Primary Pyrolysis Behavior of Wood Gasification Focusing on the Constituent Polymers

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Gasification is a potential way to convert wood into liquid fuels and chemicals as well as gaseous fuels. However, tar problem exists as a major challenging technical issue for its commercialization. Gasification is considered as a two-stage process, which includes primary pyrolysis to form primary tar and char, followed by their reactions with gasifying agents such as oxygen and steam. Thus, primary pyrolysis must be important for final product composition through acting as a source of the reactants with gasifying agents. Understanding the primary pyrolysis behavior of wood to form volatile and carbonized products and their reactions with gasification agents are very important for understanding the overall gasification process on molecular basis. In this study, primary pyrolysis behavior of wood is presented, focusing on the behaviors of wood constituent polymers.

Japanese cedar (*Cryptomeria japonica*) wood and its constituent polymers [cellulose, hemicellulose (glucomannan and xylan), milled wood lignin] were pyrolyzed in N_2 at gasification temperature (800℃) for 30 sec in a Pyrex glass tube reactor. Through comparing the tar and char forming behaviors including tar composition, pyrolysis behavior was found to be different substantially between wood polysaccharides and lignin; 1) wood polysaccharides gave anhydrosugars, C_2-C_3 carbonyls, furans, carboxylic acids and polysaccharide-like substances as primary tar components, while lignin gave low molecular weight aromatics with 4-hydroxy-3-methoxyphenyl (guaiacyl) moiety; 2) secondary reactions including carbonization of the primary tar from wood polysaccharides occurred after condensation at the reactor wall with relatively low temperature (< 400℃), while relatively labile tar from lignin suffered the vapor phase carbonization (Fig.1).

These characteristic features became ambiguous in wood pyrolysis. This indicates the existence of the specific interactions between wood cell wall constituents. With various mixed samples of cellulose with hemicellulose or lignin, interactions between wood constituent polymers were indicated in wood pyrolysis as well as well-known influences of the inorganic substances. Especially, fairly strong interactions existed between wood polysaccharide and lignin.

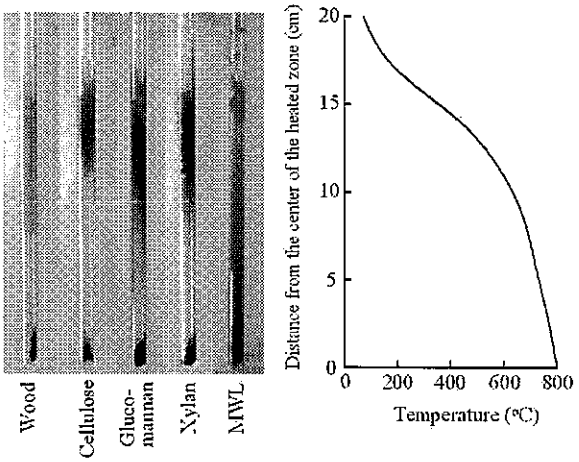

Figure 1: Pyrolysis reactors after pyrolysis of wood and its constituent polymers in N2 at 800oC for 30 sec and the temperature profile in the reactor.