

CLEANER PRODUCTION IMPLEMENTATION IN PALM OIL MILL

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**CLEANER PRODUCTION IMPLEMENTATION IN PALM OIL MILL**

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**This report is submitted  
in fulfillment of the requirement for the degree of  
Bachelor of Mechanical Engineering (Structure and Material)**

**Faculty of Mechanical Engineering**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**JUNE 2016**

## DECLARATION

I declare that this project report entitled “Cleaner Production Implementation in Palm Oil Mill” is the result of my own work except as cited in the references

Signature : .....

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Date : 29<sup>TH</sup> JUNE 2016

## APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Structure & Materials).

Signature : .....

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Date : 29<sup>TH</sup> JUNE 2016

## **DEDICATION**

Praises to the God Almighty, my beloved parent, lecturers, freinds and siblings.

## ABSTRACT

Production process does not weigh the side effect of their waste to nature, it would lead to the environmental impacts. Cleaner Production (CP) is a concept that is moving towards the pollution prevention rather than end of pipe pollution control. The production of crude palm oil (CPO) known as a dominant of carbon dioxide emission contributor to the global warming. The aim of this study is to identify the unit process of palm oil mill that contributes to the carbon dioxide emission. The selected entity for carbon dioxide emission in this case is from solid waste generation, electricity consumption, wastewater generation, diesel consumption, solid fuel consumption and water consumption. These entities is calculated to find the biggest contributor of carbon dioxide emission and linear regression analysis is performed to validate the data. Furthermore, the relationship between independent variables and dependent variables is studied to determine the selective entity has high correlation or lack of correlation for further discussion by using regression analysis. This study calculates the carbon dioxide emission by using the method that approved by Intergovernmental Panel on Climate Change (IPCC). Based on this study, solid fuel consumption has the highest contribution for the carbon dioxide emission to the environment followed by wastewater generated. Moreover, this these entities has a high correlation between amounts of fresh fruit bunch (FFB) produced and number of working hour in palm oil mill. Therefore, this two entity is suggested to implement CP options in order to reduce carbon dioxide emission significantly.

## **ABSTRAK**

*Proses pengeluaran tidak mengambil berat tentang sisa mereka yang memberikan kesan sampingan terhadap alam semula jadi, perkara ini akan memberi kesan terhadap alam sekitar. Produksi Bersih (CP) merupakan konsep yang sedang menuju ke arah pencegahan pencemaran dan bukannya akhir kawalan pencemaran paip (EOP). Pengeluaran minyak sawit mentah (CPO) di kilang kelapa sawit dikenali sebagai penyumbang dominan terhadap pemanasan global. Tujuan kajian ini adalah untuk mengenal pasti proses unit kilang minyak sawit yang menyumbang kepada pelepasan karbon dioksida. Entiti yang dipilih untuk pelepasan karbon dioksida dalam kes ini adalah dari generasi sisa pepejal, penggunaan elektrik, penjana sisa, penggunaan diesel, penggunaan bahan api pepejal dan penggunaan air. Entiti dikira untuk mencari penyumbang terbesar pelepasan karbon dioksida dan analisis regresi linear dilakukan untuk mengesahkan data. Tambahan pula, hubungan antara pembolehubah bebas dan pembolehubah bersandar dikaji untuk menentukan entiti yang terpilih mempunyai korelasi yang tinggi atau kekurangan korelasi untuk perbincangan lanjut dengan menggunakan analisis regresi. Kajian ini mengira pelepasan karbon dioksida dengan menggunakan kaedah yang diluluskan oleh Panel Antara Kerajaan mengenai Perubahan Iklim (IPCC). Berdasarkan kajian ini, penggunaan bahan api pepejal mempunyai sumbangan tertinggi bagi pelepasan karbon dioksida ke alam sekitar diikuti dengan air sisa yang dihasilkan. Selain itu, entiti ini mempunyai korelasi yang tinggi antara jumlah tandan buah segar (FFB) yang dihasilkan dan bilangan jam bekerja di kilang minyak sawit. Oleh itu, ini dua entiti dicadangkan untuk melaksanakan pilihan CP untuk mengurangkan pelepasan karbon dioksida dengan ketara.*

## ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious, and the Most Merciful. Alhamdulillah, thanks to the Almighty God, to Him we depends on and ask for guidance and help. Praises to Allah, by His grace, I have been given the strength and with His blessing I could afford to complete the thesis successfully.

A special appreciation awarded to my supervisor, Mr. Mohamed Hafiz bin Md Isa, for all the guidance in order to complete the thesis for “Projek Sarjana Muda” as one of the requirements to complete degree study. Thanks to him for the consideration and assistance, for every constructive comments and also thoughtful recommendations throughout this study. I am thankful for his patience and advice while leading me in this project. After that, I would like to thanks to Mr Ngoi Seng Heng and Mr Teo for their guidance during my internship for collecting data at Keck Seng Palm Oil Mill. I am so grateful and honored to have a supervisor like them that has a huge experience in the industry.

My deepest gratitude goes to my beloved parent, Mr Abdul Munajat bin Ab Rahman and Mrs. Nor Harlin binti Samian, to my sisters and brothers for their love, prayers, and encouragement. With sincere feelings, I would like to thank all of my friends who have contributed a lot in giving me moral support and passion to complete this thesis. Thank you for your kindness for all the time being during my study. Last but not least, thank you to those who have directly or indirectly contributed in my study, your kindness means a lot to me. Thank you very much



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**LIST OF ABBEREVATIONS**

CEF	Carbon Emission Factor
CP	Cleaner Production
CPO	Crude Palm Oil
CPKO	Palm Crude Kernel Oil
CO <sub>2</sub>	Carbon Dioxide
EFB	Empty Fruit Bunch
EOP	End of Pipe
FFA	Free Fatty Acid
FFB	Fresh Fruit Bunch
GHG	Green House Gasses
IPCC	Intergovernmental Panel on Climate Change
POME	Palm Oil Mill Effluent
PPF	Palm Press Fiber
UNEP	United Nations Environment Programmes

## LIST OF SYMBOL

$CO_2e(kgCO_2)$	=	Carbon dioxide equivalent emission
$kg CO_2/unit_{entity}$	=	Carbon emission factor (CEF)
$(unit_{entity})$	=	Utilization or production yield



## CHAPTER 1

### INTRODUCTION

#### 1.1 Background of Study

Production process is a process of creating desired product by the manufacturing plant or factory. If the process does not weigh the side effect of their waste to the nature, it will impact the environment, human, flora, fauna and ecosystem that distract the continuity of the world. (Hertwich, *et al.*, 2010) identified that the dominant pressure causes ecosystem debasing are the habitat change of the animals, pollution that contain some amount of nitrogen and phosphorus, harvesting species from the wild at rates faster than natural populations can recover, and climate change.

End-of-pipe (EOP) treatment refers to the treatment of waste generated by the production at the end of processing line. This treatment used the waste management system which is processing the waste before going off to the environment (Herdman, 1986). EOP waste

treatment has become important lately and causes the extra input of materials, energy and processes that give a consequence such as residual waste and extra disposal charges (Thani, *et al.*, 1999). Moreover, EOP treatments control the pollutants happen depends on the problems arise. Then, it makes improvement that are addressed by experts and used largely technique and technology based which is fulfilling the standards and the quality of this treatment to meet the customer requirements.

In recent years, Cleaner Production (CP) has entered the global environmental arena. The concept that introduce by CP is moving towards pollution prevention rather to treat the pollution. The approach of pollution prevention can be implemented in all sectors within small or large industrial concepts. It is also directs activities towards production aspects especially within the manufacturing sector. The implementation of CP has to include resource efficiency, which is a key factor of the transitions towards the Green Industry and Green Economy.

The term CP was defined by United Nations Environment Programmes (UNEP) in 1990 as “the continuous application of an integrated environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment”. This term are widely used for all the programs that linked with the CP advancement and it is remains legal (RECP, 2013).

CP requires changing attitudes, responsible environmental management and evaluating technology options. It is specifically works to advance the production processes which includes conserving raw materials and energy, eliminating toxic raw materials and reducing the toxicity amount of all emissions and wastes before it is discharged. It is also working to advance the

products by focusing on reducing impacts along the entire life cycle of the product, from raw material extraction to the ultimate disposal of the product. Then, to advance the services, it incorporates with environmental concerns in designing and delivering services.

## **1.2 Problem Statement**

Palm oil is used as an ingredient in our daily products, from baked goods to shampoo. The demand for palm oil product is rising worldwide. The palm oil can be used to fry the food and can be converted to biodiesel of cars and trucks in many place around the world. However, the production of crude palm oil in palm oil mill is known as one of the major polluter and become Green House Gasses (GHG) emitter that often cause the destruction of carbon-rich tropical forests and peatlands, which is a dominant contributor to global warming. In order to preserve the natural resources, protect biodiversity, and also reducing the risk of climate change, the palm oil industry is revolutionizing by using cleaner production approach.

### 1.3 Objective

The objectives of this project are as follows:

1. To identify the unit process and unit operation of a palm oil mill industry.
2. To calculate the carbon dioxide emission generated from solid waste generation, electricity consumption, water consumption, wastewater consumption, solid fuel consumption and fuel consumption.
3. To validate the value using linear regression analysis.
4. To identify the biggest contributor of carbon dioxide emission entity in a palm oil mill industry.
5. To suggest CP options for palm oil mill.

### 1.4 Scope of Project

The scope of this project are:

1. The CO<sub>2</sub> emission calculation covered only the production of process CPO with the system boundary only covered the production process of CPO.
2. The functional starting point from the receiving palm oil fresh fruit bunches (FFB) until the production of CPO in storage tanks.
3. The functional unit of this study is FFB processed per day.

## 1.5 General Methodology

These are the actions that need to carry out in order to achieve the objectives in this project:

### 1. Literature review

Journals, articles, or any material regarding to this research will be reviewed.

### 2. Data collection

The data of environmental input and environmental output are collected during industrial training of two months at Keck Seng (M) Berhad Masai Palm Oil Mill.

### 3. Validation of data

The data is validating using linear regression analysis which is known as statistical process to identify the correlation between independent and dependent variable. The independent variable used for this method is FFB processed per day and processing hour per day while dependent variable used is 6 entities that contribute to the carbon dioxide emission.

### 4. Carbon dioxide, CO<sub>2</sub> emission calculation

Carbon dioxide calculation using standards emission factor.

#### 5. Analysis and proposed solutions

Analysis will be presented on how much the carbon dioxide emission produce from the process by using calculation from the formula and identify biggest contributor of carbon dioxide emission. Then suggest the proper cleaner production (CP) implementation option with the systems to reduce carbon dioxide emission.

#### 6. Report writing

The report of this study will be written at the end of the project.

The methodology of this study is summarized in the flow chart as shown in Figure 1.1.

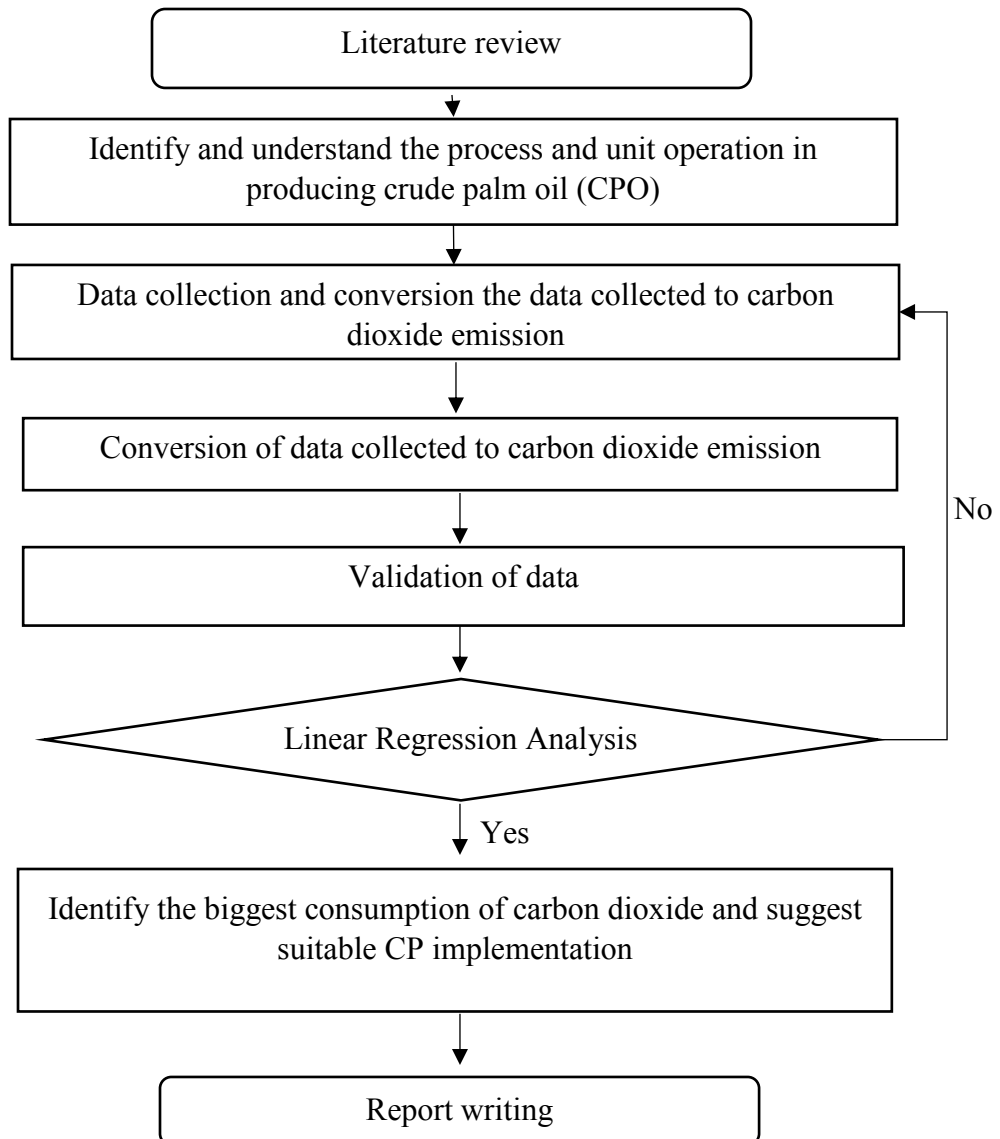


Figure 1.1 Flow chart of final year project methodology.

## 1.6 Thesis Outline

Chapter 2 shows the reviews from the previous study about the palm oil mill processing which is the basic process to compare with the Keck Seng Palm Oil Mill. Furthermore, this chapter shows the advantages of CP implementation in palm oil mill. There is the source of carbon emission obtained from the palm oil mill that is listed in this chapter. The carbon emission factor is reviewed in order to use as a calculation in methodology.

Chapter 3 focusses on the methodology on collecting the data at the Keck Seng Palm Oil Mill Berhad for 10 weeks. This chapter also aims the calculation to obtain the carbon dioxide emission from the mills. After the value are obtained, the higher consumption of carbon dioxide are analyse with the linear regression analysis.

Chapter 4 presented the data collection and the result of the validation of the data from the six entities selected to determine the correlation between dependent and independent variable for further discussion. Then, from the result of validation data and analysis of the calculation of carbon dioxide emission so that the higher consumption of the carbon dioxide emission is determined in this chapter in order to reduce the consumption of carbon dioxide by implementing CP. Next, after the data validated, the higher carbon dioxide emission is identify from solid waste generation, electricity consumption, water consumption, wastewater consumption, solid fuel consumption and fuel consumption.