Valorization of fatty acid and lignin for biochemicals and biomaterials production

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Abstract

The increasing demand for biochemicals and biomaterials has made fatty acid and lignin valorization attractive. After extracting fatty acid from the vegetable oil, biolubricant molecules can be built. Meanwhile, cellulose and lignin obtained from biomass pretreatment are the basic building blocks for biodegradable materials. In this presentation, vegetable oils were hydrolyzed to fatty acid and formed biolubricant molecules through 5-step reactions. First, hydrolysis of vegetable oils was applied. Then urea crystallization was made to separate unsaturated fatty acids. Later, epoxidation and esterification reactions were sequentially performed to obtain high-quality biolubricant. H-NMR and C-NMR were used to identify the intermediates and products. Finally, the biodegradable biolubricant (Synthetic ester types) ISO 15380 was produced. ISO V32 specification was categorized as viscosity at 40 ºC of 28.8-35.2 cSt, viscosity at 100 ºC of higher than 5.0 cSt, viscosity index higher than 104, pour point of -18 ºC, and flash point of higher than 175 ºC.

Similarly, biomass was pretreated with the organosolv technique to obtain the cellulose and lignin building blocks. The organosolv pretreatment of biomass was conducted using 25, 42, and 33 v/v% of methyl isobutyl ketone (MIBK), ethanol, and water, respectively, and sulfuric acid was used as a catalyst. The pretreatment temperature was varied from 140 to 180 °C for 40 min. As a result, the optimum pretreatment temperature of 180 °C was chosen, which recorded the lignin composition at 11.01%, with 79.92% cellulose recovery and 98.24% hemicellulose removal efficiency. At 180 °C, the cellulose purity was also the highest (73.51%). After that, cellulose was bleached with H_2O_2, where lignin removal increased from 81.15 to 98.48%, and cellulose purity rose sharply from 73.51 to 95.42%. Finally, cellulose (solid) was separated and used for nanocellulose production. In the meantime, lignin (liquid) was carried on for precipitation and dried. Then it was used for biomaterial production. FE-TEM, XRD, and FTIR were used to confirm the results.