ABSTRAK

PRODUKSI BIODIESEL DARI CPO (*CRUDE PALM OIL*) MENGGUNAKAN KATALIS CaO/SiO_2 PADA *BAFFLED STIRRED TANK REACTOR*

(Dian Prameswari, 2026, 45 Halaman, 8 Tabel, 12 Gambar, 4 Lampiran)

Meningkatnya kebutuhan energi nasional mendorong pengembangan Energi Baru Terbarukan melalui produksi biodiesel. Penelitian ini mengkaji pengaruh variasi konsentrasi katalis heterogen CaO/SiO_2 (4%, 6%, 8%) dan waktu pengadukan (20, 40, 60 menit) terhadap *yield* biodiesel dari *Crude Palm Oil* (CPO), serta menguji kinerja *Baffled Stirred Tank Reactor* berdasarkan standar SNI 7182:2015. Proses transesterifikasi dijalankan pada suhu tetap 60 °C, kecepatan 450 rpm, dan rasio molar methanol:CPO 6:1. Karakterisasi XRD menunjukkan struktur katalis didominasi fase kalsit ($CaCO_3$) dengan puncak utama pada sudut $2\theta=29{,}46^{o}$. Hasil penelitian membuktikan bahwa variasi katalis dan waktu pengadukan berpengaruh signifikan terhadap *yield*. Kondisi operasi optimum dicapai pada konsentrasi katalis 4% dan waktu pengadukan 60 menit, menghasilkan *yield* tertinggi sebesar 60,4350%. Sebaliknya, penambahan katalis berlebih hingga 8% menurunkan *yield* akibat keterbatasan perpindahan massa (*mass transfer limitation*) dan memicu reaksi saponifikasi. Evaluasi mutu menunjukkan mayoritas sampel memenuhi standar SNI 7182:2015. Pada kondisi optimum, biodiesel memiliki densitas 0,8633 g/ml, viskositas 4,46 cSt, dan angka asam 0,4374 mg-KOH/g. Namun, pada variasi katalis 8% dan waktu 60 menit, angka asam meningkat menjadi 0,5175 mg-KOH/g sehingga melebihi batas maksimal standar (0,5 mg-KOH/g). Analisis GC-MS mengonfirmasi konversi menjadi *Fatty Acid Methyl Ester* (FAME) yang didominasi Metil Palmitat (18,57%) dan Metil Oleat (13,21%). Penggunaan sekat (*baffle*) pada reaktor terbukti optimal menciptakan turbulensi guna mempercepat perpindahan massa antarfase.

Kata Kunci : Biodiesel, CPO, Katalis CaO/SiO_2, *Baffled Stirred Tank Reactor,* Transesterifikasi, SNI 7182:2015.

ABSTRACT

BIODIESEL PRODUCTION FROM CPO (CRUDE PALM OIL) USING CaO/SiO_2 CATALYST IN A BAFFLED STIRRED TANK REACTOR

(Dian Prameswari, 2026, 45 Pages, 8 Tables, 12 Figures, 4 Appendices)

The increasing national energy demand is driving the development of New Renewable Energy through biodiesel production. This study examines the effect of varying heterogeneous CaO/SiO2 catalyst concentrations (4%, 6%, 8%) and stirring times (20, 40, 60 minutes) on biodiesel yield from Crude Palm Oil (CPO), as well as testing the performance of a Baffled Stirred Tank Reactor according to SNI 7182:2015 standards. The transesterification process was carried out at a constant temperature of 60 °C, a speed of 450 rpm, and a methanol:CPO molar ratio of 6:1. XRD characterization showed that the catalyst structure is dominated by calcite (CaCO3) phase with the main peak at an angle of 2θ=29.46°. The results prove that variations in catalyst and stirring time significantly affect the yield. The optimum operating conditions were achieved at a 4% catalyst concentration and 60 minutes of stirring time, resulting in the highest yield of 60.4350%. On the other hand, adding too much catalyst up to 8% lowers the yield due to mass transfer limitations and triggers saponification reactions. Quality evaluation shows that most samples meet the SNI 7182:2015 standard. Under optimal conditions, the biodiesel has a density of 0.8633 g/ml, viscosity of 4.46 cSt, and an acid number of 0.4374 mg-KOH/g. However, with 8% catalyst and a 60-minute reaction time, the acid number rises to 0.5175 mg-KOH/g, which exceeds the maximum standard limit (0.5 mg-KOH/g). GC-MS analysis confirms conversion into Fatty Acid Methyl Ester (FAME), dominated by Methyl Palmitate (18.57%) and Methyl Oleate (13.21%). Using baffles in the reactor is proven to be effective in creating turbulence to speed up interphase mass transfer.

Keywords : Biodiesel, CPO, CaO/SiO2 Catalyst, Baffled Stirred Tank Reactor, Transesterification, SNI 7182:2015.