MODELING THE PYROLYSIS OF XYLAN IN PRESENCE OF ASH

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Work-In-Progress Abstract

One of the major concerns about the usage of biomass is the remarkable variety of its composition, in terms of both organic and inorganic matter, since it is known that small variations in their concentrations can affect the pyrolysis characteristic temperatures and product yields and compositions. It is well known that the kinetic modeling of biomass pyrolysis is essential to define the progress of the decomposition reaction paths and to evaluate the dependence of the rate of progression on process parameters. Nevertheless, most of the efforts were focused on the modification of the kinetic mechanism of cellulose pyrolysis due to the lack of experimental data assessing the effect of metals on hemicellulose and lignin pyrolysis. In this paper the effect of ash on the slow pyrolysis of xylan, commercial and demineralized beechwood xylan was investigated. These samples were subjected to pyrolysis tests up to a temperature of 973 K in both a thermogravimetric analyzer (TGA) and a pyrolysis reactor, under an inert atmosphere of nitrogen with a heating rate of 5 K/min. Weight loss profiles, product yields, and gas release rates as a function of the temperature were obtained. Finally, the experimental results were compared with the predicted values obtained using the hemicellulose sub-mechanism of the Bio-PoliMI, where the catalytic effect of the ash is included. The experimental results show that the initial decomposition temperature of the raw xylan is slightly anticipated with respect to the demineralized xylan. Moreover, as shown in Figure 1, ashes enhance cracking reactions producing permanent gases (CO and CO_2) at the expense of pyrolysis liquids.

The kinetic mechanism is able to capture the mass loss profiles but fails to predict the gaseous species release profiles during the pyrolysis process. The predicted final yield of char is in agreement with the measurements, while the gas and bio-oil final yields are under and over predicted, respectively. Finally, the inclusion of the ash catalytic reaction had a marginal impact on the predictions.

Future work aims to face this mismatch between the experimental results and kinetic predictions. A modification of the model will be pursued based on the acquisition of experimental data on demineralized xylan doped with different concentrations of potassium and/or sodium chloride.

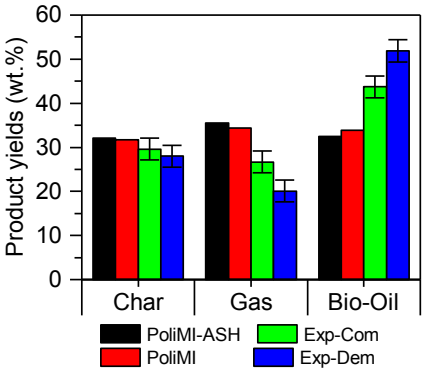

Figure 1. Experimental and predicted product yields of the xylan samples