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THE EVALUATING OF WATER UTILISATION FROM PALM OIL MILL INDUSTRY USING CLEANER PRODUCTION APPROACH

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DECLARATION

"I hereby declare that the work in this thesis is my own except for summaries and

Quotations which have been duty acknowledged"

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Special Thanks To:

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ABSTRACT

Palm oil mill industry is one of the major industries in Malaysia. The growth of this industry gives-impact to the economic, environmental and social cultured in Malaysia. The processing of crude palm oil mill use large quantities of water and energy in their production process, which can generate large quantities of wastewater, air pollution and energy waste. This project investigate the CP options in palm oil mill industry by using Cleaner Production Implementation Tools (CPIT) and Water Pinch Analysis (WPA). The result shows that the water utilisation could reduce by 20% by using CP. In order to implement it in the palm oil mill industry, there were several methods to apply the application which are by collecting data and measure the usage of water in production process. After collected data, CP implementation tools were applied to analyse the data.

ABSTRAK

Industri kilang minyak sawit adalah salah satu industri utama di Malaysia. Pertumbuhan industri ini memberi impak kepada ekonomi, alam sekitar dan sosial yang diternak di Malaysia. Pemprosesan kilang minyak sawit mentah menggunakan air yang banyak dan tenaga dalam proses pengeluaran mereka, yang mana boleh menjana sejumlah besar air sisa, pencemaran udara dan sisa tenaga. Projek ini menyiasat pilihan "Cleaner Production" dalam industri kilang minyak sawit dengan menggunakan Alat Pelaksanaan Pengeluaran (CPIT) dan Air Picit Analisis (WPA). Hasil kajian menunjukkan bahawa penggunaan air boleh di kurangkan sebanyak 20% dengan menggunakan CP. Dalam usaha untuk melaksanakannya dalam industri kilang minyak sawit, terdapat beberapa kaedah, antaranya dengan mengumpul data dan mengukur penggunaan air dalam proses pengeluaran. Selepas data dikumpul, alat pelaksanaan CP akan digunakan untuk menganalisis data.

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CHAPTER 1

INTRODUCTION

1.1   BACKGROUND OF STUDY

The main purpose of this thesis is to evaluate Cleaner production (CP) options in palm oil mill industry to reduce the water consumption. Palm oil mill is one of the major industries in Malaysia. The production of palm oil mill are using excessively amount of water in the production process. In addition, some of the industry having difficulties to comply with the current laws and regulation under the Environmental Quality Act (EQA) 1974. However with the optimisation of water usage in the production process using cleaner production approach, it can reduce the amount of water usage and consequently gives positive impact to the industry.

The cleaner production approach is one of the continuous applications of integrated preventive environmental strategy applied to the production, process and service to increase overall efficiency of the industry and reduce risk to humans and environment (Basappaji & Nagesha 2014). In addition, cleaner production is one of the main applications to consider the environmental issue that must be applied to all industry in Malaysia in order to reduce any risk to human being and environment.

1.2   PROBLEM STATEMENT

It is obvious that the production of crude palm oil using extensively huge amount of water. Improper management of water utilisation in this industry, will gives a significant impact to the environment. Thus, this research aims to investigate two problem statements from the scenario. The problem statements are:

1. The improper utilisation of water in processing crude palm oil led to high operating and maintenance cost in the industry.

2. Difficulties to treat huge amount of wastewater generated from production process. As consequence, industry facing difficulties to comply with the existing laws and regulations.

1.3   OBJECTIVE

The objectives of this research are:

1. To measure water consumption from palm oil mill industry.
2. To evaluate the cleaner production options in palm oil mill industry.

1.4   SCOPE

The scope for this research:

1. To identify the unit operation in production of crude palm oil utilise the water
2. To measure the amount of water utilised in unit operation identified
3. To investigate the root cause that contributes to extensive amount of water used in the unit operation.
4. To evaluate CP options which aim to, reduce water consumption in palm oil mill industry by using Cleaner production Implementation Tool.

CHAPTER 2

LITERATURE REVIEW

This chapter looks into the general concept of using cleaner production in palm oil mill industry. Next, this chapter describes the important of using cleaner production, principles, tools, standard and benefits of its implementation in Malaysia. In addition, this chapter also looks into a correlation between CP and Palm Oil mill by reviewing relevant case study. This will enable to retrieve important information for selected topic.

2.1   BACKGROUND OF CLEANER PRODUCTION

Cleaner production is one of the applications of an integrated preventive environmental strategy that applied to the process, products and services to increase the overall efficiency and reduces risk to human and environment. According to (Basappaji & Nagesha 2014), Cleaner production achieved through reducing the use of resources, judicial use of energy, reducing emission and wastes recycling. Cleaner production is not a solution to all environment problems, but it reduces the dependence on end-of-pipe solutions, generates less harmful wastes. Product that designed and produces

with CP in mind are often less harmful for consumers to use, and residuals are normally less of burden to wastes stream.

According to (Larderel, 2002), the term "cleaner production" was defined as "the continuous application of an integrated preventive environmental strategy to process, products and services to increase overall efficiency and reduce risks to humans and environment" – and as applicable "to the process used in any industry, to products themselves and to various services provide in society. In other words, cleaner production proved that instead of managing outputs of emissions and waste produces improved the management of raw materials and other inputs such as energy and water.

2.2   PRINCIPLE OF CLEANER PRODUCTION

The main application of cleaner production principle is a preventive environmental strategy that applied in product, process and service due to increases the efficiency in plant. The cleaner production principles are explained together with how they can be applied to urban water management (Nhapi & Hoko 2004). According to (Noor, 2009) , that six main component of CP principles:

1. **Waste elimination and reduction**: The term wastes are refers to all types of wastes including both hazardous and solid wastes. According to (Daylan et al. 2013), source reduction and material reuse will lead to reduction in total amount of waste, emissions and waste toxicity. The zinc electroplating process and its resulting environmental loads were investigated within the scope of the study, by considering the cleaner production (CP) opportunities. It shows in metal fishing industry that used electroplating of metals part in there process and technology.

2. **Non-polluting production**: Ideal production process, within the concept of cleaner production, takes place in a closed loop with zero contaminant release.

3. **Production Energy Efficiency**: Cleaner productions are producing high level of energy efficiency and conservation, due to determine

highest ratio of energy consumption in product and reduction of energy usage.

4. **Safe and Healthy work Environments**: CP minimize the risks of workers in order to make the workplace in a good condition, safe and healthier environment.

5. **Environmentally Sound Products**: health and environmental factors should be considered at the earliest point of product and process design, to full fill the life-cycle of production.

6. **Environmentally Sound Packaging**: packaging is necessary be protected the product, to market the product or facilitate ease of consumption.

2.3 TOOLS AND STANDARD FOR CLEANER PRODUCTION

The concept of cleaner production (CP) had been used in a several economics, environment and social benefits for the industries production and process. However, the implementation of the CP programs facing problem and barriers, such as lack of detailed information, tools and techniques that can be employed systematically to achieve the desired result (Lopes Silva et al. 2013). Therefore, to fulfil the requirement of achieving the desired result when implementing cleaner production is by using the tools and standard of cleaner production. The tools are:

1. **Life Cycle Assessment (LCA)**

   Life cycle assessment (LCA) is a technique that approach to the environmental impact throughout the life cycle of particular product and services from the extraction of raw material to disposal or recycling at the end of the products. For examples in crude palm oil industry, life cycle assessment has been implementing through the production or process. According to (Vijaya 2008) Life cycle assessment (LCA) is a tool to evaluate the environmental impacts of a product or process throughout its entire life cycle. Besides

that's, to identify the potential environmental impacts associated with the crude palm oil production.

2. **ISO 14000-EMS**

   ISO 14000 is a various aspects of environmental management that provide practical tools for company, organization and industrial look forward in the environmental impacts and constantly improve their environmental performance. According to (A.P.Purvanasvaran, 2010) Environmental Management System (EMS) was defined as part of management system that includes organizational structure, planning, activities, responsible, practise, procedure, process and resources for developing, implementing, achieving, reviewing and maintaining the environment policy (ISO 14001).

2.4   IMPORTANCE AND BENEFITS OF CLEANER PRODUCTION

Cleaner production is one of the importance things in the field of environmental policy and management. Furthermore, it is provides a long-term technique to eliminate or reduce the emission. For example, in the industry of vanadium extraction from stone coal, one of the strategies used to tackle various problems caused by the production process is the implementation of cleaner production (Jia et al. 2014). Cleaner production program provide the long-term of comprehensive of natural environment that increase health and living standard, to the human being and industrial side.

As mentioned before, there are numerous benefits while using the cleaner production activities. The development and application of cleaner production offer multiple benefits for the adopter such as: reduced the emissions, less waste and cost saving from reduced resource use and savings on waste costs (Montalvo & Kemp 2008).

In addition, the benefits of cleaner production has totally change the environmental issues, due to reducing the emission and long-term the

technique to eliminate waste. There are several benefits that contain in cleaner production that implement in Malaysian Industries (DOE, 2002)**:**

1. **Reduction of Operating Costs**: CP program can be reducing material costs by adopting production and packaging procedure that consume fewer resources. In the case study of Taiyo Yuden (Sarawak) Sdn. Bhd, due to the benefits of cleaner production implemented in the industries, it has reduces the water usage up to 40 %, energy consumption save to 95% and material packaging labelling and transportation to 30 %.

2. **Reduction of Ecological Damage**: CP provides obvious benefits for the natural environment. For Examples, in the case of Texas Instruments Malaysia SDN. Bhd. Cleaner production implemented in the process simplification and reduction of chemical and oil usage, The benefits of cleaner production has been eliminate use of oil and solvent (TCE) degreasing process and totally eliminate usage of waste oil and solvent.

3. **Improved Company image**: CP program improving the company image by positively toward management of the place on providing safe working environment. In order to providing the safety working environment, cleaner production has fulfil the requirement by solving the dust emission from stack, water pollution and boundary noise level in Malayan Cement Industries Sdn. Bhd .

2.5   PALM OIL MILL INDUSTRY

2.5.1   Background of Palm Oil Mill Industry in Malaysia

Palm oil mill is one of the leading agricultural industries in Malaysia with average crude palm oil production of more than 13 million tonne per year. However, production of such huge amount of crude palm oil has consequently resulted to even larger amount of palm oil mill effluent (Lam & Lee 2011). In

Malaysia, the total production of crude palm oil in 2008 was 17,734,441 tonnes (Wu et al. 2010).

According to (Yusof Basiron, 2004) crude palm oil in Malaysia is over a century old. Introduced as an ornamental in 1871, the oil palm was commercially exploited as an oil crop only from 1911 when the first oil palm estate was established. Oil palm or *Elaeis guineensis*, to the Palmae family, is the most productive oil production plant in the world. Oil palm contains high nutrient which mainly depends on the yield potential determined by the genetic make-up of planting material and yield limit set by climatic factor such as water, effective sunshine and temperature (Praven Fatemeh Rupani, 2010). However, the production generates largest amount of waste in form the oil extraction process such as mesocarp, fibre, shell, empty fruit bunch (EFB) and palm oil mill effluent (POME).

2.5.2 Palm Oil Mill Process

Palm oil mill extract the Crude palm Oil (CPO) and palm kernel from fresh fruit bunch using mechanical process. According to, (Praven Fatemeh Rupani, 2010) several units of operations are involved in order to extracted palm oil mill after the fresh fruit bunches (FFB) are transported to the palm oil mills. Figure 2.1 show the fresh fruit bunch in loading ramp before processing.

Figure 2.1: Fresh Fruit bunch before processing at palm oil mill

A palm oil mill has many operation units in the process. This comprises sterilization, stripping, digestion and pressing, clarification, purification, drying and storage. For a kernels line there are steps such as nut/fibre (separation), nut conditioning, and cracking, cracked mixture separation and kernel drying storage. Figure 2.2 shows the process from fresh fruit bunch into crude palm oil and palm kernels.
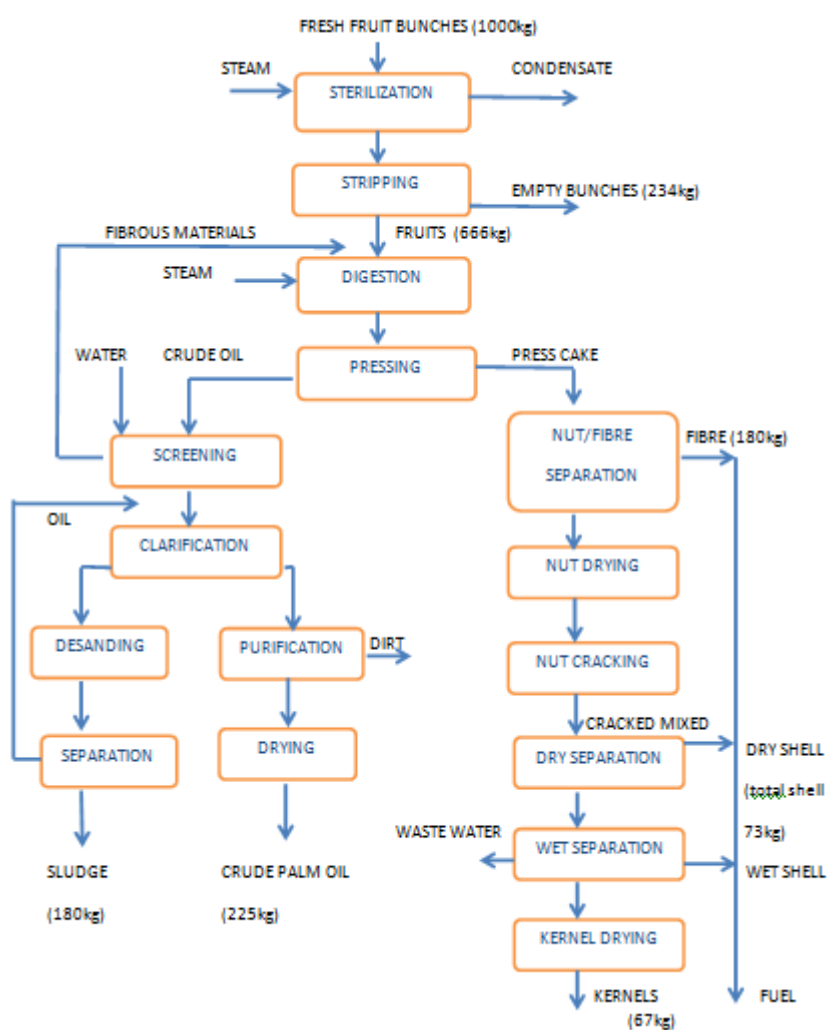

Figure 2.2: Flow chart of palm oil mill process