論文概要
[Abstract of Thesis]

論文題目[Thesis Title] * Biorefinery of Plantation Hardwoods in Indonesia for Isolation of Cellulose and Lignin（インドネシア産植林広葉樹のバイオリファイナリーのためのセルロースとリグニンの単離 ）

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Biorefinery is the sustainable processing of lignocellulosic material like hardwood, linked together with separation and technology process into various products and energy. As the southeast country, Indonesia is well-known for its forest and several commercial hardwood plantations. This study introduced *Acacia crassicarpa* and *Eucalyptus pellita* for cellulose and lignin isolation. The objectives are to evaluate the additives (SAQ and 2-MAQ) application for prehydrolysis-soda cooking. Secondly, to assess the precipitated lignin from black liquor prehydrolysis-soda cooking and to seek the potency of hydrolysate as a unit biorefinery product.

The stages start with prehydrolysis, cooking, and bleaching. Lignin isolation was extracted from black liquor obtained from the wood cooking process. Hydrochloric acid dropped into the black liquor as acid precipitation until it reached pH 2.5. Later, the processing black liquor was centrifuged and washed to obtain excellent isolated lignin.

This study conducted prehydrolysis for 3 h at 150 ºC, followed by 3 h and 160 ºC cooking. Fifty-gram o.d of the wood chip was subjected to the stainless steel reactor equipped with temperature-controlled. The water ratio to the wood chip was 5 g/L. Various active alkaline (AA) dosages were charged starting from 17, 20, 23, and 26% for soda and kraft cooking for *A.crassicarpa* by applying 0.125% dosage of soluble anthraquinone (SAQ) as cooking additives. It clearly showed that soda cooking consumed more active alkaline to reach the similar kappa number of kraft cooking. Also, it exhibited a high delignification rate and provided a reasonable pulp yield by using SAQ as an additive.

Oxygen bleaching (O)-Chlorin dioxide mixed with 0.1% Psa(D_o)-Alkali extraction with hydrogen peroxide bleaching (Ep)- final chlorine dioxide (D_1) were the bleaching sequence for the elemental chlorine-free process (ECF). The final pulp obtained 88.1% ISO brightness, 94.1% ISO α-cellulose, 10.3 mPa·s viscosity, and 0.02% ash content.

This study revealed that prehydrolysis and soda-SAQ as cooking additives decreased the delignification and preserved the pulp yield. However, a recent study reported that impurities of anthraquinone synthesis might harm human health. Because of this, an evaluation of 2-methylanthraquinone (2-MAQ) as additives were subjected to the cooking process for *A.crassicarpa* and *E.pellita.*

After screening the 2-MAQ dosages for *E.pellita*, it turned out that 0.06% 2-MAQ gave a satisfactory result for delignification, brightness, and pulp yield. The result showed that *E.pellita* consumed less active alkaline than *A.crassicarpa* and reached a similar kappa number. At 15% AA, the kappa number of *E.pellita* is slightly lower than the 20% AA of *A.crassicarpa*. Pure cellulose as dissolving pulp quality was obtained from the *E. pellita,* where the α-cellulose content, brightness, viscosity, and ash content were 95.2%, 90.4% ISO, 9.8 mPa·s, and 0.07%, respectively. *A. crassicarpa* showed a low brightness of 88.0% ISO and high viscosity of 10.6 mPa·s slightly.

The presence of 2-MAQ studied dissolved lignin in black liquor as cooking additives. By applying the 2-MAQ, the dissolved lignin in black liquor and precipitated lignin has been depolymerized. Both hydrolysate liquor of wood was detected to contain the presence of xylo-oligomers and xylose as a monomer in the liquor, which supported the potency of hydrolysate liquor for furfural production.

This study concluded that *A.crassicarpa* and *E.pellita* have a high potential for biorefinery feedstock by applying prehydrolysis soda cooking with the 2-MAQ method. In order to produce isolated cellulose and lignin together with pentoses derivative product from hydrolysate liquor.