## Influence of Biomass Chemical Properties on Torrefaction Characteristics

Suriyati Binti Saleh<sup>b</sup>, Brian Brun Hansen<sup>a</sup>, Peter Arendt Jensen<sup>a</sup>, and Kim Dam-Johansen<sup>a</sup> <sup>a</sup> CHEC, Department of Chemical and Biochemical Engineering, Technical University of Denmark, Søltofts Plads, Building 229, DK-2800 Lyngby, Denmark <sup>b</sup> Faculty of Chemical and Natural Resources Engineering, University Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Pahang, Malaysia

## ABSTRACT

Different biomass types may differ with respect to torrefaction characteristics, and an improved understanding and ability to predict the torrefaction performance is, therefore, desired. In this study, the influence of the chemical properties (lignocellulose composition and alkali content) on the torrefaction behavior with respect to mass loss and grindability is investigated by simultaneous thermal analysis (STA) and by using a combined torrefaction and grinding reactor. The torrefaction behavior of six raw biomass samples and selected pretreated samples (washed and impregnated with KCl and K<sub>2</sub>CO<sub>3</sub>) has been studied. The investigated biomasses have reasonably similar carbohydrate compositions (hemicelluloses 18-25 wt % db; cellulose 38-48 wt % db; lignin 17-29 wt % db) with the exception of spruce bark, which is lower in hemicellulose content (12.9 wt % db) and cellulose content (24 wt % db), and higher in lignin content (36.8 wt % db). An increasing biomass potassium (K) content decreases the temperature of maximal conversion for both raw and alkaliimpregnated biomass samples, thus decreasing the solid product yield at 270 and 300 °C. This was especially pronounced when the biomass potassium content increased from 0 to 0.2 wt %. However, the higher lignin content in bark causes a higher solid yield than what would be expected from the alkali content, illustrating that both potassium content and lignocellulose composition affect the solid yield obtained by torrefaction. The grindability of the torrefied products was evaluated by determining the d<sub>50</sub> value of the particle size distribution of the biomass before and after torrefaction in the combined torrefaction and mill reactor. A significant decrease in  $d_{50}$  value was observed when the alkali content increased from 0 to 0.2 wt % db, whereas no additional effect is seen for higher potassium contents.

## DOI: 10.1021/ef401788m