



## Construction of a Mobile Oil Palm Frond Chopper

Somporn Phromduang\* and Saisunee Pongpatanasuegsa

The Industrial Engineering field, College of Engineering, Rangsit University, Pathum Thani, Thailand

\*Corresponding author, E-mail: Thum15@hotmail.com

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### Abstract

A Mobile Oil Palm Frond Chopper was designed and built to destroy the oil palm frond in the garden to reduce transportation problems of the oil palm frond. The essential components of the machine consist of machine structure, 13-horsepower engine, transmission system, four chopping blades, and moving wheels. From the performance test of the machine under various speeds of the chopper blade at 600, 800, 1,000, and 1200 rpm, the test results showed that the rotation speed of the cutting disk directly affects the optimization of the machine work, and the size of the oil palm frond obtained from the test decreases when the cutting speed of the cutting disk increases. With the speed of 1,000 rounds per minute, it can mince the oil palm frond with a maximum of 4,150 grams per minute and an average size of scraps oil palm frond is 2.3 centimeters.

**Keywords:** *Palm oil, Oil Palm Frond, Sub-chopper*

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### 1. Introduction

Palm oil is an economic crop of Thailand that is important for food and energy security. There are more than 200,000 Palm oil planters, more than 1,800 merchants who gather Palm oil fruit or Palm collection centers. There are about 190 of the Palm oil industry plants, including palm oil mills, palm oil refinery, and biodiesel production plants (Agricultural Research Development Agency, 2015). Planting palm oil in Thailand in the year 2018, there is an area of 5,878,127 rai with a total output of 15,534,984 tons in the country (Office of Agricultural Economics, 2018).

In order to manage the palm oil plantations, farmers must cut the oil palm frond (OPF) every time that the oil palm bunch is harvested which in general, farmers will harvest the Oil palm bunch every 15 days. Therefore, in each month, the oil palm fronds will be cut off as shown in Figure 1, at least two fronds per plant or 44 fronds per rai when using the rate of 22 palm trees per rai (Eksomtramage et al., 2005). In the case of a new palm plantation that has not yet been produced, it is necessary to trim the Oil Palm Frond once a year. Most farmers will gather the oil palm fronds that were cut from the palm trees into a pile in the palm grove between the palm oil trees, which they divided into several piles and each pile will have the same amount. Then let the decomposition time decay into soil fertilizer for palm trees which takes longer than one year to decompose (Poonnayom, Yaemphuan, Wattnajitsiri, Triwanapong, & Kimapong, 2018).



**Figure 1** Post-harvest Oil palm frond trimming (Chaipattana Foundation. 2017)



However, the management of large-scale plantation areas requires management of the area for growing palm trees in order to make ease of work with efficiency and produce the desired product especially in the cutting of Oil palm frond which has much cutting off causing problems in the storage of the cut palm fronds. The Oil palm frond chopper is a tool that is used to break down the Oil palm frond to be 4-5 centimeters smaller in order to use in fertilizing the soil and used as food for animal husbandry (Poksawat & Songkong, 2011). However, conveying the palm fronds out of the area in order to use a massive wood chopper that cannot be moved to destroy the Oil palm frond in the area of the cuttings causing difficulties in operations. Therefore, this work has designed and built a Mobile Oil Palm Frond Chopper to use to destroy oil palm fronds within the palm plantations immediately and to reduce the problem of palm transportation. Besides, scraps of chopping can also be used for other benefits.

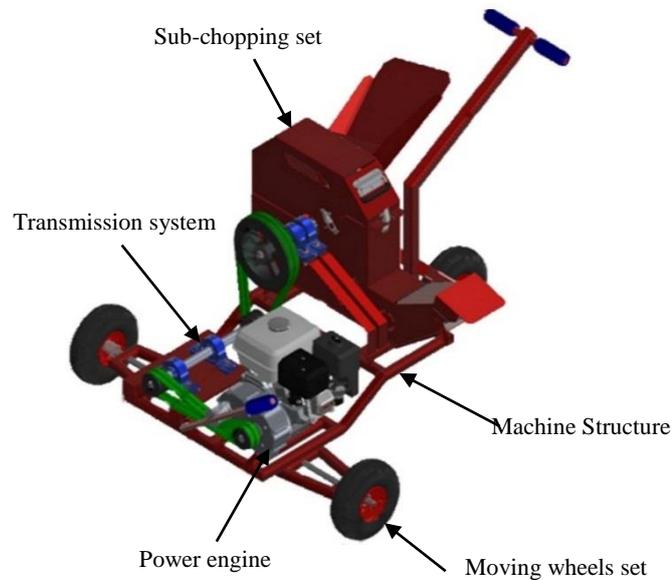
## 2. Methodology

### 2.1 Exploring of oil palm characteristics

Oil palm frond means all parts of the leaf consisting of leaves and petioles from the Palm oil tree, which is called Oil Palm Frond (Oil Palm Frond, OPF) (Chanjula, 2015). Oil Palm Frond from the base to the tip will have an average weight of 3.55 kilograms, an average length of 3,761 millimeters, the cross-sectional of the base is 34.74 mm thick, 111.91 mm wide, and the cross-sectional of the tail is 2.16 mm thick and 2.10 mm wide, and the cross-sectional of the tip is 2.16 mm thick and 2.10 mm wide. Oil Palm Frond from base to tip will have an average weight of 3.55 kilograms, an average length of 3,761 millimeters, a thickness of 34.74 - 2.16 millimeters, and a width of 111.91 - 2.10 millimeters (Poonnayom et al., 2018).

### 2.2 Design and build a prototype machine

From the results of studies on problems and various information, for the design of A Mobile Oil Palm Frond Chopper can be designed using engineering design principles and use computer programs to help in design (CAD) (Krutz, Thomson, & Claar, 1994; Shigley, & Mischke, 1989). Machine components consist of the main components, namely the machine structure, power engine, the power transmission system, the chopper, and the moving wheel, as shown in Figure 2. The construction of a Mobile Oil Palm Frond Chopper is shown in Figure 3. It is starting from the machine structure, which is the whole weight-bearing part of the machine which is manufactured from SS400 carbon steel, angle size 50 x 50 X 2.50 mm. The power engine used for driving has a size of 13 horsepower in which the transmission system of the engine consists of a belt set, a Pulley set, and a variable speed driveshaft to send power to the chopper. The sub-chopping set consists of the cutting disc is made from S50C material, and four cutting blades are made from SKD11 material that has been heat-treated to increase strength and lifetime of the blade.



**Figure 2** Prototypes model by CAD program



**Figure 3** A Mobile Oil Palm Frond Chopper

### 3. Testing process

The experimental operation of A Mobile Oil Palm Frond Chopper by determining the cutting speed of the cutting disc at 600, 800, 1,000, and 1200 rpm is a test condition ( Poonnayom et al., 2018). In order to find the right round speed for machining the oil palm frond, it will take 30 minutes for each experiment and repeat at least three times. While collecting the results, the machine performance will be evaluated by calculating the chopping efficiency as in equation 1 (Lungkpin et al., 2016). From then, the obtained scraps of chopping fronds will be taken to measure the size and record the results further.

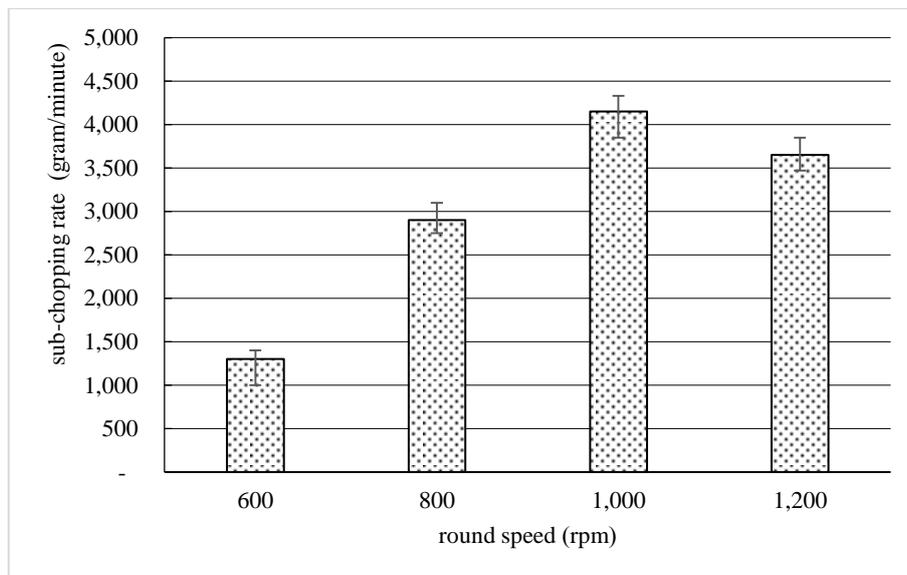
$$\text{Work Performance} = \text{Scraps of chopping Palm} / \text{Working time} \quad (1)$$



#### 4. Test results

From the test results under the specified conditions, it is found that the rpm affects the efficiency of the machine, as shown in figure 4. It was found that the oil palm frond sub-chopping rate tended to increase at the speed of 600-1,000 rpm and the sub-chopping rate decreased when experimenting speed at 1,200 rpm which due to at this speed, the cutting blade rotates too fast, resulting in a difficulty in pushing the oil palm frond into the sub-chopping set; therefore, affecting in the rate of sub-chopping at that speed. The test results at the cutting speed of the cutting disc at 600, 800, 1,000, and 1200 rpm had an average chopping rate of Oil palm frond equal to 1,300, 2,900, 4,150, and 3,650 grams per minute respectively.

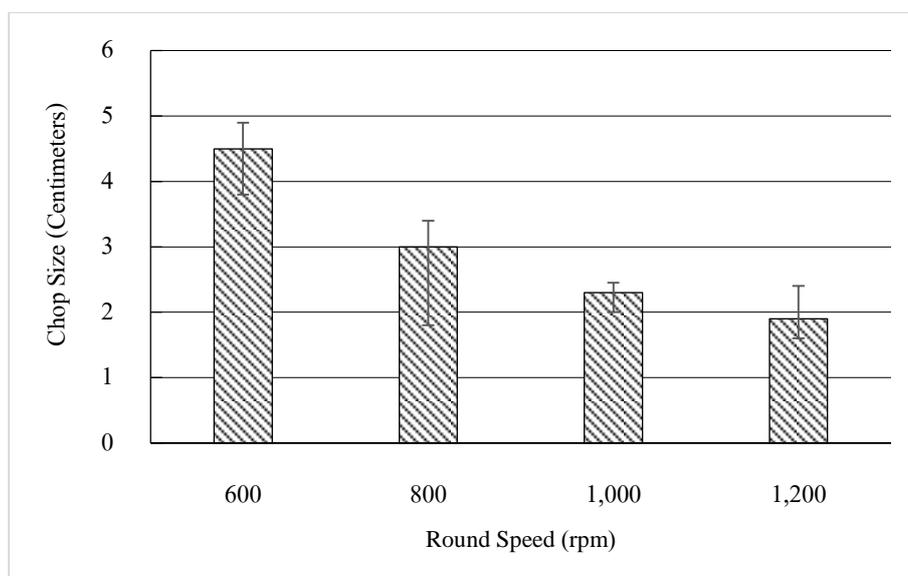
While the scraps of oil palm fronds undergoing sub-chopping of each variable have distinct characteristics and sizes, as in Figure 5. Scraps from the sub-chopping at 600 and 800 rpm are relatively large, while scraps from the sub-chopping at 1,000 and 1,200 rpm have a lot of fine scraps and mixed with some of the large scraps. The size of the scraps oil palm frond that has been chopped at 600, 800, 1,000, and 1200 rpm has an average size of 4.5, 3, 2.3, and 1.9 centimeters, respectively, as in Figure 6.



**Figure 4** The relationship between the cutting round speed and sub-chopping rate of the oil palm frond



**Figure 5** Comparison of the scraps oil palm fronds that passed sub-chopping of each round speed



**Figure 6** Comparison of scraps oil palm frond's sizes that passed sub-chopping

## 5. Conclusion

The construction of A Mobile Oil Palm Frond Chopper is conclusion the operation as follows:

- Oil Palm Frond Chopper from the designed and construction is 1,200 millimeters width, 1,500 millimeters length, 900 millimeters height, cutting speed 600-1,200 rounds per minute, the number of 4 blades, and the engine power is 13 horsepower.
- The appropriate speed in the sub-chopping of oil palm frond is 1,000 rpm, which can sub-chopping of oil palm frond 4,150 grams per minute and the average size of scraps oil palm frond is 2.3 centimeters.
- The size of the tested scraps oil palm frond decreased when the cutting speed of the cutting disc increased.
- The increased rotation speed of the cutting disc directly affects work efficiency.

## 6. Acknowledgment

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