UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Fencing Improvement at Palm Oil Mill to Reduce Costly Waste

Thesis submitted in accordance with the partial requirements of the
Universiti Teknikal Malaysia Melaka for the
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By

Mohd Khairul Al'fat'hah bin Izman
B050910125
900107055241

Faculty of Manufacturing Engineering
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FENCING IMPROVEMENT TO REDUCE WASTE AT PALM OIL MILL

Mohd Khairul Al'fat'hah bin Izman

B050910125

UNIVERSITI TEKNIKAL MELAKA MALAYSIA

2013

DECLARATION

I hereby, declare this project study entitled “FENCING IMPROVEMENT TO REDUCE WASTE AT PALM OIL MILL” is the results of my own research Except as cited in the reference.

Signature	:	…….
Author Name	:	MOHD KHAIRUL AL’FAT’HAH BIN IZMAN
Date	:	31MAY 2013

APPROVAL

This thesis submitted to the senate of UTeM and has been accepted as part Fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Process). The members of the supervisory committee are as follows:

Signature	:	…….
Supervisor:	:	EN ALAMIN BIN MOHAMED SULTAN
Date	:	31/5/2013

ABSTRAK

Projek kajian ini membentangkan penambahbaikkan ‘pagar’ di kilang minyak sawit untuk mengurangkan sisa/baziran. Umumnya, bahan pagar yang dipanggil logam berkembang diperbuat daripada keluli lembut menemui kegagalan dalam perkhidmatan aplikasi pagar itu. Kegagalan ini menyumbang perbelanjaan besar yang sia-sia dan membazir dalam penyelenggaraan pagar di stesen pemprosesan. Kegagalan pagar juga menyumbang kepada sisa seperti sisa masa, sisa tenaga, sisa pengangkutan, sisa menunggu, sisa kecacatan produk, dan lain-lain. Kegagalan pagar ini juga member kesan kepada kualiti Buah Tandan Segar (BTS) produk akhir iaitu kualiti minyaknya. Alat pembuatan Lean seperti kaizen adalah pendekatan terbaik untuk menyelesaikan isu yang berkaitan dengan bahan buangan.

Pendekatan Kaizen digunakan dengan bantuan analisis kegagalan bahan untuk mengenalpasti punca kegagalan logam berkembang dan menjalankan beberapa analisis. Untuk itu, sampel yang diambil dari pagar akan menjalani penyediaan sampel, prosedur pembersihan, ujian tanpa musnah, ujian mekanikal, ujian kimia, ujiaan makro dan mikrostruktur untuk mengenalpasti tingkahlaku dan ciri-ciri sampel untuk diakses ke dalam Perisian Cambriged Pemilih (CES).

Keputusan yang dikumpulkan dari ujian dianalisis dan kesimpulan punca kegagalan itu dapat dibuat. Merujuk kepada keputusan keseluruhan, penggantian bahan telah dipilih untuk menjadi pelaksanaan Kaizen yang dicadangkan. Perisian Cambridge Pendidikan Pemilih telah digunakan untuk membantu proses pemilihan bahan mencari bahan terbaik untuk menggantikan bahan sedia ada.

ABSTRACT

This project study presented a fencing improvement at palm oil mill to reduce costly waste. Typically, fencing material called expanded metal made of mild steel comes to failure in service. The failure contributes great unnecessary expenditure on process station maintenance. The failure of fencing also contribute to waste such as time waste, energy waste, transportation waste, waiting waste, product defect waste, etc. The failure also affects the quality of Fresh Fruit Bunch (FFB) end product. Lean manufacturing tool such as kaizen is the best approach to solve issue related with waste. Kaizen approach is used with the aid of material failure analysis to identify the root cause of expanded metal failure and undergo some analysis. For that matter, the sample taken from fencing has undergo sample preparation and cleaning procedure, follow up by mechanically test, chemical test, and micro and macro examination. The behavior, characteristic of sample also has been identified. Testing analysis was compiled and the type of failure is justified.

Regarding on the overall result, the replacement of material was chosen to be the proposed kaizen implementation. Cambridge Education Selector (CES) software was used to aid the material selection process to find the best material to replace current material. The criteria of properties, behavior and characteristic from testing procedure were access into the CES software and took into consideration in material selection procedure.

DEDICATION

First and foremost, , I would like to express my greatest appreciation to Universiti Teknikal Malaysia Melaka for giving me the opportunity to undergo my final year "Projek Sarjana Muda" under the supervision of Mr. Al Amin bin Mohamed Sultan. A special thank you also goes to my supervisor Mr. Al Amin bin Mohamed Sultan and Co. Supervisor, Professor Qumrul Ahsan for their dedication and guidance during the period of undergoing my project. Last but not least, I want to thank my mom and dad for their support as well as to all my friends who never give up encouraging me to complete this report.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

ASM	-	American Society for Metal
ASTM	-	American Society of Test and Material
CES	-	Cambridge Education Selector
CPO	-	Crude Palm Oil
DOBI	-	Deterioration Of Bleach Index
EDX	-	Energy Dispersive X-ray
ETP	-	Economic Transformation Programme
FFA	-	Free Fatty Acid
FFB	-	Fresh Fruit Bunch
ICP	-	Inductively Coupled Plasma
JCPDS	-	Joint Committee for Powder Diffraction Standards
KER	-	Kernel Extraction Rate
KNL	-	Know Need Learning issue
LW	-	Long Way
LWM	-	Long Way Measurement
NKEAs	-	National Key Economic Areas
OER	-	Oil Extraction Rate
OES	-	Optical Emission Spectrometry
OM	-	Optical Microscope
PBL	-	Problem Based Learning
PDA	-	Pulse Distribution Analysis
PDF	-	International Powder Diffraction File
POM	-	Palm Oil Mill
PV	-	Peroxide Value
RIR	-	Reference Intensity Ratio
SEM	-	Scanning Electron Microscope
SW	-	Short Way
SWM	-	Short Way Measurement

TQM	-	Total Quality Management
UTeM	-	UniversitiTeknikal Malaysia Melaka
UTM	-	Universal Testing Machine
XRD	-	X-ray Diffraction

CHAPTER 1
INTRODUCTION

1.1 Overview of Study

This report presents a study on problem identification skill using quality tools in industry based-problem at one of palm oil mill process stations. The problem solving skill such as Kaizen is implementing in order to reduce waste at a palm oil mill. The material failure analysis approach also is used to aid the Kaizen process. The following result will later determine the most suitable solution to solve the failure problem faced by fencing (expanded metal) and outline several prevention methods and improvement of the material. In this chapter, the report will present about some background of this study, the problem arises in the palm oil mill. This chapter also highlights the objective of the study and also the limitation of this study.

1.2 Background of study

Palm oil mill has several process stations that will process the Fresh Fruit Bunch (FFB) from Palm Oil Estate into a major product which are Crude Palm Oil (CPO) and Kernel Palm Oil. The first operation carried out on FFB in a palm oil mill is the loading of FFB into the ramp or hopper at the reception station. The reception facilities are designed to accommodate the type of FFB transport system adopted by supplying estates whether in bulk or containerized transport by lorry or tractor. The efficiency of a palm oil mill and

the quality of its produce is very much dependant on the standard and quality of crop that is processed.

Maycock .J.H (1994) has shown that the vast area of the reception station ensures a quick turnaround of transport to unload the fruit into a ramp. The ramp is also designed to minimize the spillage of loose fruits that sometimes carried either separately or along the FFB. The ramp is also known as FFB storage which hold the FFB under certain time before letting it go through conveyor at the bottom of the ramp. The conveyor at the bottom of the ramp is heading to the next station which performs FFB sterilization process. The ramp in this mill has a steep shape design for a certain reason to enable free falling impact of the FFB and loose fruit in the end of the ramp.

At the end of the ramp, there are two portion areas that help in holding the numerous amount of FFB and loose fruit which are the top portion consist of fencing and the bottom portion consist of barricade door. The fencing acts as barricade at the top portion to block all the FFB and loose fruit from continuous flow in the conveyor. The hydraulic system is used to move the flat barricade door at the bottom portion up and down to control and minimize the movement of FFB or loose fruit fill up in the conveyor.

The conveyor used to deliver the FFB and loose fruit is designed to partition of compartment and has a capacity limitation whereby each compartment can only be filled up to approximately 180 kg which is equal to 5-6 bunch of FFB at a time. Therefore the flowing of FFB and loose fruit into the conveyor must be controlled carefully to prevent any incoming maintenance problem due to overload matter. The fencing and flat barricade door are simply made up of mild steel in same design and thickness.

Recht. R and Wilderom. C , (1998) has written that Lean manufacturing is a systematic approach used to identify and eliminate the waste and enabling to make continuous improvement. Several maintenance is performed at process station in order to repair damage occur while fruit processing take place in a mill. Quality tool can be used in order to determine the most critical process station area in the mill that contribute to

higher maintenance cost. As an alternative, there are 3 major quality tools which are Pareto Chart, Histograms, Control Charts and Cause and Effect Diagram.

Hicks B.J (2007) has stated that the major waste at the focus process station can be determined by using quality control tools. Hence, the identified problem can be solved to reduce costly waste by suggesting improvement through engineering approach such as material failure analysis to increase efficiency of focus area in the mill process cycle. There are 7 types of major waste identified in lean manufacturing which are over production waste, waiting waste, inventory waste, over or less processing waste, transportation waste, defect waste and energy waste.

Recht. R and Wilderom. C , (1998) classifies that in order to solve problem identified from statistical quality control tool, another lean manufacturing approach is used. Kaizen is an excellent technique for reducing or eliminating rework. Kaizen is a system of continuous improvement in quality, technology, processes, company culture, productivity, safety and leadership. The word Kaizen means “continuous improvement” in Japanese. Kaizen is an intensive and focused approach to process improvement. In this matter the studies of material failure analysis will aid in suggesting the best kaizen approach to solve the problem along with the waste occur.

1.2 Problem Statement

Fencing of the ramp at the FFB reception station need to be repaired and replace. The flat barricade door at the bottom portion of fencing is powered by hydraulic power and is controlled by a worker at a time. As the time passed, the fencing act as a barricade to hold against the palm oil fruit is swollen, expanded and broken. The fencing is suspected to be a failure due to impact force by the FFB that falling into the ramp but the investigation has been carried out to determine whether the material is failure before or after the being hit by FFB.

Initial inference stated that the fencing might come into failure due to material failure or design failure or both. However, after the observation has been made on the surface of the fencing there are brownish color surface appear on the surface of fencing which is known to be rusty. A corrosion phenomenon has always been a nightmare in the industrial environment, especially when it involved withdelaying processing time as it absolutely affecting the quality of a product later. Design of a product gives a great impact on product to carry out their task upon given application. A product is a failure when it cannot achieve its service life when it is expected to be.

Due to this situation, when the fencing comes into failure, the flat barricade door is stuck under the expanded fencing failure when worker in charge undergoes their duty to release the FFB from the ramp. As a result there is a delay time of operation at that station which contributes to high lead time for a process station. As the barricade door doesn't open the fruit cannot be released and the worker needs to manually pull out the fruit out of the cage. The station has more than one barricade door so this problem may not seem as a huge matter so the process still can be proceed as long as there is another functional barricade door but the station with damage flat barricade door cannot proceed along the FFB will remain there until a maintenance worker fix the fence. While waiting the fencing getting fixed at the end of the week the quality of fruit decrease as the FFB processing period prolonged. The free fatty acid content is higher for late process of FFB. In addition there is several waste identified along with the problem such as energy waste, time waste, waiting waste, talent waste and transportation waste.

As getting inspiration from this kind of situations, this paper consists research of this wear mechanism and in the mean time includes the investigation of root cause failure of expanded metal that is used in fencing application at reception station.This collaborative project is held with one of Sime Darby Palm Oil Milllocated at Sua Betong, Negeri Sembilan that held fully operation process of Palm Oil Fresh Fruit Bunch.

Figure 1.0: Fencing failure at reception station

1.3 Objective of study

The objectives of this study are:

a) To investigate the root cause of fencing (expanded metal) failure at the reception station by using material failure analysis approach.
b) To suggest a Kaizen strategy for fencing (expanded metal) to overcome the failure problem.

1.4 Scope of study

The project studies for this final year project only cover one station in Sime Darby (Sua Betong) palm oil mill. Due to company rule and regulation, there is some constraint has been put through on other processing station to protect confidential information. Therefore the only case study that can be carried out is at the reception station of FFB. The case studies only cover the material area in order to fulfill the final year project requirement level. The tools used also focus only Kaizenin lean manufacturing. Machine use to study about material behavior is by using either Scanning Electron Microscope(SEM) or Optical Microscope (OM) and other material failure analysis field related laboratory destructive and non- destructive testing.