

FAST PYROLYSIS BIO-OIL PRODUCTION IN A ENTRAINED FLOW REACTOR PILOT

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Bio-oil produced from biomass fast pyrolysis could constitute an alternative to fossil liquid fuels, especially to be combusted for local district heating. So far, only few studies have dealt with bio-oil production by biomass fast pyrolysis in an entrained flow reactor [1], yet it could constitute an alternative to the better-known fluidised bed pyrolysis process.

In the context of the BOIL project with the CCIAG Company (Grenoble district heating), a new pilot based on an entrained flow reactor concept has been designed [2]. The pilot design has been carried out on the basis of woody biomass fast pyrolysis experiments and modeling performed in a drop tube reactor as a first step laboratory-scale study, and also CFD modeling [2-3].

The facility is composed of a biomass injection system with a hopper and a feeding screw, an electrically heated pyrolysis reactor, a cyclone to separate gas and char, 3 heat exchangers to cool the gas (at 30°C, 0°C and 0°C respectively) and condense bio-oil, and a post-combustion unit to burn the incondensable species. Gas temperature is maintained at 350°C from the reactor outlet to the entrance of the first heat exchanger in order to avoid bio-oil condensation.

Several conditions were tested in 14 runs: 3 different biomass feedstocks, varying biomass feeding rates from 2 to 9 kg/h and two reactor temperatures 500°C and 550°C. 85 kg of bio-oil has been produced for combustion tests. Recovered bio-oil mass yield is on average 50%, its LHV is about 15 MJ/kg, its water content 26%w and its pH 2.15. We identified three main difficulties during the runs: about 15% of the bio-oil go through the heat exchanger, some char particles go through the cyclone which causes regular plugging of the first heat exchanger. Detailed analyses of the bio-oil produced have been done and the chemical and physical bio-oil characteristics have been compared to the European Standard recommendations [4].

With a regularly cleaning of the first heat exchanger, we successfully produce bio-oil with physical and chemical properties in agreement with the European Standard recommendations.

Combustion tests of the bio-oil produced have been carried on by the CIRAD. They succeeded in obtaining a stable flame (without the use of a pilot flame) in a 50 kW burner and a 250 kW combustion chamber. However the physical and chemical characteristics of the bio-oil involve the use of specific pump and pulverization system adapted.

In perspective for future projects, it would be interesting to perform pilot modifications in order to increase bio-oil yield and to minimize heat exchanger cleaning, and to test other resources like agricultural biomass or solid recovered fuels.

Bibliography

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