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# Electron Beam Treatment and Characterization of Lignin Obtained from Black Liquor by A Mini-Pilot Scale Extraction System

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Black liquor is biomass-based industrial waste obtained from the chemical pulping process of wood. The lignocellulosic materials such as lignin, hemicellulose and other extractives are dissolved into black liquor. Lignin, which can also be extracted from black liquor, exhibits good thermal stability and high carbon yield. In the present study, compared to the lignin obtained by a lab-scale experimental set-up, a relatively large amount of lignin was extracted from black liquor by a mini-pilot scale extraction system. Lignin extraction was performed by adjusting the pH value by adding sulfuric acid and, then neutralizing by filtering and washing it with distilled water. The extracted lignin was treated by irradiation process at different electron beam absorption doses. Electron beam irradiation process was performed at ambient temperature in air by using industrial-level radiation facility. Prior to electron beam processing, a certain amount of the extracted lignin was placed in a polyethylene bag. The electron beam energy used was 1.14 MeV, the current was 7.2 mA, and the moving conveying rate was 10 m/min. The irradiation was done in the electron beam channel, at which the samples to be irradiated were placed in the moving cart. The electron beam absorption dose was controlled by the number of sample irradiations exposed in the channel. The absorption doses ranging from 100 to 1000 kGy were irradiated to the extracted lignin. The extracted lignin and the irradiated lignin were characterized through various analytical methods such as attenuated reflectance- Fourier transform infrared spectroscopy (ATR-FTIR), proton-nuclear magnetic resonance spectroscopy (1H-NMR), thermogravimetry analysis (TGA), and scanning electron microscopy (SEM). The result shows that the lignin obtained from black liquor by a mini-pilot scale extraction system indicates chemical characteristics of typical lignin. The present study suggests that the lignin extracted by a scaled-up process and also the irradiated lignin may be used for preparing lignin-based activated carbon through carbonization and activation processes.

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