BIOMASS PYROLYSIS FOR MILD COMBUSTION AND DRY REFORMING FEEDSTOCKS PRODUCTION

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Abstract
Pyrolysis is an established process for biomass thermal treatment. However, the potential use of the different pyrolysis products is still being widely investigated due to their complexity and to the great variability of their properties depending on many parameters (e.g. operational parameters of the process, feedstock biomass characteristics, pre- and post-treatments). In the framework of the project MINICOR - MILD Combustion with Nitrogen and Carbon Dioxide Reforming, funded by the European Innovation Council, biomass residues are processed through pyrolysis to form different products: permanent gases, bio-oil and biochar. Biochar is designed for nitrogen adsorption from several sources, while the other products can be converted through combustion or dry-reforming under MILD conditions for energy or bio-fuel production, given its high fuel flexibility, high efficiency and low environmental impact. Straw, hardwood (poplar) and softwood (mixed residues) have been selected as biomass feedstock. Temperatures 360, 450, and 600 °C and a heating rate of 10 °C/min were selected for the experimental tests of the selected biomasses. Moreover, the effect of solid holding time at 0 and 1 h was considered. The permanent gases produced during pyrolysis were analyzed online via micro-Gas Chromatography, and the corresponding heating value was subsequently calculated. The bio-oil was collected and analyzed offline with different analytical techniques, such as Gas Chromatography coupled with Mass Spectroscopy (GC-MS) for oxygenated compounds identification and quantification, and Karl Fisher Titration for water content determination. The gas composition analysis shows that for pyrolysis temperatures higher than 450 °C, all the combinations of feedstocks, temperatures and solid holding times result in a gas mixture suitable for MILD combustion. The bio-oil composition gives fundamental information on how to create surrogates (as single species or as a mixture) to gain insight into the reaction mechanism and the optimal operating condition for the non-catalytic dry reforming of such complex feedstock.

Acknowledgment
This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101115506