INVESTIGATION ON PERFORMANCE, COMBUSTION AND EMISSION CHARACTERISTICS USING BIODIESEL-BUTANOL-WATER BLENDS IN DIESEL ENGINE

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Pada masa ini, keperluan untuk tenaga alternatif dalam mesin penyalaan mampatan telah mendapat banyak perhatian untuk meminimumkan penggunaan pada sumber tenaga berasaskan minyak fosil. Kelestarian alam sekitar dan krisis iklim adalah dua sebab utama di sebalik pembangunan tenaga global moden. Bahan bakar campuran alkohol sentiasa memenuhi keperluan ini. Dalam karya yang disajikan, studi eksperimental dilakukan mengenai kesan pembakaran, prestasi, dan pelepasan enjin diesel dengan menggunakan bahan bakar diesel yang dicampur dengan biodiesel, butanol, dan air sebagai bahan tambahan. Semua bahan bakar campuran adalah: B10Bu5W0 (95% B10 + 5% Butanol), B10Bu10W0 (90% B10 + 10% Butanol), B10Bu5W5 (90% B10 + 5% Butanol + 5% air), dan B10Bu10W5 (85% B10 + 10% Butanol + 5% air). Semua bahan bakar ini diuji dan dibandingkan hasilnya dengan D100 (diesel tulen) dengan menggunakan enjin diesel silinder tunggal Yanmar TF120M. Dua jenis keadaan engine digunakan, variasi kecepatan iaitu 1200 rpm - 2400 rpm dengan 300 kenaikan pada keadaan beban tetap, dan variasi beban iaitu beban rendah, setengah beban dan beban penuh pada kecepatan tetap 1800 rpm. Fokus analisis ini adalah pada pembakaran, prestasi, dan pelepasan. Hasilnya menunjukkan bahawa campuran biodiesel dan butanol berpotensi sebagai bahan bakar alternatif utama pada prestasi. Hasilnya menunjukkan bahawa pembakaran semua bahan bakar campuran meningkat berbanding D100. Tekanan silinder yang lebih tinggi juga meningkat apabila rpm dan beban meningkat. Dari segi pelepasan, penambahan air ke dalam bahan bakar menghasilkan hasil yang lebih baik berbanding dengan bahan bakar lain terutama untuk NOx. Telah terbukti bahawa penambahan butanol mempunyai hasil yang positif, baik sebagai bahan bakar alternatif serta baik untuk alam sekitar.

ABSTRACT

Currently, the need for alternative energies in compression-ignition engines has gotten a lot of attention to minimize the world's reliance on fossil oil-based energy resources. Environmental sustainability and the climate crisis are the two major reasons behind modern global energy development. Alcohol mix fuels are constantly trying to meet these needs. In the presented work, an experimental study is carried out on the impact of the combustion, performance, and emission of diesel engine by using diesel fuel blended with biodiesel, butanol, and water as additive. All blended fuels are: B10Bu5W0 (95% B10 + 5% Butanol), B10Bu10W0 (90% B10 + 10% Butanol), B10Bu5W5 (90% B10 + 5% Butanol + 5% water), and B10Bu10W5 (85% B10+ 10% Butanol + 5% water). All these fuels are tested and compared the result with D100 (pure diesel) by using Yanmar TF120M single cylinder water cool diesel engine. Two types of engine condition were used, speed variations which is 1200 rpm – 2400 rpm with 300 increments at constant load condition, and load variations which is low load, half load and full load at constant speed of 1800 rpm. The focus of this analysis is on combustion, performance, and emissions. The results suggest that biodiesel and butanol blend have possible potential as alternative fuel especially on performance. The result shows that the combustion of all blended fuels is increasing compared to D100. Also, higher peak cylinder pressure was increased as rpm and load increased. In term of emissions, the addition of water to the blended fuels produced better result compared to others fuels especially for NO_x. It was proved that the addition of butanol had a positive result, both as an alternative fuel and in the environment.

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