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FAST PYROLYSIS IN A VERTICAL IMAGE FURNACE: COMPARISON WITH OTHER SYSTEMS

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Nowadays, ligno-cellulosic biomass is considered as a renewable carbon resource. It represents a relevant alternative to reduce greenhouse gases emissions. Last decades, many scientists and industrials have been interested in thermochemical conversion of biomass such as gasification. In order to model these reactors, it is important to observe thermochemical phenomena, through dedicated experiments close to the industrial conditions. Accordingly, it is interesting to study the pyrolysis step, notably in conditions representative of fluidized bed, one of the major technologies to gasify biomass. The aim of this communication is to present and compare the new vertical image furnace realized by LRGP and four other fast pyrolysis setups: wire mesh reactor [1], free fall reactor [2], radiant furnace [3] and other image furnaces [4, 5].

The vertical image furnace is based on the former horizontal setup which has been described in details in previous works [4,6]. The principle is to concentrate the radiation of a 5 kW xenon arc lamp on a biomass sample. The lamp is settled at the first focus of an elliptical mirror. The light beams are concentrated at the second focus where the biomass sample is placed inside a cylindrical reactor. A controlled flow of nitrogen at ambient temperature sweeps this reactor to quench vapours and prevent any gas-phase reactions. The radiant flux applied to the biomass can reach 800 kW.m². This is the maximum heat flux encountered by a solid fuel injected inside a fluidized bed [6]. During pyrolysis, gases are collected in a sampling bag, liquids are condensed in a cold bath (T = 223K) and aerosols are filtered. The solid residue is remained in the reactor. As soon as the light beams are switched off, the different products could be recovered, weighted and analysed (CHON, Karl Fischer, GC and HPLC). The main innovations of this setup are the heat flux modulation over time to reproduce fluidized bed conditions, the pyrometric temperature measurement and the vertical orientation of the concentrated beams. This feature allows studying very thin samples of wood pieces which are pyrolysed in chemical regime, but also other kind of biomass (powders and liquids).

The comparison of this new setup with other fast pyrolysis lab reactors focuses on technical features: maximum temperature, heating rate, pressure, solid residence time, gas-phase conditions (temperature and residence time), type of biomass sample and its dimensions. This comparison allows evaluating advantages and drawbacks of this vertical image furnace setup.

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