J106 Fast Pyrolysis of Malaysian EFB Biomass using Py-GC/MS Technique

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Introduction

Fast pyrolysis is a thermal decomposition process of biomass in the absence of oxygen at medium temperature between 350 to 600 °C and short retention time of 1-2 seconds. In Malaysia, empty fruit bunches (EFB) is a well known palm oil waste produced during its milling process. With annual emission of more than 18 million tons of EFB in Malaysia, converting this waste into crude oil, which is called "bio-oil," using fast pyrolysis brings highly potential opportunities. In this paper, the authors investigate the organic components and the quality of bio-oil that could be produced using fast pyrolysis with different temperature settings. Pyrolysis was carried out using the py-GC/MS (Pyrolysis Gas Chromatography Mass Spectrometry) technique to determine the percentage of different organic groups in the pyrolyzed vapor.

Materials and Methods

EFB was dried, milled and sieved and a fraction of average particle diameter of 125µm was used for the experiments. The water content was approximately 10%. Py-GC/MS experiments were performed in a Shimadzu PYR-4A pyrolyser (Chemical Data System) interfaced to a gas chromatograph (Shimadzu) coupled to a mass selective detector (Shimadzu) operating in electron impact mode (EI) at 70 eV. The pyrolysis was carried out at three different temperatures, 400, 500 and 600 °C, using a platinum sample bucket and sample weight of 1-2 mg. The pyrolysis chamber was purged with helium. The temperature of the injector was held at 290 °C. The GC separation was carried out with a fused silica capillary column. A temperature program from 40 to 290 °C at 4 deg/min was applied with isotherm periods of 2 min at 40 °C and of 30 min at 290 °C.

Results and Discussion

The py-GC/MS technique was used to study the effect of temperature on the distribution of the pyrolysis products. The semi-quantitative approach based on the peak area used in this study is based on a previous work [1]. Resulted chromatograms showed a very complicated profile, thus, the peaks in the chromatograms were grouped based on their functional group. Fig. 1 (a, b) shows the organic group percentage for different pyrolysis temperatures. Fig. 1(a) shows that both aldehydes and acids, which result in corrosiveness and instability properties of bio-oil, give a peak value at 500 °C, while it is lower considerably at 400 °C. Alcohols behave similarly as shown in Fig. 1(b). Esters percentage which is very important for high quality bio-oil shows high reduction with temperature.

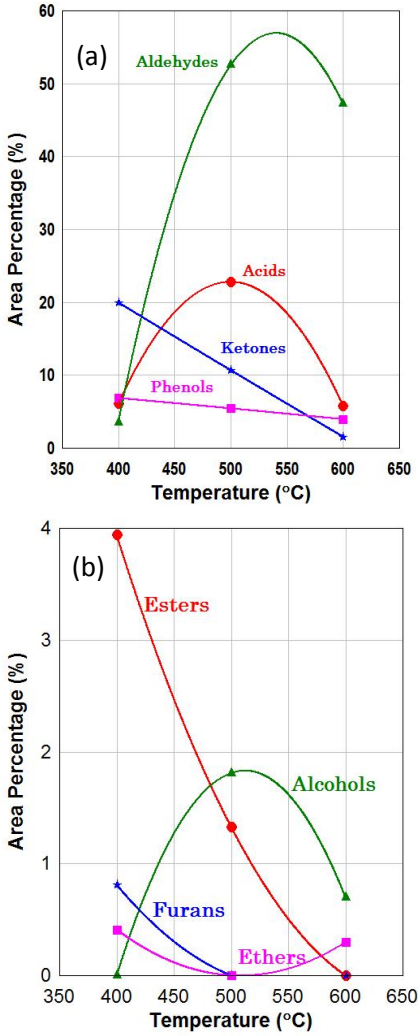

Figure 1(a, b): Percentages of different chemical groups resulted from fast pyrolysis of EFB at different temperatures.

Conclusion

It is obvious that the reaction temperature has a very important effect on the product distribution from the fast pyrolysis of EFB. The decomposed products from EFB showed very high percentages of aldehydes and acids, and thus high corrosiveness and instability for bio-oil are expected.

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References

1) Adam, Judit *et. al.*, "Pyrolysis of biomass in the presence of Al-MCM-41 type catalysts," *Fuel*, **84**, 1494–1502 (2005).

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