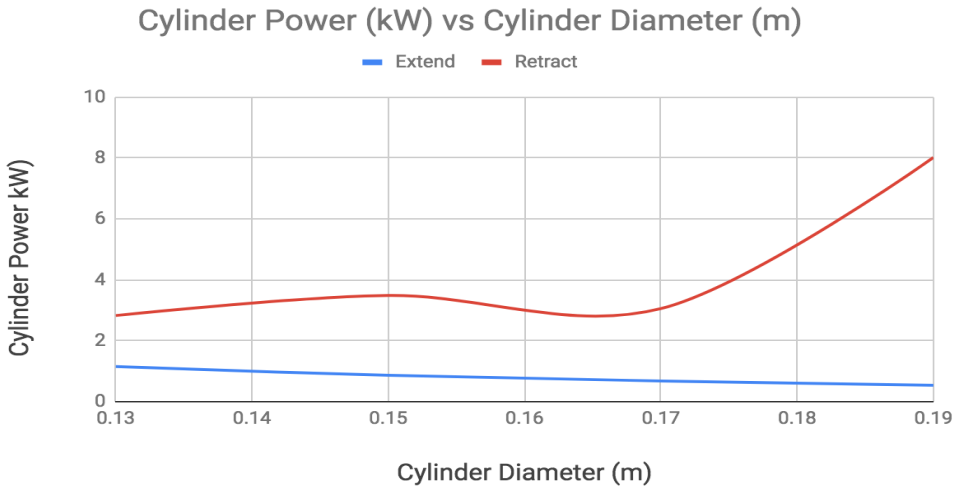

Figure 1 Power vs Diameter for Dual Hydraulic Cylinder

For the purpose of comparison, the efficiency of the system using single and dual cylinder with the same cylinder diameter of 0.13 m was determined. It was based on the same cylinder piston and piston rod diameters. The results of analysis are shown in Table 1 below.

Table 1 Comparison of Efficiency between Single and Dual Cylinder

Number of Cylinder	Diameter (m)		Volumetric Flow Rate (LPM)		Pump Efficiency (%)
	Piston	Piston Rod	Theoretical	Actual	
Single	0.13	0.1	125	85	68.00
Dual	0.13	0.1	120	85	70.83

Based on that, it shows that dual cylinder has better system efficiency with value of 70.83%. Because of that, it has been chosen as the hydraulic cylinder configuration for the lifter system.

4.0 SUMMARY

The aim of this study is to determine the size of hydraulic cylinder that is going to be equipped in the new lifter system for 6x6 oil palm fruit bunch transporter vehicle. Theoretical analysis was carried in order to determine the optimum cylinder size. The main parameter under investigation was the cylinder power when it is operating at maximum stroke of 50 cm. It was based on the maximum speed of operation under the maximum load. Cylinder diameter of 0.13 m was chosen for the new lifter system because it required lowest power and had comparable performance as bigger cylinder diameter such as 0.17 m. Dual cylinder configuration was also chosen due to higher system's efficiency when comparing it with single cylinder configuration.

5.0 REFERENCES

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