Pelletizing Properties of Torrefied Biomass

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Torrefaction of wood is a thermo-chemical conversion process improving the handling, storage and combustion properties. The resulting material is an attractive fuel, both for combustion and gasification processes. The handling properties of the material can be further improved by compressing the torrefied biomass into fuel pellets of high density. The resulting pellets are relatively resistant to moisture uptake, fungal decay and are easy to comminute into small particles. Nevertheless the pelletization of torrefied wood is challenging, since the thermal degradation of wood polymers reduces the ability to form stable bonds during the pelletizing process.

The present paper compares the pelletizing properties of untreated wood and wood torrefied at 250, 275 and 300 °C. The thermal degradation of lignin and hemicelluloses was studied by means of infrared spectroscopy and chemical analysis. The pelletizing properties were determined using a single pellet press and the pellet stability was analyzed by compression testing. The bonding mechanisms in the different pellets were compared by fracture surface analysis and scanning electron microscopy.

The biomass composition changed drastically during the torrefaction process. Infrared spectroscopy and fiber analysis both showed that hemicelluloses are most sensitive to thermal degradation, but also lignin and cellulose are affected. Polymer degradation depended largely on the torrefaction temperature. The pelletizing properties of wood changed with torrefaction, resulting in an increase of friction in the press channel of the pellet press and lower compression strength of the pellet. Fracture surface analysis of the pellets revealed a change in bonding mechanism for the torrefied wood due to polymer degradation which lowered pellet strength. Suggestions are made on how to overcome the technical problems related to the pelletization of torrefied wood by raw material choice, change of processing conditions and the addition of additives.