MAY 2002
182
MPOB TT No. 170

SOLVENT-SODA EXTRACTION OF CELLULOSE AND LIGNIN FROM OIL PALM BIOMASS

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MPOB INFORMATION SERIES ISSN 1511-7871

Oil palm biomass (OPB) consists of empty fruit bunches, oil palm fronds, oil palm trunks, mesocarp fibres and oil palm shells. Oil palm empty fruit bunches (EFB) contain about 77.7% holocellulose which consists of 44.2% and 33.5% alphacellulose and hemicellulose respectively and 20.4% lignin (Basiron and Husin, 1996).

Lignin is a phenolic polymeric complex that attaches with cellulose and hemicellulose. Whereas, cellulose is a linear polymer of glucose (six carbon sugar) and hemicellulose is a branched polymer of xylose (five carbon sugar). Extraction of these components from lignocellulosic materials, with minimal waste by-products and with environmentally friendly process, has to be taken into consideration in order to make it economically viable and acceptable.

This project is a continuation and modification of the Alcell process (Husin *et al.*,1999), which involves lower energy consumption, simultaneous lignin precipitation and higher grade cellulose pulp production. Compared to the conventional cellulose production using chlorite method (Wise *et al.*, 1946; Green, 1963), this method is an environmentally friendly process, which involves usage of alcohol that can be produced by fermentation of simple sugars extracted from the hydrolysis of cellulose. This non-sulphur cellulose produced is highly suitable in the food and pharmaceutical industries (Paszner and Cho, 1989).

SOLVENT-SODA EXTRACTION

The process involves cooking of the biomass chips in a digester at temperature of 160°C – 170°C for a period of 1.5 to 2 hr in an alcohol-water solution (first digester) before the resultant solvent black liquor was separated from the pulp by filtration. The second stage of cooking involves the delignification process using soda at temperature of 100°C – 120°C for a period of 0.5 to 1 hr (*Figure 1*).

Both first and second digestion black liquor were mixed prior to the lignin precipitation in order to increase the lignin extraction and to accelerate the lignin precipitation process (*Figure 1*). This produced high molecular and lower molecular lignin respectively.

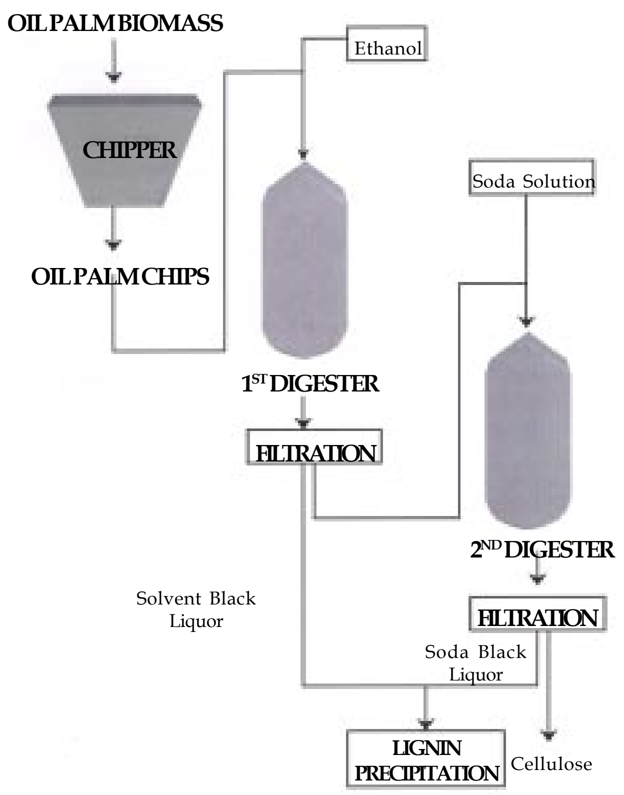

Figure 1. Diagram of the two-stage processes of solvent-soda extraction of lignin and cellulose of OPB.

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The chemical characteristics of the pulped fibres is shown in *Table 1.*

TABLE 1. CHEMICAL CHARACTERISTICS OF PULP PRODUCED FROM THE TWO-STAGE SOLVENT-SODA EXTRACTION OF OIL PALM BIOMASS

Chemical analysis	(%, o.d.w.)
Yield of pulp	45.05
Moisture content	4.32
Cold water solubility	3.43
Hot water solubility	6.27
1% NaOH solubility	7.42
Lignin content	3.66
Holocellulose content	82.50
α- cellulose content	66.25

Black liquor and lignin from first and second stage of digestion.

Pulped fibre and alphacellulose from the solvent-soda extraction of EFB.

BENEFITS OF THE PROCESS

- Reduces energy consumption by two-stage process;
- Second stage cooking induces the delignification of the cellulose pulp, hence, simple oxygen bleaching is sufficient to produce pure cellulose;
- Combining the first and second digestion black liquor is a modified process to increase the precipitation of lignin;
- Producing hydrophobic lignin which is suitable for wood panel adhesive formulation; and
- Producing non-sulphur or non-toxic cellulose.

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