Thermogravimetric catalytic pyrolysis and kinetic studies of coconutmcopra and rice husk for possible maximum production of pyrolysis oil

Vekes Balasundram[a], *Norazana Ibrahim*[a], *, *Rafiziana Md Kasmani*[a], *Mohd. Kamaruddin Abd. Hamid*[b], *Ruzinah Isha*[c], *Hasrinah Hasbullah*[d], *Roshafima Rasit Ali*[e]

[a]Clean and Efficient Energy Research Group, Faculty of Chemical and Energy Engineering, Universiti Teknologi Malaysia (UTM), 81310 UTM, Johor Bahru, Johor, Malaysia

[b]Process Systems Engineering Centre (PROSPECT), Research Institute for Sustainable Environment, Universiti Teknologi Malaysia (UTM), 81310 UTM, Johor Bahru, Johor, Malaysia

[c]Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia Pahang, 26300, Gambang, Pahang, Malaysia

[d]Advanced Membrane Technology Centre (AMTEC), Faculty of Chemical and Energy Engineering, Universiti Teknologi Malaysia (UTM), 81310 UTM, Johor Bahru, Johor, Malaysia

[e]Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia

ABSTRACT

The main objective of the present work is to study the effect of Nickel-Cerium/Alumina multifunctional catalyst (Ni-Ce/Al_2O_3) mass loading on pyrolysis of coconut copra and rice husk via thermogravimetric analysis. The sample is pyrolyzed from 30 °C up to 700 °C at a constant heating rate of 10 °C/min in nitrogen environment flowing at 150 mL/min. The multifunctional catalyst (Ni-Ce/Al_2O_3) was prepared via incipient wet impregnation method. Pyrolysis feedstocks were prepared based on biomass to catalyst mass loading ratio. The TG-DTG curve shows that the presences of catalyst significantly affect the devolatilization rate of biomass. Among TGA-pyrolyzed coconut copra samples, the CC-3 (1:0.15) has achieved the highest mass loss (83.3%). For rice husk, the non-catalytic sample has attained the highest mass loss of volatile matter (48.7%). In addition, the kinetic characteristics of non-catalytic and catalytic pyrolysis of biomass were also studied and calculated by employing the Coats-Redfern integral method. The CC-1 has lower activation energy (53.10 kJ/mol) than that of catalytic sample particularly CC-3 (79.28 kJ/mol). The presence of a catalyst on rice husk is able to reduce the activation energy of non-catalytic rice husk sample from 49.78 to 45.24 kJ/mol.

KEYWORDS: Catalytic pyrolysis; Coconut copra; Rice husk; Thermogravimetric analysis (TGA)