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Title :
Pyrolysis Of Shredded Oil Palm Empty Fruit Bunches Impregnated with Cobalt Catalyst

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The world community is concerned with the depletion of fossil fuel and looking at alternative energy resources such as biomass, solar, hydro and wind. With the growth of palm oil production in Malaysia, the amount of biomass residues generated also shows a corresponding increase. Currently, there are several routes being studied to convert the biomass to liquid bio oil, bio char and gases depending on the pyrolysis condition. Catalytic pyrolysis is proposed to be a viable technology to convert this biomass by having a catalyst introduced during the pyrolysis process and in contact physically with the biomass, in the formation of higher quality bio oil. The first goal of this thesis is to analyse the possibility of shredded oil palm empty fruit bunches (SOPEFB) as a catalyst support/carrier by direct impregnation method using cobalt as the catalyst. The concentration of the cobalt aqueous solution were prepared for 5,10,15 and 20 wt% and the SOPEFB samples were soaked in these solutions with the different soaking time. The functional groups that are involve in the reaction such as ion exchange and adsorption, leading to metal uptake by the SOPEFB. Results show that the sorption equilibrium is achieved approximately after 24 hours. The adsorption capacity was 8.12, 9.27, 11.16 and 12.06 mg/g of SOPEFB for the 5, 10, 15 and 20 wt% of cobalt aqueous solutions respectively. The adsorption follows both Langmuir and Freundlich isotherm, however, the correlation coefficient showed that Freundlich equilibrium data fitted well than Langmuir model indicated the surface heterogeneity of the SOPEFB. The second goal is to study the thermal decomposition and kinetic reaction of the pyrolysis of the impregnated SOPEFB with cobalt catalyst. Thermogravimetric analysis (TGA) was carried out to elucidate chemical kinetics of the pyrolysis of the non impregnated SOPEFB and impregnated SOPEFB with cobalt catalyst. The kinetic parameters were calculated using least square with minimizing sum of error technique. The results show that the activation energy (E_a) of SOPEFB is in the range of 80 to 100kJ/mol and the order of reaction (n) was discovered in the range of 2.0 to 3.0. The model used to predict the rate equations agree with the experimental data with the coefficient of determination (R^2) in the range of 0.70 to 0.97. Fixed bed pyrolysis was performed to evaluate the pyrolysis and catalytic pyrolysis of SOPEFB in a simple batch system. The effects of pyrolysis temperature and the cobalt catalyst content on the yield of products were investigated. Results showed that the maximum oil yield is obtained at 500°C of pyrolysis temperature. The use of cobalt catalyst has a positive impact on the yields of small molecular weight compounds. It is believed that the hydrocarbon vapour from the thermal decomposition of SOPEFB immediately came into contact with cobalt on the SOPEFB surface. The cracking of the hydrocarbon may involve reactions on the cobalt surface as well as subsequent reactions in the vapour phase. Overall, this study confirms the possibility of SOPEFB to become a cobalt catalyst support/carrier and at the same time the product of catalytic pyrolysis of the SOPEFB can be cracked to smaller molecular weight and subsequently upgraded the quality of the bio oil.