EFEK WAKTU INJEKSI DAN DURASI INJEKSI TERHADAP PERFORMA DAN EMISI MESIN DIESEL R180 DI BERBAGAI KONDISI DIESEL-ETANOL

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ABSTRAK

Penelitian ini bertujuan untuk menganalisis pengaruh variasi waktu injeksi dan durasi injeksi terhadap performa dan emisi gas buang mesin diesel R180 menggunakan bahan bakar diesel dan campuran diesel–etanol. Metode penelitian dilakukan secara numerik menggunakan *software* Diesel-RK dengan validasi terhadap data katalog mesin, dimana deviasi hasil simulasi berada dibawah 5%. Variasi yang dilakukan adalah waktu injeksi durasi injeksi pada sudut tertentu, serta campuran etanol pada putaran mesin 2600 rpm. Hasil menunjukkan daya maksimum tertinggi diperoleh pada bahan bakar diesel murni dengan waktu injeksi, sedangkan pada campuran diesel–etanol 5% daya maksimum pada kondisi yang sama. Peningkatan durasi injeksi menyebabkan penurunan daya hingga 10–15% pada seluruh variasi bahan bakar. Nilai *specific fuel consumption* (SFC) terendah tercatat pada campuran diesel–etanol 5, sedangkan peningkatan fraksi etanol meningkatkan SFC akibat penurunan nilai kalor bahan bakar. Dari sisi emisi, penggunaan campuran diesel–etanol menunjukkan kecenderungan penurunan emisi NOx dan CO_2 dibandingkan diesel murni, khususnya pada durasi injeksi yang lebih pendek. Secara keseluruhan, kombinasi optimal dengan campuran etanol merupakan kondisi paling baik untuk menghasilkan performa mesin yang tinggi dengan konsumsi bahan bakar dan emisi gas buang yang lebih rendah pada mesin diesel R180.

Kata Kunci : Waktu Injeksi, Durasi Injeksi, Mesin Diesel R180, Performa Mesin, Emisi

THE EFFECT OF INJECTION TIMING AND DURATION ON THE PERFORMANCE AND EMISSIONS OF AN R180 DIESEL ENGINE UNDER VARIOUS DIESEL-ETHANOL CONDITIONS

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ABSTRACT

This study aims to analyze the effect of injection timing and injection duration variations on the performance and exhaust emissions of an R180 diesel engine using diesel fuel and a diesel-ethanol blend. The research method was conducted numerically using Diesel-RK software with validation against engine catalog data, where the simulation deviation was below 5%. The variations applied were injection timing and injection duration at specific angles, as well as ethanol blends at an engine speed of 2600 rpm. The results showed that the highest maximum power was obtained with pure diesel fuel and injection timing, while with a 5% diesel-ethanol blend, maximum power was obtained under the same conditions. Increasing the injection duration caused a 10-15% decrease in power for all fuel variations. The lowest specific fuel consumption (SFC) value was recorded in the 5% diesel-ethanol mixture, while an increase in the ethanol fraction increased the SFC due to a decrease in the fuel calorific value. In terms of emissions, the use of diesel-ethanol mixtures showed a tendency to reduce NOx and CO_2 emissions compared to pure diesel, especially at shorter injection durations. Overall, the optimal combination with ethanol blends is the best condition for producing high engine performance with lower fuel consumption and exhaust emissions in the R180 diesel engine.

Keyword : *Injection Timing, Injection Duration, Diesel Engine R180, Engine Power, Emissions*