Experimental study on temperature profile of fixed-bed gasification of oil-palm fronds

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Abstrak

Currently the world’s second largest palm oil producer Malaysia produces a large amount of oil palm biomass each year. Although some oil palm parts and derivatives like empty fruit bunch and fibre have been commercialized as fuel, less attention has been given to oil palm fronds (OPF). Initial feasibility and characterization studies of OPF showed that it is highly feasible as fuel for gasification to produce high value gaseous fuel or syngas. This paper discusses the experimental gasification attempt carried out on OPF using a 50 kW lab scale downdraft gasifier and its results. The conducted study focused on the temperature distributions within the reactor and the characteristics of the dynamic temperature profile for each temperature zones during operation. An average pyrolysis zone temperature of 324oC and an average oxidation zone temperature of 796oC were obtained over a total gasification period of 74 minutes. A maximum oxidation zone temperature of 952oC was obtained at 486 lpm inlet air flow rate and 10 kg/hr feedstock consumption rate. Stable bluish flare was produced for more than 70% of the total gasification time. Similar temperature profile was obtained comparing the results from OPF gasification with that of woody biomass. Furthermore, the successful ignition of the syngas produced from OPF gasification ascertained that OPF indeed has a higher potential as gasification feedstock. Hence, more detailed studies need to be done for better understanding in exploiting the biomass as a high prospect alternative energy solution. In addition, a study of the effect of initial moisture content of OPF feedstock on the temperature distribution profile along the gasifier bed showed that initial moisture content of feedstock in the range of 15% gives a satisfactory result, while experiments with feedstock having higher moisture content resulted in lower zone temperature values.