Influence of fast pyrolysis conditions on yield and structural transformation of biomass chars

Abstract:

Fast pyrolysis of biomass (wood, straw, rice husk) and its major components (cellulose, hemicellulose, lignin) was conducted in a wire mesh reactor. The aim of this study was to understand the influence of temperature (350–1400 °C), heating rate (10–3000 °C/s), particle size (0.05–2 mm) and holding time (1–4 s) on the char morphology and char yield. Scanning electron microscopy (SEM) and elemental analysis were conducted to determine the effect of operating conditions on char softening and melting during pyrolysis. The char yield decreased with heating rate for rates \( \leq 600 \, ^\circ C/s \); above this value a similar biomass char yield was obtained. The potassium content affected the char yield stronger than other minerals, while the distribution of the three major biomass constituents (cellulose, hemicellulose, lignin) affected the char yield only to a minor degree. Moreover, it was found that the heat treatment temperature had a larger influence on the char yield than the heating rate. Scanning electron microscopy indicated different types of biomass char plasticization influenced by the applied temperatures, heating rates, particle sizes and holding times, except for the rice husk char that formed chars with a structure similar to the parental fuel at all
conditions. The less severe morphological changes of rice husk char were attributed to a high silica content.