

ABSTRAK

PENGARUH WAKTU REAKSI TERHADAP KUALITAS BIODIESEL DARI MINYAK JELANTAH MENGGUNAKAN ENZIM LIPASE (*EVERSA TRANSFORM 2.0*) IMOBILISASI PADA *PACKED BED REACTOR*

(Putri Amanda Septiani, 75 Halaman, 10 Tabel, 22 Gambar, 4 Lampiran)

Minyak jelantah berpotensi menjadi bahan baku biodiesel karena jumlahnya melimpah, harganya murah, dan pemanfaatannya mengurangi limbah rumah tangga maupun industri pangan. Penelitian ini mengkaji pengaruh waktu reaksi terhadap kualitas biodiesel dari minyak jelantah menggunakan enzim lipase *Eversa Transform 2.0* yang diimobilisasi pada resin Purolite MB400 dalam *Packed Bed Reactor* (PBR). Transesterifikasi berlangsung pada suhu 40°C, laju alir 0,5 mL/menit, kecepatan pengadukan 400 rpm, dan rasio molar minyak:metanol 1:5, dengan variasi waktu reaksi 1, 3, 5, 7, dan 9 jam serta massa enzim 10 g dan 15 g. Minyak jelantah lebih dulu melewati *pre-treatment* dan netralisasi. Kadar FFA diukur dengan titrasi alkalimetri mengacu SNI 7709:2019, kadar air dengan metode oven terbuka, dan zat pengotor dengan penyaringan gravimetri menghasilkan FFA 0,273%, kadar air 0,1%, dan zat pengotor 0,1%. *Yield* biodiesel meningkat seiring bertambahnya waktu reaksi hingga mencapai 91,27% pada massa enzim 10 g di jam ke-9, namun peningkatan *yield* setelah jam ke-7 relatif kecil. Viskositas diuji dengan viskometer, densitas dengan piknometer, titik nyala dengan *flash point tester*, bilangan iodine dan gliserol total dengan titrasi iodometri, bilangan saponifikasi dan bilangan asam dengan titrasi asam-basa, serta angka setana dengan *cetane analyzer*, mengacu SNI 7182:2015 menghasilkan viskositas 2,60 cSt, densitas 876 kg/m³, titik nyala 192,1°C, bilangan iodine 49,91 g I₂/100 g, bilangan saponifikasi 127,53 mg KOH/g, angka setana 75,7, bilangan asam 0,2244 mg KOH/g, gliserol total 0,1934%, dan kadar metil ester 97,054%. Berdasarkan hasil tersebut, kondisi optimum penelitian diperoleh pada massa enzim 10 g dan waktu reaksi 7 jam, karena peningkatan *yield* setelahnya tidak signifikan dan karakteristik kualitas biodiesel pada kondisi tersebut telah memenuhi standar mutu biodiesel sesuai SNI 7182:2015.

Kata Kunci: Biodiesel, Minyak Jelantah, Transesterifikasi Enzimatik, *Packed Bed Reactor*, FAME

ABSTRACT

THE EFFECT OF REACTION TIME ON THE QUALITY OF BIODIESEL FROM WASTE-COOKED OIL USING LIPASE ENZYME (EVERSA TRANSFORM 2.0) IMMOBILIZATION IN A PACKED BED REACTOR

(Putri Amanda Septiani, 75 Pages, 10 Tables, 22 Figures, 4 Attachment)

Waste cooking oil is a promising biodiesel feedstock because it is abundant, cheap, and its use cuts down household and food-industry waste. This study examines how reaction time affects the quality of biodiesel produced from waste cooking oil using Eversa Transform 2.0 lipase immobilized on Purolite MB400 resin in a Packed Bed Reactor (PBR). Transesterification ran at 40°C, a flow rate of 0.5 mL/min, a stirring speed of 400 rpm, and an oil-to-methanol molar ratio of 1:5, with reaction times of 1, 3, 5, 7, and 9 hours and enzyme loads of 10 g and 15 g. The oil first went through pretreatment and neutralization. FFA content was measured by alkalimetric titration following SNI 7709:2019, moisture by the open-oven method, and impurities by gravimetric filtration, giving an FFA of 0.273%, moisture of 0.1%, and impurities of 0.1%. Biodiesel yield increased with longer reaction time, reaching 91.27% at 10 g enzyme after 9 hours, although the increase beyond 7 hours (90.39%) was relatively small. Viscosity was tested with a viscometer, density with a pycnometer, flash point with a flash point tester, iodine value and total glycerol by iodometric titration, saponification and acid value by acid-base titration, and cetane number with a cetane analyzer, following SNI 7182:2015. This gave a viscosity of 2.60 cSt, density of 876 kg/m³, flash point of 192.1°C, iodine value of 49.91 g I₂/100 g, saponification value of 127.53 mg KOH/g, cetane number of 75.7, acid value of 0.2244 mg KOH/g, total glycerol of 0.1934%, and methyl ester content of 97.054%. Based on these results, the optimum condition was obtained at 10 g enzyme and 7 hours of reaction, since the yield gain beyond this point was insignificant while all quality parameters at this condition met the biodiesel quality standard according to SNI 7182:2015.

Keywords: *Biodiesel, Waste Cooking Oil, Enzymatic Transesterification, Packed Bed Reactor, FAME*