Characterization of Residual Particulates from Biomass Entrained Flow Gasification

Biomass gasification experiments were carried out in a bench scale entrained flow reactor, and the produced solid particles were collected by a cyclone and a metal filter for subsequent characterization. During wood gasification, the major part of the solid material collected in the filter is soot. Scanning electron microscopy (SEM) images coupled with energy dispersive spectroscopy (EDS) show agglomerated nanosize spherical soot particles (<100 nm) that are very rich in carbon. In comparison to wood gasification, the soot content in the filter sample from straw gasification is quite low, while the contents of KCl and K2SO4 in the filter sample are high. SEM images of the straw filter samples show that with steam addition during gasification, where the soot yield is lower, the filter sample becomes richer in KCl and K2SO4 and appears as irregular crystals, and the typical particle size increases from below 100 nm to above 100 nm. During gasification of dried lignin, the filter sample mainly consists of soot and nonvolatile inorganic matter. SEM images of the parent wood particles and the derived char samples show that they have similar structure, size, and shape but the derived char particle surface looks smoother indicating some degree of melting. The reactivity of the organic fraction of the samples was determined by thermogravimetry, and it was found that char was more reactive than soot with respect to both oxidation and CO2 gasification. The activation energy for the soot conversion is higher than for the char conversion. These results support the observation from gasification experiments that char is more easily converted than soot. Surprisingly, the soot produced at a higher temperature is more reactive than the soot produced at a lower temperature.

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