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Fast entrained bio-oil production in an entrained flow pilot reaction

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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. In the first experiments performed in the pilot, several conditions were tested: 3 different biomass feedstocks, varying biomass feeding rates from 2 to 9 kg/h and two reactor temperatures 500°C and 550°C. Recovered bio-oil mass yield is on average 40% and its LHV is about 15 MJ/kg. A certain percentage of bio-oil is found after the 3 condensers which means that they are not totally efficient yet. Detailed analyses of the bio-oil produced are in progress. The chemical and physical bio-oil characteristics will be compared to the European Standard recommendations [4].The next steps will be to test bio-oil combustion.

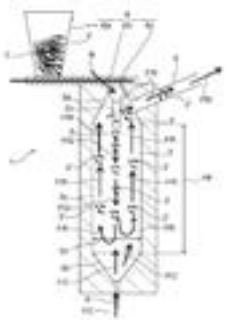

Figure1: Fast pyrolysis reactor with counter current flow of hot gas [2]

Recent Publications

1. J.A. Knight, C.W. Gorton, R.J. Kovac, Biomass 6, pp. 69-76, 1984.
2. Fast pyrolysis reactor for organic biomass materials with against flow injection of hot gases - US 20170166818 A1
3. Guizani, S.Valin, J.Billlaud, M.Peyrot, S.Salvador, Fuel, 2017, 207, pp.71-84.
4. C.Guizani, S.Valin, M.Peyrot, G.Ratel S.Salvador, Woody biomass fast pyrolysis in a drop tube reactor - Pyro2016 conference
5. Fast pyrolysis bio-oils for industrial boilers – Requirements and test methods – EN 16900

Biography

Marine Peyrot works in the LTCB laboratory for 10 years in the LITEN CEA in Grenoble; she has her expertise in biomass and waste pyrolysis and gasification, and more particularly in reactor modeling.The Laboratory for Thermal Conversion of Bioresources (LTCB) works on the development of biomass and waste-to-energy processes (heat, electricity), as well as processes dedicated to the production of 2G/3G biofuels and green chemicals. It has wide expertise in gasification processes and technologies dedicated to dry resources (fixed bed, fluidized bed, entrained flow reactor) and wet resources (hydrothermal liquefaction, supercritical water gasification). It is equipped with numerous analytical devices to characterize the products (gas, bio-oil, bio-crude, char), study the reaction kinetics, and analyze the inorganic species and their interactions with materials.

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