CHAPTER 1

INTRODUCTION

1.1 Background of the Study

The energy sources which is from fossil fuels such as oil, coal and natural gas represent the prime energy sources in the world which approximately 80% of the total use more than 400 EJ per year (Saidur et al., 2011). However, it is anticipated that these source of energy will be depleted within the next 40-50 years. Moreover, the expected environmental damages such as the global warming, acid rain and urban smog due to the production of emissions from these sources have tempted the world to reduce the carbon emissions by 80% and shift towards the utilizing a variety of renewable energy resources which are less environmentally harmful such as solar, wind and biomass. Malaysia could very soon experience an energy crisis if the abundant use of its energy sources continues. Therefore, it is unavoidable that Malaysia also seeks renewable sources for future electricity generation.

Biomass is one of the renewable energy sources that can produce biogas, liquid fuels and electricity which makes it as versatile fuel (Saidur et al., 2011). Sometimes biomass is classified as combustible materials that can be used as an energy source. Biomass is classified as renewable energy source because its supplies are not limited and waste always exist for example wastes from plantation. Actually, there are five major sectors that contribute to the biomass energy in Malaysia such as forestry, rubber cultivation, coca cultivation, sugar cane cultivation, animal wastes, urban wastes and oil palm cultivation (Chuah et al., 2006).

Energy from biomass can be converted via three general categories such as physical or chemical processes and biological conversion and thermochemical process (Chuah et al., 2006). Basically, physical processes include pressing processes and extraction of vegetable oils, which can be used directly or indirectly as biofuels. Meanwhile, chemical processes generally involve chemical transformations of oil and other products extracted from plants in order to convert them into biofuels. For biological processes, it consists of two processes namely alcoholic fermentation and biomethanization from biodegrable organic matter to produce biogas. Thermochemical conversion technologies processes consist of four processes for instance combustion, gasification, pyrolysis and torrefaction which are being utilized for converting biomass into useful form of energy (Asadullah et al., 2014). In torrefaction, solid fuel is produced which is comparable to coal and is termed as bio-coal. Any type of biomass can be considered for torrefaction including woody biomass, forestry by-products, agricultural biomass and even municipal solid wastes. In Malaysia, it is preferable to use oil palm wastes in this process since there are abundantly available of wastes from palm oil milling, plantation and harvesting activities.

Oil palm industry is one of the most important products that enhance the Malaysia’s economy and agricultural sector. According to a report by World growth Palm Oil Green Development (2009), 4,500,000 hectares land used for 17.7 million tonnes of palm oil plantation in 2008 and thus make Malaysia becomes the second world’s largest producer and exporter of palm oil. Malaysia was recorded as world’s largest producer and exporter of the palm oil, accounting for approximately 60% of the world's oil and fat production (Khalil et al., 2012). The oil palm mill significantly contributes to the environmental degradation since the manufacturing process will generate large quantities of solid wastes such as empty fruit bunches (EFB), palm mesocarp fruit fibers (PMF), palm kernel shells (PKS), oil palm frond (OPF), oil palm trunk (OPT) and palm oil mill effluent (POME).

1.2 Motivation

The combination of torrefaction and pelletization is an alternative process for the production of biopellets from a wide range of biomass feedstock. The combination of both processes leads to some improvements in biopellet production such as producing biopellets with high calorific value, hydrophobic nature (water resistance) and good grindability through torrefaction and high density through pelletization. The implementation of torrefaction within pelletization process offers solutions to the problems encountered with the durability and biological degradation of biopellets meanwhile the implementation of pelletization within the torrefaction process offers solutions to the drawbacks of torrefied biomass such as the low volumetric energy density and dust formation.

1.3 Problem Statement

Although biomass is one of the promising renewable energy resources, there are some drawbacks about biomass that need to be considered such as higher energy consumption for collection and uneven composition such as hemicellulose, cellulose and lignin that makes process design and process control more complicated, lower calorific value and high cost for handling and transportation (Stelt et al, 2011). The high moisture content in the biomass also makes its less productive and increases biological degradation during storage (Medic et al., 2012). Recently, there is pre-treatement process under an inert atmosphere which is called as torrefaction has been found to be effective for enhancing the shelf life of biomass. Nevertheless, the drawbacks of torrefied biomass also need to be considered such as the non-standardized shape of torrefied biomass formed, low density, and high cost of handling. As a solution, the physical value of torrefied biomass can be improved by introducing mechanical treatment such as pelletization. Hence, it is important to study the effect of torrefaction and pelletization on the different type of oil palm wastes at certain temperatures to improve the chemical and physical properties of them.