5.6.11 Design of bench-scale fast pyrolysis reactor for bio-fuel production

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Fast pyrolysis technology had been studied extensively with a purpose to utilize biomass for fuel and energy application. The main product from this process, bio-oil can be further processed into transportation fuel, power generation and chemicals. The most challenging aspect is to develop an economic viable platform for processing capital. Biomass contains low energy content of ~150 kg/m^3, which corresponds to high transportation cost from source to processing plant. Conversion of biomass into liquid fuels can increase the energy content by 10 times higher and reduce transport cost up to 87 %. As such, in situ fast pyrolysis reactor is required to tackle this problem. Ablative reactor is the most suitable design for mobile application compared to other popular technology such as fluid bed, microwave and rotating reactors. The reactor is small in size, do not require carrier gas and can process large or ununiformed particle feed size. MyPyros, a new bench-scale fast pyrolysis reactor had been developed to fulfill the abovementioned objective. This reactor is composed of feeding unit, heating unit, char separating unit and condensation unit. The reactor is equipped with a screw feeder to create optimum centrifugal and mechanical force for rapid biomass decomposition. The operating temperature varies around ~ 450 to 500 °C, while the processing capacity is around 5-20 g/min. Electrical heating is used to provide a steady and uniform heat supply for the reactor. Vapors are passed through char separator and cyclone before being condensed at 20 °C. MyPyros was able to generate 15-20 % of bio-oil, 50-55 % char and 25-35 % non-condensable gases. Further works are required to improve the efficiency of reactor for a higher conversion rate. This study serves as an initial work for in situ fast pyrolysis process with regards to biomass to bio-oil conversion.