

## **Torrefaction of biomass: influence of operating conditions on products and grindability**

*Jean-Michel Commandré, Patrick Rousset*

CIRAD, UPR 42 Biomasse Energie, TA B 42/16, 73, Avenue J.-F. Breton, 34398 Montpellier cedex 5, France

Biomass is a renewable fuel, increasingly considered as an important resource for alternative fuels with significant environmental advantages. Thermo-chemical conversion of biomass is a mean to produce energy and to reduce greenhouse gases. Rapid gasification of biomass at high temperature is one of the most promising technologies for the syngas production and can be achieved in several seconds in an entrained flow reactor. At high temperature (1400°C), it is possible to obtain a syngas (CO, H<sub>2</sub> and CO<sub>2</sub>) containing very small amounts of residual hydrocarbons and solid carbon (char). Heat and mass transfers are very effective in this kind of reactor, but the biomass must be dried and ground to particles measuring several hundreds of micrometers prior to injection. These preliminary steps, especially grinding, consume large amounts of energy and represent obstacles that need to be overcome in order to expand the use of biomass in thermo-chemical processes.

Torrefaction is a technology which allows moisture and low weight organic volatile components of biomass to be removed, producing a hydrophobic solid residue with an increased energy density (on a mass basis) and greatly reduced grinding energy consumption compared to fresh biomass<sup>1</sup>. Electricity requirements for size reduction of torrefied wood are 50 to 85 % smaller in comparison with fresh wood<sup>2</sup>.

In this work, a specially designed crossed fixed-bed reactor was used to characterise influence of operating conditions on torrefied biomass properties. Condensable species were recovered thank to a cooling device afterwards the crossed fixed bed; gaseous species were continuously quantified by a µGC. Mass balance was evaluated by quantification of the biomass mass loss and species released.

The nature of biomass (wood, straw) was considered. For each sample of torrefied biomass, mass loss, proximate analysis and lower heating value were quantified.

The torrefied wood grindability was evaluated thank to the energy consumption of a specific grinder.

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<sup>1</sup> Bridgeman TG, Jones JM, Shield I, Williams PT. Torrefaction of reed canary grass, wheat straw and willow to enhance solid fuel qualities and combustion properties. *Fuel* (2007), doi:10.1016/j.fuel.2007.05.041.

<sup>2</sup> Bergman PCA, Boersma AR, Kiel JHA, Prins MJ, Ptasiński KJ, Janssen FJJG. Torrefaction for entrained flow gasification of biomass. In: Van Swaaij WPM, Fjällström T, Helm P, Grassi A, editors. Second world biomass conference, Rome, Italy. ETA-Florence and WIP-Munich, 2004: 679-82.