Evaluation the Reactivity of Woody Biomass with Pyrolysis Molecular Beam Mass Spectrometry (Py-MBMS)

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Abstract

Thermochemical conversion technologies, e.g., torrefaction, pyrolysis or gasification can be applied to a wide variety of biomass materials, and generate a wide variety of intermediate products, e.g., energy dense solid fuels, pyrolysis oils and syngas. Depending on the reaction conditions the yield and properties of these intermediate products can vary widely. In this work pyrolysis-molecular beam mass spectrometry (py-MBMS) was used to analyze the composition of different biomass feedstocks, and then to measure the yield and composition of the intermediate products produced under different conditions.

In the case of torrefaction hardwoods appear to be more reactive than softwoods. The elemental yields and mass yields were linearly correlated, suggesting that the torrefaction vapors have similar elemental composition throughout the process. The composition and yield of pyrolysis oils are heavily dependent on the feedstock and also presence of minerals. In the case of gasification the composition and yield of tars, and the reactivity and yield of chars were also sensitive to reaction conditions and mineral. The py-MBMS also allows for differentiation of the aromatic reaction products coming from lignin and the reaction products coming from the carbohydrate component. As expected both are sensitive to the thermal environment, but the carbohydrate fragments are more sensitive to the presence of minerals.