

ABSTRACT

The increasing fossil fuel consumption in Indonesia's industrial and transport sectors, coupled with the high volume of waste oil generation (650 million liters/year), necessitates sustainable energy alternatives. This study aims to analyze the effect of blending diesel fuel (CN 53) with pyrolysis waste oil on the performance and emissions of a common rail diesel engine. The experiment utilized fuel variations of OB0 (0%), OB20 (20%), and OB40 (40%) at engine speeds of 800, 1,500, and 2,000 rpm. Observed parameters included calorific value, Fuel Consumption (FC), Specific Fuel Consumption (SFC), as well as CO and NOx emissions. Results indicated that adding waste oil reduced the calorific value by up to 2.1% in OB40 (46.23 MJ/kg). This combustion quality reduction led to increased fuel consumption; at 2,000 rpm, FC for OB40 rose by 52.9%, with a significant increase in SFC compared to OB0. Regarding emissions, waste oil blends drastically increased CO emissions at idle (800 rpm) but successfully reduced CO at medium speed (1,500 rpm). Conversely, NOx emissions showed significant improvement at high speeds; at 2,000 rpm, NOx for OB40 was recorded at 33.8 ppm, significantly lower than OB0 at 61.7 ppm. It is concluded that while waste oil blends decrease fuel efficiency, they offer potential benefits in reducing NOx emissions at higher engine speeds.

Keywords: Diesel Engine; Common Rail; Exhaust Gas Emission; Fuel Consumption; Calorific Value; waste Oil.

INTISARI

Peningkatan konsumsi bahan bakar fosil di sektor industri dan transportasi serta tingginya volume limbah oli bekas (650 juta liter/tahun) di Indonesia menuntut adanya alternatif energi yang berkelanjutan. Penelitian ini bertujuan menganalisis pengaruh penggunaan campuran solar (CN 53) dan oli bekas hasil pirolisis terhadap performa dan emisi mesin diesel *common rail*. Pengujian dilakukan menggunakan variasi bahan bakar OB0 (0%), OB20 (20%), dan OB40 (40%) pada putaran mesin 800, 1.500, dan 2.000 rpm. Parameter yang diamati meliputi nilai kalor, *Fuel Consumption* (FC), *Specific Fuel Consumption* (SFC), serta emisi CO dan NOx. Hasil penelitian menunjukkan penambahan oli bekas menurunkan nilai kalor hingga 2,1% pada OB40 (46,23 MJ/kg). Penurunan kualitas pembakaran ini berdampak pada peningkatan konsumsi bahan bakar; pada 2.000 rpm, FC OB40 meningkat 52,9% dan SFC meningkat signifikan dibandingkan OB0. Dari sisi emisi, campuran oli bekas meningkatkan emisi CO secara drastis pada kondisi *idle* (800 rpm), namun mampu menurunkan CO pada putaran menengah (1.500 rpm). Sebaliknya, emisi NOx justru mengalami perbaikan signifikan pada putaran tinggi; pada 2.000 rpm, emisi NOx OB40 tercatat 33,8 ppm, jauh lebih rendah dibandingkan OB0 sebesar 61,7 ppm. Disimpulkan bahwa meskipun campuran oli bekas menurunkan efisiensi bahan bakar, bahan bakar ini memiliki potensi dalam mereduksi emisi NOx pada putaran mesin tinggi.

Kata kunci: Mesin Diesel; *Common Rail*; Emisi Gas Buang; Konsumsi Bahan Bakar; Nilai Kalor; Oli Bekas.