UNIVERSITI TEKNOLOGI MARA

THERMAL BEHAVIOUR OF CO-UTILISATION OF SILANTEK COAL AND EMPTY FRUIT BUNCH USING THERMOGRAVIMETRIC ANALYSIS

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ABSTRACT

For many years, agricultural residues have been used as a source of energy. Agricultural residues are recognised as sustainable energy sources in current environmental and fossil fuel energy production. It is critical to research the characteristics of biomass and coal to comprehend their behaviour before they can be used on a larger scale. A thermal analysis was conducted to investigate the thermal behaviour of Malaysian bituminous coal (Silantek coal) and oil palm biomass (Empty fruit bunch) under pyrolysis and combustion. The investigation was done using a thermogravimetric analyser using nitrogen gas and air at a flowrate of 50mL/min. This study involves four different heating rates of 10, 20, 40, and 60°C/min to further calculate the kinetic parameter. Chemical characteristics of proximate, ultimate, and calorific were also examined. To investigate the effect of blending on coal and biomass five different ratios (0, 20, 50, 80, and 100) were selected. The DTG data obtained showed three stages of thermal degradation of empty fruit bunch (EFB) while only two regions appeared for Silantek coal (SC) due to different fuel properties. Biomass releases higher volatile quantities which increase the peak high as the amount increases. In addition, the temperature of maximum decomposition reaction shifted to a lower temperature as biomass increased. Both SC and EFB blends also did not follow their individual samples, which indicates the interaction of coal and biomass. Furthermore, an intense evaluation curve with multiple peaks appears during combustion. As the biomass increases, the time taken for the sample to completely burn decreases due to the higher reactivity of EFB which fastens the combustion of volatile matter. Toward the end of combustion, it reports a negative synergistic interaction between SC and EFB which was also suggested by other researchers. The results of kinetic parameters for pyrolysis were calculated using the Kissinger method (model free), which assumes the interaction as a first-order reaction. The activation energy (Ea) and preexponential factor (A) were calculated for each blend to find the best blending ratio for EFB and SC. As for combustion, a model fitting method (Cost-Redfern) was used to determine the kinetic parameters. It shows that, the diffusion reaction mechanism is the best reaction method to find Ea and A values with a regression coefficient higher than 0.95. The findings of this study add to understanding of the behaviour of Malaysian bituminous coal and oil palm biomass, which are important for energy generation in the future.

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