

A STUDY TO PROPOSE SOLUTION ON PALM OIL  
MILL SCREW PRESS MACHINE BREAKDOWN  
USING QC TOOLS

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA  
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## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

**TAJUK: A STUDY TO PROPOSE SOLUTION ON PALM OIL MILL SCREW PRESS MACHINE BREAKDOWN USING QC TOOLS**

**SESI PENGAJIAN: 2015/2016 Semester 2**

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I hereby, declared this report entitled “A Study to Propose Solution on Palm Oil Mill Screw Press Machine Breakdown Using QC Tools” is the results of my own research except as cited in references.

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## **APPROVAL**

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Process) (Hons.). The member of the supervisory is as follow:

.....

(Project Supervisor)



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**A STUDY TO PROPOSE SOLUTION ON PALM OIL MILL  
SCREW PRESS MACHINE BREAKDOWN USING QC  
TOOLS**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Process) (Hons.)

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## **ABSTRACT**

This research is used to study and propose solution on palm oil mill screw press machine breakdown using quality tools. This study focused on the screw press breakdown issue in Kanowit Oil Mill. Throughout this study, it can help to identify the critical breakdown type in screw press machine and identified the major cause of the major breakdown. The objectives of this study is to identify the root cause of screw press machine breakdown by using various quality tools and to propose the solution to address the screw press machine failure. The data collection for this study is gained from the interview, survey and historical data. In order to analyse the data collection, some of statistical quality tools were used such as a check-sheet, Pareto chart and Cause and Effect Diagram. The results of this study, showed that the major breakdown was a broken drive shaft. Meanwhile, the sudden breakdown by the entrance of foreign material has been justified as the root cause. To overcome the entrance of foreign materials; the magnetic separator is recommended to be installed for removing of the metal chunk. Besides, trash removal and trash strainer were used to sieve sand, stones or other undesirable materials.

## ABSTRAK

Penyelidikan ini dijalankan untuk mengkaji dan mencadangkan penyelesaian kepada masalah kerosakan mesin skrew penekan buah sawit dengan menggunakan alat kualiti. Kajian ini memberi tumpuan kepada isu kerosakan mesin skrew penekan buah sawit di Kanowit Oil Mill. Melalui kajian ini, ianya boleh membantu untuk mengenal pasti jenis kerosakan yang paling kritikal dalam mesin skrew penekan dan mengenal pasti punca utama masalah kerosakan mesin skrew penekan. Objektif kajian ini adalah untuk mengenal pasti punca kerosakan mesin screw press dengan menggunakan pelbagai alat kualiti dan mencadangkan penyelesaian untuk menangani kegagalan mesin skrew penekan. Pengumpulan data untuk kajian ini diperolehi daripada temubual, survey dan data-data sebelumnya. Untuk tujuan analisis dalam kajian ini, data yang diperolehi akan dianalisis dengan menggunakan daftar lembaran, Pareto rajah berserta dengan rajah sebab dan akibat. Berdasarkan kajian ini, aci pemacu yang patah merupakan masalah kerosakan yang paling utama dalam mesin screw press. Sementara itu, kemasukan benda asing merupakan masalah utama yang menyebabkan kerosakan aci pemacu. Untuk mengatasi masalah kemasukan bahan asing, pemisah magnet dicadangkan untuk dipasang untuk memerangkap ketulan logam. Manakala *trash removal* dan *trash strainer* digunakan untuk menapis pasir, batu atau bahan-bahan lain yang tidak diinginkan.

## **DEDICATION**

This work is dedicated to my parents Balai Anak Ramping and Terusa Anak Blalang, who have always loved me unconditionally and have taught me to work hard for the things that I aspire to achieve.



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# LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

|      |   |  |
|------|---|--|
| FFB  | - | Fresh Fruit Bunches                        |
| CPO  | - | Crude Palm Oil                             |
| PK   | - | Palm Kernel                                |
| FFA  | - | Fruit Fatty Acid                           |
| MPOB | - | Malaysia Palm Oil Board                    |
| MBTF | - | Mean Time Between Failure                  |
| PM   | - | Preventive Maintenance                     |
| RCA  | - | Root Cause Analysis                        |
| OEE  | - | Overall Equipment Effectiveness            |
| SMED | - | Single Minute Exchange Die                 |
| TPM  | - | Total Productive Maintenance               |
| CMMS | - | Computerized Maintenance Management System |
| UCL  | - | Upper Control Limit                        |
| LCL  | - | Lower Control Limit                        |
| PDCA | - | Plan-Do-Check-Act                          |
| PSM  | - | Projek Sarjana Muda                        |
| MPa  | - | Mega Pascal                                |
| HB   | - | Britnell Hardness                          |
| >    | - | More than                                  |
| <    | - | Less than                                  |
| %    | - | Percentage                                 |



# **CHAPTER 1**

## **INTRODUCTION**

This chapter covers the background of study, problem statement, objectives and scope that related with this project

### **1.1 Background of Study**

This research is industrial based project with Kanowit Oil Mill. Basically the research is about the analysis and improvement of the screw press machine breakdown by using quality control tools and case study analysis.

In the palm oil industry, screw press is the primary equipment to separate the palm fruit components which are oil and solid waste (also called press cake). The output from the screw press process are liquid (crude palm oil and water) and solid (mesocarp fibre, nuts, broken kernel and shell). They are then fed into two different production process which is crude palm oil extraction and palm kernel extraction (Harun et al., 2015).

One of the main issues faced by the company is excessive unpredicted breakdown of screw press machine due to various reasons. Some of the reported causes of screw press machine breakdown are broken drive shaft, wear and tear, leakage at joints, low hydraulic pressure and broken coupling module. Normally the machine breakdown occurs due to the unintended present of foreign objects such as stone, iron bar, a wrench and gravel that cause by poor housekeeping. The other causes of

the breakdown are loose thread, worn disc plate, clogging due to overfeed and leakage of gearbox (Harun et al., 2015).

In order to detect the problem with the screw press machine, the company uses lab sampling technique and visual inspection. The company tried to relate the quality control data from the lab test to the breakdown issue. Lab test is done to examine the press cake condition. The lab sampling is done every 2 hours after the process starts. It was postulated that machine problem can be detected by calculating the oil losses and crack mixtures such as un-cracked nut, half-cracked nuts, whole kernel, broken kernel and shells in the sample. Unfortunately, the study failed to establish any relationship between the quality and the breakdown issue.

Current solution taken by the mill to address the screw press breakdown problem by implementing preventive maintenance system. Even though the solution has been taken, but the mill still cannot solve the breakdown issue completely. Because of this problem, the aim of this project to identify the root cause of the breakdown and to propose possible solution to solve the issue

## **1.2 Problem Statement**

The company faces the problem with the screw press breakdown. The solution taken by the company is preventive maintenance. However the occurrences of the failure still at the unacceptable level. In the press station, the company only checks the quality of the product. The company tried to relate the quality data with the breakdown issue. Unfortunately, there is no relationship between the quality and the breakdown issue. There is no effort by company trying to address the root cause of the breakdown issues in screw press machine. In addressing this breakdown issue, the aim of this project is to identify the root cause of press screw machine breakdown and propose solution to address the identified root cause using various quality tools techniques.

### **1.3 Objectives**

The objectives of this project are:

1. To identify the root cause of screw press machine breakdown by using various quality tools.
2. To propose solution to address screw press machine failure.

### **1.4 Scope of Project**

This project focuses on the pressing process for the palm oil industry only. The machine that will be investigated is screw press machine. Basically, this project will investigate the breakdown of the screw press machine issue only. This project will be conducted at Kanowit Oil Mill only. The tools that will be used in solving this problem are seven quality control tools. The project will be based on one year of historical production data to identify the root cause of the machine failure. This project will be ended by proposed the solution to the company only. The solution will be proposed based on the previous case study.

## **CHAPTER 2**

### **LITERATURE REVIEW**

This chapter is about the literature review. In this chapter the issues that will be discussed are process description, machine breakdown issues, seven quality control tools and PDCA approach.

#### **2.1 Process description**

According to Fazeeda et al., (2015) the mill will receive the fresh fruit bunches (FFB) from the FFB contributor or estates. After receiving the FFB, grading process will be done on the loading ramp. The fresh fruit bunch from the ramp is transferred to the fresh fruit bunch conveyor. Then the fresh fruit bunch in the conveyor will be distributed into the cages. Then the hydraulic indexers and the cage transfer carriage system will transfer the filled cages to the sterilizer and undergoes the sterilization process. After sterilization process is ended the sterilized fruit bunch will be transferred to the tipper by using the hydraulic indexers and a cage transfer carriage system. Then sterilize fruit bunch will transfer to sterilized fruit conveyor. Sterilized fruit conveyor is used to feed the sterilized fruit bunches evenly and regularly into the thresher for threshing process. Threshing process is used to separate fruitlets and calyx leaves from the sterilized bunch. After that, the fruitlet is fed into the digester by using the conveyor over digester. Digester is used to perform rupturing of the oil bearing cells in the fruit pulp, for stripping the pericarp from the nuts and makes the mash to be homogenous the fibre and nuts mixed evenly. The digested mash from the digester is fed into the press by means of vertical chute into the press worm. As the fruits progress toward the outlets of the

cage, the pressure on the mash increases and the oil is squeezed out through the cages holes and allowing the cake to be expelled at the front end of the press.

#### Crude palm oil extraction

1. The crude oil gutter is used to convey the discharged oil from the press to the vibrating screen. The oil from the press will be filtered by using the vibrating screen and transfer to crude oil tank. The crude oil from the crude oil tank is pumped into the vertical clarifier tank.
2. Then skimmer is used to transfer the oil to the pure oil tank, meanwhile underflow pipe will be used to transfer the sludge in the sludge tank.
3. The sludge from the sludge tank will be processed by using the sludge separator. The free oil from the sludge separator will be transferred to reclaimed oil tank and then pumped into the crude oil tank for further processing. The remaining sludge is pumped off to the effluent pond.
4. The clarified palm oil skimmed off from the vertical clarifier still contains small amount of dirt and moisture. Hence, high speed centrifuging purifier is used to purify the clarified crude oil.
5. The moisture content of the purified oil after the purifier is still considered high; so the vacuum drier is used to attain the suitable moisture which is below 0.15%.
6. The dry at the bottom of the vessel is then fed into the pump to be pumped into the storage tank.
7. The crude palm oil with minimum or no deterioration of quality is stored in the oil storage tank. The moisture of the CPO must be <20%, dirt should be <0.05% and Fruit Fatty Acid (FFA) must be <5.00%.

#### Palm Kernel Extraction

The press cake after preliminary treatment by the cake breaker conveyor is fed into the separating air column of the depericarper to winnow the fibre from the nuts. During the rotation of the depericarper drum the nuts are lifted and dropped. This process will cause the nuts to be polished.

The nut will be feed into the wet nut elevator. Wet nut elevator is used to lift the wet nut that discharged from the depericarper drum to the nut bin storage for further processing. Then ripple mill is used to crack the nut efficiently. After that he

cracked nut is conveyed to the hydrocyclone. Hydrocyclone is used to separate the kernel from the shell. The kernels from hydrocyclones are conveyed by conveyor and elevator to be distributed to the two units of the kernel drying silo. Kernel silo capacity is approximately 60 metric tonnes. Then the kernel dryer will be used to dry the kernel to the final moisture content of less than 7% moisture.

At the same time due to the suction effect of the fibre cyclone fan, all loose fibre is drawn through the fibre trunking and into fibre cyclone. The fibre and the shell will be transferred to boiler house. Boiler is used to convert the fuel namely fibre and palm shell to heat energy in the boiler furnace. This heat energy is transferred to the water in the water circuit of the boiler to convert it to steam. The steam is supplied to the turbine in the power house for generating electricity (Fazeeda et al., 2015). Figure 2.1 shows the basic process flow for processing fresh fruit bunch in palm oil mill industry.

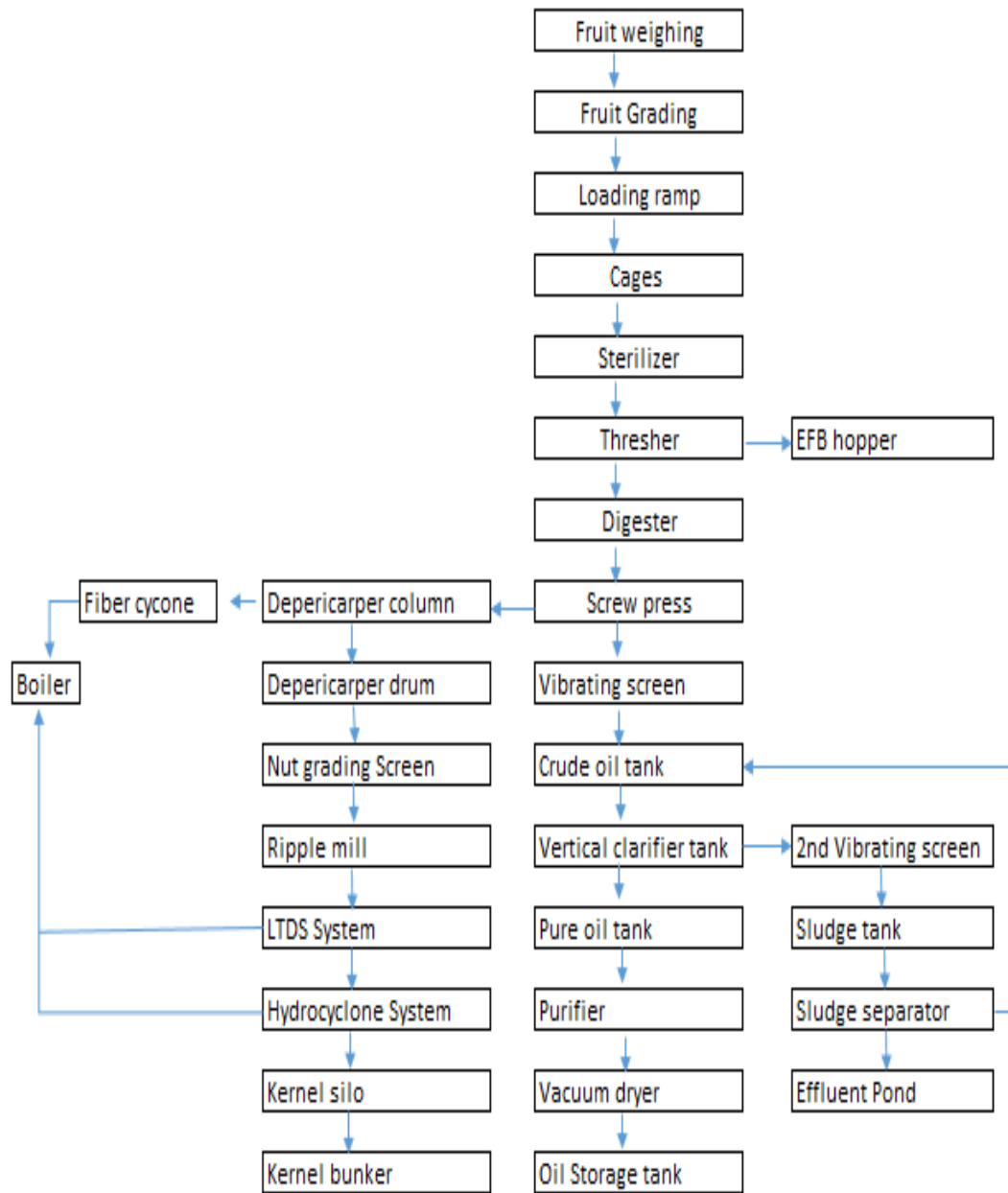


Figure 2. 1: Process flow of palm oil mill (Fazeeda et al., 2015)

## 2.2 Screw press machine and pressing process

For this project, the main focus area is pressing process. The machine that will be used is double screw press machine. In the palm oil industry, screw press is the primary equipment to separate the palm fruit components which are oil and solid waste (also called press cake). The output from the screw press process are liquid (crude palm oil and water) and solid (mesocarp fibre, nuts, broken kernel and shell). They are then fed into two different production process which is crude palm oil extraction and palm kernel extraction

The mill use double screw press machine. Basically, there are 4 units of double screw press are used. In the continuous double screw press, there are two parallel scrolls (worm screw) running side by side in a common perforated press cage. Positioned at the front end are twin cones which are controlled by hydraulic pressure, which pressure is kept automatically within preset limit.

The breakdown is categorized in accordance to the construction of the screw press unit which is main part and auxillary part. The main parts in the screw press are press cage, screw flight and adjusting cylinder; meanwhile the auxillary parts are driving motor, gear box and hydraulic cylinder (Harun et al., 2015)

In order to prevent the machine breakdown, the mill use method preventive maintenance such as schedule renewal. For schedule renewal, only two components are involved which are worm screw and press cage. The running hour for the worm screw is 600 hours and press cage is 1000 hours (Harun et al., 2015).

The company try to relate the quality of the product with the breakdown problem in the screw press machine. There are no program that is used to address the issue. Lab sampling is done to examine the press cake condition. The lab sampling is done every 2 hours after the process is started. The machine problem is detected by calculating the oil losses and crack mixtures such as un-cracked nut, half-cracked nuts, whole kernel, broken kernel and shells in the sample.