**UNIVERSITI TEKNOLOGI MARA**

# DEVELOPMENT OF BIOCHAR USING NON-DIRECT FIRING SYSTEM FROM PALM OIL FROND-PHYSICAL CHARACTERISTICS

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# ABSTRACT

Oil palm industry is the leading sector for Malaysia's economy and become the largest exporter of palm oil worldwide and the second largest producer after Indonesia. The abundant of waste generated from oil palm industry in the year 2012 about 95.21 million tonnes of oil palm waste with the expectation in 2020 a serious waste management problems occur with approximately 88.74 Mt of biomass can be produced. During pruning period, the average of 4 kg per dry frond that lead to a total production of palm fronds around 5500 kg hectare per year. However, this highest abundance of OPF waste that has the potential to be converted into useful products though the environmental sustainability is still lacking. In this study, it aims to analyze the best parameter in preparing bio char from OPF and characterization of bio char based on its physical characteristics. This experiment is a batch experiments using a jacketed pyrolyzer applying non-direct firing system with 500 gram of palm frond biomass feed into the pyrolyzer. The heating rate was used at $20^0$C/min to rise into target terminal temperature at $400^0$C, $500^0$C and $600^0$C. The terminal pyrolysis temperature used effect the quality of bio char produced. The best temperature parameter for this experiment was found at 400 $^0$C which produced 16.071 $m^2$/g of BET surface area, alkaline pH and porous structure compare to others two temperatures. Thus, it has potential to adsorb heavy metal contaminants with lower pyrolysis temperature, suitable for acidic soil and act as adsorbent. In this study, oil palm frond represents as a source for renewable energy and environment-friendly product.

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# INTRODUCTION

## 1.1 Research Background

Oil palm industry is the backbone to change Malaysia's economy and plays a major role as the largest exporter of palm oil worldwide and the second largest producer after Indonesia. There are few types of oil palm species available globally but in Malaysia, oil is extracted from mesocarp of oil palm species called *Elaeis Guineensis*. Oil palm has become a global interest for its renewable and sustainable raw materials. In reality, oil palm agricultural has begun in the year 1917 at a slow growth and after the last 50 years of the plantation, and then the development was in rapid pace through large-scale investment on that agricultural industry. Thus, production of palm oil is increasing. In 1976, the palm oil industry has grown to 26.6% and in 2010, it increased to 26.8%. It has become the most important crop in Malaysia. In 2009, the total world production from oil palm industry was 45.10 million tonnes. Over the years, oil palm production has shown an increase thus cause the ranking from $10^{th}$ position to second position (Abdullah, 2011).

In Malaysia, 94% of biomass enormously produced from oil palm sector either by palm oil mill or plantation field and the balance is from the agricultural and forestry sectors like wood, rice husks and sugar cane (Sulaiman et al., 2013). Solid oil palm biomass from the palm oil mill throughout the year consist of empty fruit bunch (EPF), mesocarp fiber (MF), palm kernel shell (PKS), oil palm trunk (OPT) and oil palm frond (OPF). Each of fresh fruit bunch (FFB) containing 21% crude palm oil (CPO), 6-7% palm kernel, 13.5-15% MF, 5.5-7% PKS and 22-23% EFB (Kong et al., 2014). The oil palm production in the year 2012 generated 95.21 million tonnes of oil palm waste (Ani, 2016). In 2020, approximately 88.74 Mt of lignocellulosic biomass can be produced, leading to serious waste management problems (Kabir, Mohd Din, & Hameed, 2017). The average weight of palm fronds that had entered the cutting period is equal to 4 kg per dry frond, with a total production of palm fronds around 5500 kg hectare per year (Maulina & Iriansyah, 2018).