



ABSTRAK

Pabrik pulp dari batang kelapa sawit direncanakan memiliki kapasitas produksi sebesar 60.000 ton/tahun dan beroperasi selama 330 hari/tahun. Bahan baku utama yang digunakan adalah batang kelapa sawit. Proses pembuatan pulp dilakukan dengan proses *pulping*, yaitu mereaksikan batang kelapa sawit dengan *white liquor* dengan tekanan 3 bar dan suhu 170 °C kemudian dilakukan delignifikasi menggunakan NaOH dan O₂ dengan tekanan 3 bar dan 85 °C. Selanjutnya, pulp akan memasuki proses *bleaching* melalui dua tahapan, yaitu menggunakan ClO₂ pada tahap pertama dan H₂O₂ dan NaOH pada tahap kedua. Pulp yang dihasilkan akan dikeringkan menggunakan *dryer* menjadi *sheet pulp* dan disimpan di gudang.

Proses *pulping* menghasilkan produk samping berupa *black liquor* yang akan dipekatkan hingga *consistency* 80% menggunakan evaporator dan digunakan sebagai bahan bakar pada *recovery boiler*. Penggunaan *black liquor* sebagai bahan bakar akan menghasilkan *steam* yang digunakan untuk membangkitkan listrik sebesar 14,45 MW dan *smelt* yang kaya akan Na₂CO₃. *Smelt* akan dilarutkan dengan menggunakan air dan menghasilkan *green liquor* sebagai bahan baku untuk memproduksi *white liquor* kembali. Proses *recovery white liquor* akan dilakukan melalui dua tahap, yaitu tahap pertama proses *slaking* dan tahap kedua proses *causticizing* dengan tekanan 1 atm dan suhu 95 °C. Pada proses *slaking*, CaO akan dilarutkan di dalam *green liquor* dan menghasilkan Ca(OH)₂ kemudian dilanjutkan proses *causticizing* yang mereaksikan Na₂CO₃ dalam *green liquor* dan Ca(OH)₂ sehingga menghasilkan NaOH dan CaCO₃. Selanjutnya, *white liquor* dipisahkan dari CaCO₃ dan ditambahkan dengan *make-up chemical white liquor* berupa NaOH, Na₂S, dan Na₂SO₄.

Pabrik pulp dari batang kelapa sawit akan dibangun pada lahan seluas 9,81 hektar dan luas bangunan seluas 2,06 hektar dengan jumlah karyawan sebanyak 365 orang. Pabrik ini akan dibangun di kawasan industri PT Riau Andalan Pulp and Paper (RAPP), Kecamatan Pangkalan Kerinci, Kabupaten Pelalawan, Provinsi Riau. Untuk mendukung proses produksi, dibutuhkan utilitas berupa *make-up water* sebanyak 197,85 m³/jam, udara sebanyak 208025,47 m³/jam, dan listrik sebesar 3,83 MW.

Pendirian pabrik membutuhkan *fixed capital* sebesar \$146.782.833 dan Rp396.462.748.534, *working capital* sebesar \$10.597.339 dan Rp11.513.337.948, *manufacturing cost* sebesar \$34.838.143 dan Rp77.526.887.242, serta *general expenses* sebesar \$16.273.003 dan Rp39.928.015.623. Pabrik ini memiliki *return of investment* (ROI) sebelum pajak sebesar 2,35%, *payout time* (POT) sebelum pajak selama 10,34 tahun, *discounted cash flow rate of return* (DCFRR) sebesar 11,62%, *breakeven point* (BEP) sebesar 86,54% dan *shutdown point* (SDP) sebesar 33,27%. Berdasarkan hasil evaluasi ekonomi, didapatkan kesimpulan bahwa pabrik pulp dari batang kelapa sawit dengan kapasitas 60.000 ton/tahun kurang menarik dan tidak layak untuk dikaji lebih lanjut.

Kata kunci: Pulp, Batang Kelapa Sawit, Perancangan Pabrik



ABSTRACT

The palm oil trunk-based pulp mill is designed to have a production capacity of 60,000 tons per year and operate for 330 days annually. The primary raw material used is palm oil trunks. The pulp production process involves pulping, in which palm oil trunks react with white liquor under a pressure of 3 bar and a temperature of 170 °C, followed by delignification using NaOH and O₂ at a pressure of 3 bar and a temperature of 85 °C. Subsequently, the pulp undergoes a two-stage bleaching process: the first stage utilizes ClO₂, while the second stage employs H₂O₂ and NaOH. The resulting pulp is then dried using a dryer to form sheet pulp and stored in a warehouse.

The pulping process generates a by-product known as black liquor, which is concentrated to 80% consistency using an evaporator and utilized as fuel in the recovery boiler. The use of black liquor as fuel produces steam, which is used to generate 14.45 MW of electricity, and smelt, which is rich in Na₂CO₃. The smelt is dissolved in water to produce green liquor, which serves as a raw material for white liquor production. The white liquor recovery process consists of two stages: the first stage is slaking, and the second stage is causticizing, conducted at a pressure of 1 atm and a temperature of 95 °C. In the slaking process, CaO is dissolved in green liquor, forming Ca(OH)₂, which is then reacted with Na₂CO₃ in the causticizing process to produce NaOH and CaCO₃. The white liquor is then separated from CaCO₃ and supplemented with additional white liquor make-up chemical such as NaOH, Na₂S, and Na₂SO₄.

The palm oil trunk-based pulp mill will be constructed on a land area of 9.81 hectares with a building area of 2.06 hectares and will employ 365 workers. The plant will be built in the industrial area of PT Riau Andalan Pulp and Paper (RAPP), Pangkalan Kerinci District, Pelalawan Regency, Riau Province. To support the production process, utilities required include makeup water of 197.85 m³/hour, air supply of 208025.47 m³/hour, and electricity amounting to 3.83 MW.

The establishment of the plant requires a fixed capital of \$146,782,833 and Rp396,462,748,534, working capital of \$10,597,339 and Rp11,513,337,948, manufacturing cost of \$34,838,143 and Rp77,526,887,242, also general expenses of \$16,273,003 and Rp39,928,015,623. The plant has a return on investment (ROI) before tax of 2.35%, a payout time (POT) before tax of 10.34 years, a discounted cash flow rate of return (DCFRR) of 11.62%, a breakeven point (BEP) of 86.54%, and a shutdown point (SDP) of 33.27%. Based on the economic evaluation results, it is concluded that the palm oil trunk-based pulp mill with a capacity of 60,000 tons per year is not yet attractive and not feasible for further study.

Keywords: Pulp, Palm Oil Trunk, Plant Design