CHAPTER I
INTRODUCTION

This chapter contains background, problem formulation, research objectives, research scopes, outline of report.

1.1 Background

The national palm oil industry is a strategic industry in the macro economy which plays a role in generating the largest foreign exchange, driving the national economy, developing national sovereignty, the community economy and in absorbing labor. In 2022, the achievement of CPO production was 46.729 million tons with total domestic consumption reaching 20.968 million tons. Exports of palm oil in 2022 amounted to 30.803 million tons with an export value of US$ 39.28 billion (CPO, processed and its derivatives). The ten destination countries for Indonesia's palm oil exports are China, India, the USA, Pakistan, Malaysia, the Netherlands, Bangladesh, Egypt, Russia and Italy. With these achievements in production, domestic consumption and exports, domestic palm oil stocks are estimated to reach 3.658 million tons (GAPKI, 2023).

Based on the roles, benefits, and growth rates of palm oil production and consumption in Indonesia, the palm oil industry must be ready to compete fiercely in achieving production targets to meet market demand. This causes companies engaged in the processing of palm oil to immediately address the factors inhibiting production growth.

One of the companies engaged in the national palm oil industry is PT SMART Tbk (SMART) which is a subsidiary of Golden Agri Resources (GAR), which operates under the brand Sinar Mas Agribusiness and Food in Indonesia which was established in 1962 and its shares are listed on the Indonesia Stock Exchange since 1992. The company is one of the leading integrated and publicly

listed palm-based consumer companies in Indonesia that focuses on sustainable palm oil production. SMART's main activities have started from managing around 137 thousand hectares of oil palm plantations in Indonesia, including plasma land, harvesting and processing fresh fruit bunches into crude palm oil (CPO) and palm kernel (PK), to processing them into various industrial and consumer products such as cooking oil, margarine, shortening, biodiesel, and oleochemicals, as well as trade in palm-based products worldwide.

PT SMART Tbk Padang Halaban Mill or commonly abbreviated as PHLM is one of the palm oil mills owned by PT SMART Tbk which is engaged in the processing of Fresh Fruit Bunch (FFB) into Crude Palm Oil (CPO) and Palm Kernel (PK). PHLM was first established in 1928 by a Dutch company and began to be acquired by Sinarmas in 1963 with the company's initial name PT Airlines Perkebunan Sumcama Padang Halaban with a factory capacity of 30 tons/hour. In 1991 the company changed its name to PT SMART Corporation which then changed its name to PT SMART Tbk in 1999.

In general, the production of CPO and PK in PHLM starts with the arrival of FFB in receiving station. In this station the FFB is weighed at the weighbridge, graded at the grading area, and then accommodated at the loading ramp to be forwarded to the truck with a first in first out (FIFO) system. The FFB are then cooked in a sterilizer with saturated steam in order to deactivating the lipase enzyme to avoid the rising of free fatty acid (FFA). Besides that, the sterilization also aims to facilitate the process of separating the fruitlet with the bunch at the thresher station. The fruitlets from the thresher station then are chopped and stirred so that the nuts and mesocarp are separated and the oil cells are released resulting in a cake. Furthermore, the cake that has been produced on the digester machine is pressed on a screw press machine to extract oil in the mesocarp to get crude oil and nut fiber (press cake). The resulting crude oil flows into the oil gutter while the nut fiber will enter the cake breaker conveyor. The results of the oil extraction are then filtered, precipitated, centrifuged, and refined at the clarification station to produce oil with production quality according to standards and then stored at the storage tank. The

nut fiber is processed at the nut and kernel station to separate fiber and nuts, kernels and shells, dry the kernels and then store them in silos. The FFB processing flow can be seen in **Figure 1.1**.

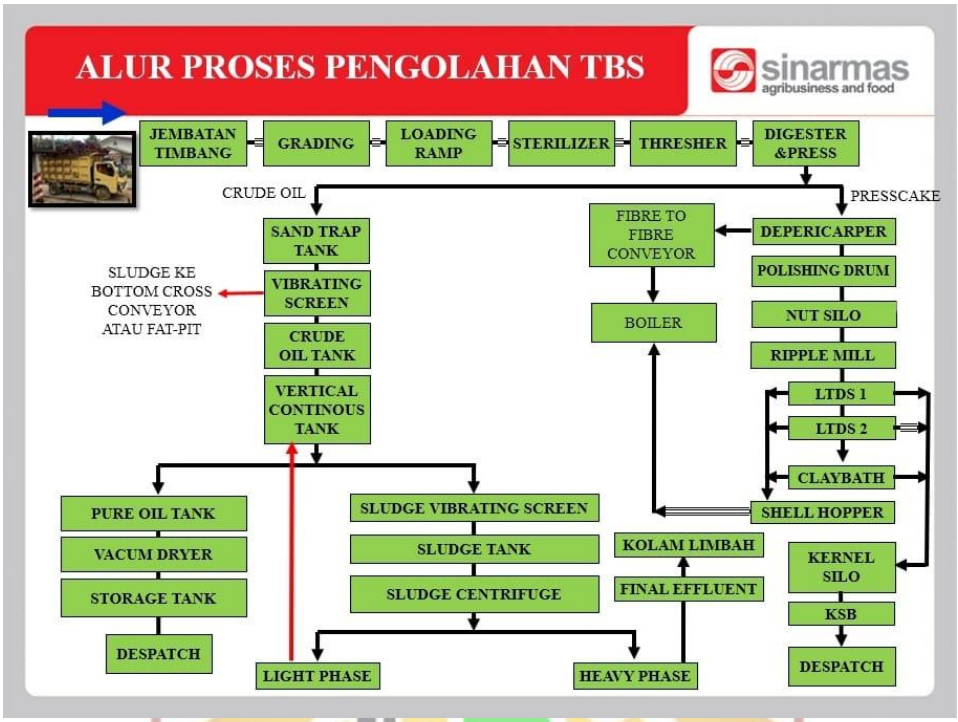

Figure 1.1 FFB Processing Flow
(**Source:** PT SMART Tbk Padang Halaban Mill)

Currently, the factory capacity of PHLM is 60 tons/hour. The high production capacity of the factory causes the machines that are operated to be required to have a high level of reliability in order to meet predetermined production targets.

Maintenance has an important role in ensuring the smooth operation of the machines and equipment used. According to Stevenson (2012), the objective of maintenance is to maintain the production system to work in a good order at minimal cost. A good operating condition for machines needs to be maintain in order to avoid the disruptions of production, addition of production costs, missed or delayed delivery dates and to maintain a high quality. This makes maintenance support the company simultaneously to increase the amount of production.

Maintenance activities cover all aspects of production and facilities such as machines, equipment, and buildings. Maintenance is also one of the activities that require money to be implemented.

Based on the results of an interview with Mr. Chetto Mohammed as a production controller staff, the maintenance activities implemented by the company are preventive maintenance, predictive maintenance, corrective maintenance, and overhaul. Preventive maintenance is carried out every 2 hours before starting the production process and every week for the entire machine. Predictive maintenance is carried out by repairing or replacing parts based on predictions using diagnostic tools to measure trends such as heat, vibration, etc., and then compare them with the engineering limit. Corrective maintenance is carried out in the event of failure while the machine is operating. Overhaul is a comprehensive engine repair activity. The company carries out an overhaul once a year.

Even though the company has carried out preventive and predictive maintenance activities, machine failure while the machine is operating which causes the company to carry out corrective maintenance still occurs frequently.

Corrective maintenance often occurs at the digester and press station. In 2021 to 2022 there are 771 times of failure with total repair cost of Rp. 2,076,891,852 at the digester and press station. On average, corrective maintenance occurs 2 times a day at this digester and press station with an average cost of Rp.3,473,063 per day. The digester and press station is one of the important stations because here the main activity of the CPO processing process, namely oil extraction, occurs. This station works to extract as much oil as possible from the fruitlet with a minimum of cracked nuts. To achieve this goal, it is necessary to maintain the reliability of the machines so that they can operate optimally. Therefore, scheduling periodic replacement is necessary to minimize the occurrence of breakdowns on the machine. The structure of each machine can be seen in **Figure 1.2** and **Figure 1.3**.

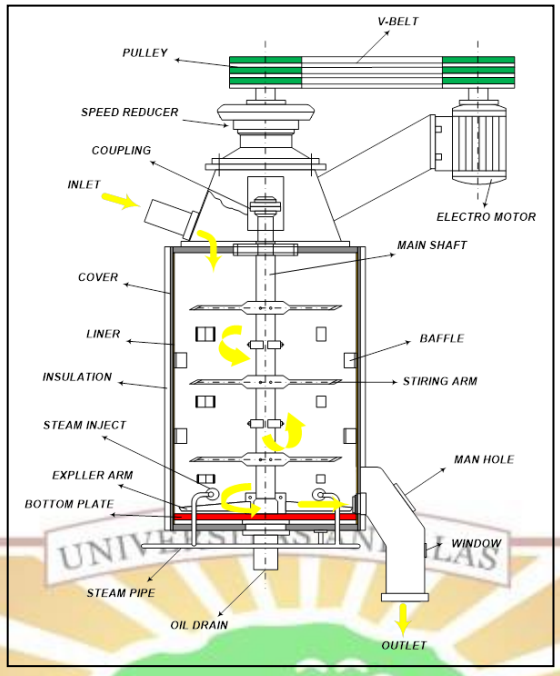

Figure 1.2 The Structure of Digester Machine
(**Source:** PT SMART Tbk Padang Halaban Mill)

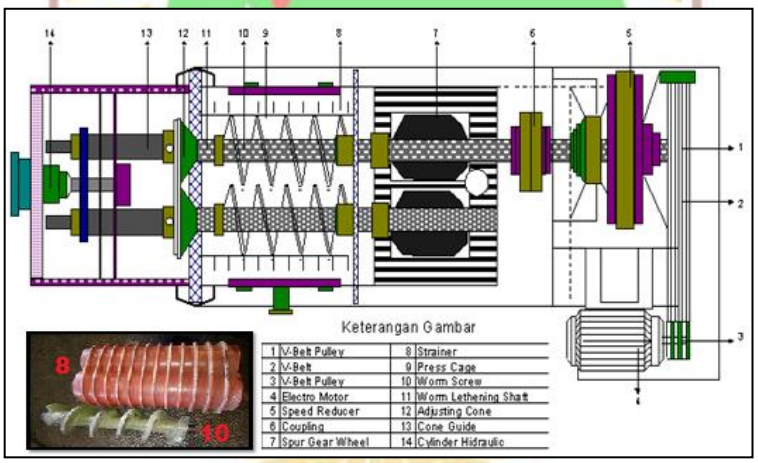

Figure 1.3 The Structure of Screw Press Machine
(**Source:** PT SMART Tbk Padang Halaban Mill)

In the digester and press station there are 6 machines with the capacity of each machine is 15 tons/hour. Based on interview with Mr. Chetto Mohammed, some main components failures in digester and press station requires a difficult replacement process due to the need of machine disassembly and reassembly. This causes a high downtime and the breakdown of the machine which can reduce the production capacity that can lead to the addition of the working hour. The

breakdown of the machine is also bothering the production process and time that can cause oil losses. It is necessary for the company to minimize the downtime of machine breakdown during the operation time because according to Laggoune et al., (2009), stated that in a system that runs continuously, breakdown of the machine causes a greater cost than the cost of purchasing components for replacement. That is why these disturbances during the operation time adding more costs that must be incurred by the company.

The amount of disturbance or damage is closely related to the level of reliability of an equipment. The level of reliability means the opportunity for an equipment not to be damaged at a certain time and work as expected. Efforts to reduce the frequency of equipment breakdowns or failure can increase the reliability of the equipment by improving the maintenance system. Improved maintenance system can improve productivity. With regular maintenance, it is possible to estimate the possibility of damage to production facilities in the future by taking into account past maintenance data.

Based on the problems that have been explained, to assist management in analyzing the maintenance of digester and screw press machines, it is necessary to conduct research to determine the time interval for replacing the components of the digester and screw press machines in order to reduce machine downtime and reduce production losses and maintenance costs. One of the methods that can be used is the optimal preventive age replacement method to minimize downtime. This method is carried out by determining the action of replacing components when their operations have reached the specified age. With the availability of the proposed replacement schedule for the components, it is hoped that it will be able to increase production operations on the digester and screw press machine so that it does not interfere with the smooth production of PT SMART Tbk Padang Halaban Mill.

1.2 Problem Formulation

Based on the background explained, the problem formulation for this research is what is the replacement time interval for the components in the digester and screw press machine to minimize downtime at PT SMART Tbk Padang Halaban Mill.

1.3 Research Objectives

The objective for this research is to obtained replacement time interval for components in digester and screw press machine to minimize downtime at PT SMART Tbk Padang Halaban Mill.

1.4 Research Scopes

The scopes for this research are:

1. The machines failure data used is the data from 2021 to 2022
2. This research only focuses on the mechanical parts of the machine
3. This research does not consider costs in its calculations

1.5 Outline of Report

The outline of this final project report are as follows:

CHAPTER I INTRODUCTION

This chapter contains background, problem formulation, research objectives, research scopes, outline of report.

CHAPTER II LITERATURE REVIEW

This chapter contains theoretical basis that are directly related to the problem under this research. The theories related to this research are maintenance system, preventive maintenance, Mean Time to Failure (MTTF) and Mean Time to Repair (MTTR) concept, reliability concept, and the optimal preventive age replacement to minimize the downtime.

CHAPTER III RESEARCH METHODOLOGY

This chapter contains the steps of research consists of preliminary study, literature review, problem formulation, data collection, data processing, discussion, conclusion, and research methodology flowchart.

CHAPTER IV DATA COLLECTION AND PROCESSING

This chapter contains the process of data collection and processing. The data collected in this research is regarding the time and frequency of damage to machine components, the time between machine component failures and the length downtime of the machine. Data processing in this research begins by determining the distribution of time to repair and time to failure data. Next, the mean time to failure and mean time to repair are calculated based on the selected distribution. After that, the optimal preventive replacement time is calculated to minimize downtime and the components are grouped into several modules based on the closest preventive replacement time. Lastly, a comparison of the actual downtime and the proposed downtime is carried out.

CHAPTER V ANALYSIS

This chapter contains analysis of maintenance policies and analysis of replacement time intervals for screw press and digester machine components at PT SMART Tbk Padang Halaban Mill.

CHAPTER VI CONCLUSION AND SUGGESTION

This chapter contains conclusions based on this final project research that has been carried out and suggestions provided for further research.