

ABSTRAK

Pabrik biodiesel ini direncanakan akan dibangun di daerah Kawasan Industri Gresik, Jawa Timur dengan luas lahan 26.834 m² dan kapasitas produksi 29.932,950 kg/jam yang beroperasi selama 340 hari dengan total 171 karyawan. Proses pembuatan biodiesel menggunakan metode reaksi dua tahap esterifikasi metanol superkritis non katalitik. Reaksi tahap pertama merupakan reaksi hidrolisis antara minyak jelantah dengan air di dalam reaktor alir pipa dengan kondisi operasi 250°C dan 78,954 atm serta perbandingan mol minyak jelantah dan air sebesar 1:20 yang menghasilkan konversi sebesar 98,50%. Reaksi tahap kedua adalah reaksi esterifikasi antara asam lemak bebas dengan metanol di dalam reaktor alir pipa yang beroperasi pada 270°C dan 78,954 atm serta perbandingan mol asam lemak bebas dengan metanol sebesar 1:20 yang menghasilkan FAME (Fatty Acid Methyl Ester) sebesar 29.978,262 kg/jam dengan konversi 95%. Utilitas yang dibutuhkan untuk setiap tahunnya yaitu 1.080.438,346 kg/jam air pembangkit, 151.692,666 kg/jam air pendingin, 2.279,000 kg/jam air domestic dan *service water*, 15.618,717 kg/jam air proses, 2.058,714 kg/jam bahan bakar, dan 9.281,256 kW listrik. Pabrik biodiesel ini memiliki tingkat resiko tinggi (*high risk*) karena beroperasi pada kondisi metanol superkritis. Hasil evaluasi ekonomi menunjukkan modal tetap sebesar Rp. 613.757.451.526, modal kerja sebesar Rp. 1.048.908.020.551, keuntungan sebelum pajak Rp. 341.056.843.532, keuntungan setelah pajak Rp. 170.528.421.766. Berdasarkan hasil studi kelayakan diperoleh *Return on Investment* sebelum pajak (ROI_b) sebesar 55,67% dan *Return on Investment* sesudah pajak (ROI_a) sebesar 27,78%, *Pay Out Time* sebelum pajak (POT_b) sebesar 1,50 tahun dan *Pay Out Time* sesudah pajak (POT_a) sebesar 2,70 tahun, *Break Even Point* (BEP) sebesar 41,43%, *Shut Down Point* (SDP) sebesar 27,72%, dan *Discounted Cash Flow Rate of Return* (DCFR) sebesar 17,79%. Berdasarkan hasil evaluasi ekonomi ini, dapat disimpulkan bahwa pabrik biodiesel dengan bahan dasar minyak jelantah sebesar 250.000 ton/tahun secara ekonomi layak untuk didirikan.

Kata-kata kunci: biodiesel, minyak jelantah, dua tahap esterifikasi metanol superkritis

ABSTRACT

Biodiesel is planned to be built in the Gresik Industrial Estate area, East Java with a land area of 26,834 m² and a production capacity of 29.932.950 kg/hour which operates for 340 days with a total of 171 employees. The method uses a non-catalytic two-stage supercritical esterification reaction. The first phase of the reaction is the hydrolysis reaction between used cooking oil and water in the plug flow reactor with 250°C and 78,954 atm and the mole ratio of used cooking oil and water at 1:20 which a conversion of 98.50%. The second stage of the reaction is the esterification reaction between free fatty acids and methanol in the plug flow reactor with 270°C and 78,954 atm and the ratio of moles of free fatty acids to methanol at 1:20 which produces FAME (Fatty Acid Methyl Ester) of 29.978.262 kg/hour with 95% conversion. Utilities needed for each year are 1.080.438.346 kg/hour of generator water, 151.692.666 kg/hour of cooling water, 2.279.000 kg/hour of domestic and service water, 15.618.717 kg/hour of process water, 2.058.714 kg/hour of fuel, and 9.281.256 kW electricity. This biodiesel plant has a high risk because it operates with supercritical methanol conditions. The economic evaluation results show a fixed capital of Rp. 613.757.451.526, working capital of Rp. 1.048.908.020.551, pre-tax profits of Rp. 341.056.843.532, profit after tax Rp. 170.528.421.766. Based on the results of the feasibility study obtained before-tax Return on Investment (ROI_b) of 55.67% and after-tax Return on Investment (ROI_a) of 27.78%, Pay-Out Time before tax (POT_b) of 1.50 years and Pay Out Time after tax (POT_a) of 2.70 years, Break Even Point (BEP) of 41.43%, Shut Down Point (SDP) of 27.72%, and Discounted Cash Flow Rate of Return (DCFR) of 17.79%. Based on the results of this economic evaluation, it can be concluded that the biodiesel plant with used cooking oil as much as 250,000 tons/year is economically feasible to be established.

Keyword: Biodiesel, used cooking oil, two step supercritical methanol esterification