**Abstarct**

Malaysia is the largest producer of palm oil and contributes 43% of worldwide production

(Shuit et al., 2009). Beside palm oil, palm oil industry generated 169.72 million metric tons

solid wastes which contribute 85.5% of total biomass waste produced in the country (Khan

et al., 2010). This huge amount of wastes can be converted into valuable chemical feed stocks

and fuels due to environmental problems associated with conventional fossil fuels.

It is well known that lignocellulosic biomass mainly consists of hemicellulose, cellulose and

lignin. The usual proportions (wt%) vary as 40-50% cellulose, 20-60% hemicellulose and 10-

25% lignin (Yang et al., 2007). The thermal decomposition of these individuals is important

since they influence the basics of thermochemical conversion processes such as pyrolysis,

combustion and gasification. Decomposition of these components is intensively studied in

the literature. Demirbas et al. (2001) observed the ease of lignocellulosic biomass

components decomposition as hemicellulose > cellulose >>> lignin. Based on different

reasoning, Yang et al. (2007) proposed different decomposition regions of 220-300 °C, 300-

340 °C and >340 °C for hemicellulose, cellulose and lignin, respectively. Lignin is the last to

decompose due to its heavy cross linked structure (Guo & Lua, 2001).

Several techniques are available to study the kinetics of biomass decomposition. Among

these, thermogravimetric analysis (TGA) is the most popular and simplest technique

(Luangkiattikhun et al., 2008), based on the observation of sample mass loss against time or

temperature at a specific heating rate. TGA provides high precision (Várhegyi et al., 2009),

fast rate data collection and high repeatability (Yang et al., 2004) under well defined kinetic

control region.

Very few attempts have been carried out to study the kinetics of empty fruit bunch (EFB)

and palm shell (PS) using TGA. Guo & Lua (2001) presented the effect of sample particle

size and heating rate on pyrolysis process and kinetic parameters for PS. They concluded a

first order reaction mechanism for the decomposition of PS at different heating rates. They

also suggested higher heating rates for faster and easy thermal decomposition of PS. Yang et

al. (2004) studied activation energy for decompositions of hemicellulose and cellulose in EFB

and PS by considering different temperature region for first order kinetic reaction. They

evaluated average activation energy and pre-exponential factor from single-step

decompositions of hemicellulose and cellulose. Luangkiattikhun et al. (2008) considered the effect of heating rate and sample particle size on the thermogram behaviour and kinetic

parameters for palm oil shell, fibre and kernel. They observed that there is no significant

effect of particle size on the thermogram behaviour at lower temperature i.e. <320 °C for

palm oil shell. They further proposed nth order reaction mechanism to evaluate the kinetic

parameters based on different models.

Previous works reported on EFB and PS kinetics were based on single heating rate in which

activation energy is only a function of temperature. The present work evaluate the kinetic

parameters based on a method, which requires at least three sets of experimental data

generated at different heating rates. This method allows the dependence of activation

energy on temperature and conversion at a desired heating rate (Vyazovkin & Wight, 1999)

Secondly, lignin decomposition in EFB and PS is not intensively studied at relatively high

heating rates. Present work considers lignin decomposition in EFB and PS to understand the

effect of lignin content on kinetic parameters and decomposition rate. Furthermore, pure

lignin decomposition is studied based on its thermogram analysis and kinetic parameters.

In this work, the kinetics of biomass decomposition which includes EFB, PS, pure cellulose

and lignin were investigated using TGA under non-isothermal conditions. The detail

thermogram analysis was presented to understand the decomposition of cellulose,

hemicellulose and lignin as major components in lignocellulosic biomass. The

decomposition kinetics of cellulose and lignin were studied under single-step first order

kinetic model. Meanwhile, the decomposition of EFB and PS were reported based on single step

nth order kinetic model. Activation energy, pre-exponential factor and order of reaction

were determined and discussed in comparison to the values reported in the literature.