CHARACTERIZATION OF LIGNIN BY MEANS OF DEVOLATILIZATION AND COMBUSTION TESTS ON AN ISOTHERMAL PLUG FLOW REACTOR (IPFR)

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The combustion behaviour of a lignin produced by steam explosion was investigated using an Isothermal Plug Flow Reactor (IPFR). The adopted procedure was much more detailed than the one commonly adopted to characterize biomasses in the IPFR, especially concerning the char combustion tests. In fact, although the here presented tests, as well as the devolatilization ones, were performed at only two different temperatures (900–1200°C), several oxygen concentrations were tested for each one. The char combustion tests were performed with 2%, 4%, 8% oxygen in the flue gases and, furthermore, a char gasification test with water and carbon dioxide was performed by injecting char into the IPFR maintaining an oxygen-free atmosphere.

The samples collected from the IPFR underwent several laboratory analyses: proximate, ultimate, particle size distribution and ash composition. In particular, the conversion during devolatilization and char combustion was calculated according to the ash tracer method, which assumes the ash content being inert all through the processes occurring in the IPFR. The experimentally determined conversion trends are the basic data to get a reliable description of the fuel combustion according to different kinetic models.

The results of the lignin characterization are shown with particular attention on the conversion trends versus the residence time. All of the experimental measures follow the expected trends, indicating that the data can be considered highly reliable to determine the kinetic parameters to be used to describe the devolatilization and char combustion of this fuel. The validation of the ash tracer method, given by comparing the ash composition of some selected samples, increases even more the degree of reliability of these results.

Moreover, the wide range of available data coming from the ultimate analysis and the particle size distribution analysis allows investigation of other phenomena concerning devolatilization and char combustion of this lignin. The average composition of the released volatiles can be estimated, as well as the one of the char combustion products; the particle size evolution during both processes can also be studied.

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