EVALUATION OF COMBUSTION CHARACTERISTICS, PERFORMANCE AND EXHAUST EMISSION FOR DIESEL FUEL WITH VARIOUS TYPE NANO PARTICLE BLENDS.

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MASTER OF SCIENCE

UNIVERSITI MALAYSIA PAHANG

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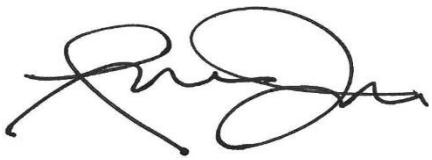

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ABSTRAK

Penyelidikan ini mengkaji kesan campuran zarah nano (aluminium oksida, karbon nanotube dan silikon oksida) dalam bahan bakar diesel terhadap sifat fisio-kimia, ciri pembakaran, prestasi dan pelepasan ekzos mesin silinder tunggal empat lejang dengan suntikan langsung. Zarah nano banyak digunakan sebagai bahan tambahan kerana mempunya nisbah permukaan bagi isipadu yang tinggi oleh itu menambah baik sifat terma. Tetapi kebanyakan literatur masa lalu hanya menumpukan pada satu jenis zarah nano dan bukannya campuran zarah nano. Jadi penyelidikan ini akan menggunakan metodologi respons permukaan untuk menentukan nisbah campuran terbaik. Selain itu zarah nano sangat mahal untuk dihasilkan, jadi campuran optimum setiap zarah nano dalam bahan bakar diesel dikenal pasti dengan menggunakan metodologi respons permukaan Box-Behnken untuk memaksimumkan prestasi dan mengurangkan pelepasan bagi minyak diesel. Zarah nano tersebar dalam dos 25, 50 dan 100 ppm dalam minyak diesel tulen menggunakan pemproses ultrasonik selama 30 minit. Campuran bahan bakar aluminium oksida (Al_2O_3) dan karbon nanotube (CNT) menunjukkan pengurangan kelikatan kinematik sebanyak 9.6 hingga 18.8% berbanding dengan diesel tulen. Sementara itu, nilai kalori meningkat sebanyak 4.12% dengan campuran CNT. Walau bagaimanapun, nombor cetane tidak berubah dengan tambahan partikel zarah nano. Bahan bakar campuran diuji secara eksperimen dengan enjin diesel empat lejang silinder tunggal YANMAR TF120M pada beban enjin 0, 25, 50, 75 dan 100% daripada 5.9 bar tekanan purata efektif brek (BMEP) pada kelajuan enjin 1500 rpm. Hasil kajian menunjukkan bahawa penggunaan penggunaan bahan bakar brek (BSFC) menunjukkan penurunan hingga 19.8%, sementara peningkatan 18.8% ditunjukkan pada kecekapan terma brek (BTE). Selanjutnya, model dari metodologi permukaan tindak balas (RSM) digunakan untuk pengoptimuman dengan tujuan meminimumkan penggunaan bahan bakar, CO, CO_2, NOx dan pelepasan HC. Dengan menggunakan pendekatan ini, bahan bakar campuran dengan 100 ppm Al_2O_3 dan 100 ppm CNT dengan 79.13 ppm SiO_2 dianggap memberikan ciri pelepasan dan prestasi yang optimum dengan kehendak maksimum 0.9846 pada 25% beban enjin.

ABSTRACT

This research investigates the effect of nanoparticles (aluminium oxides, carbon nanotubes and silicone oxide) blend in diesel fuel on physio-chemical properties, combustion characteristics, performance and exhaust emission of a four-stroke single cylinder engine with direct injection. Nanoparticle is widely use as additive due to its high surface to volume ratio thus have better thermal properties. But most the past literatures only focus on single nanoparticle instead of mixture of nanoparticle. So this research will utilise response surface methodology to determine the best blend ratio of the three nanoparticles. Beside that nanoparticle is very expensive to produce, so optimal concentration of each nanoparticle in diesel fuel was determined by using Box-Behnken's response surface methodology to maximise the performance and reduce emission of diesel fuel. The nanoparticles were dispersed in a dosage of 25, 50 and 100 ppm in pure diesel fuel using ultrasonic processor for 30 minutes. Aluminium oxides (Al_2O_3) and carbon nanotubes (CNT) fuel blends show reduction of kinematic viscosity by 9.6 to 18.8 % compared to diesel fuel. Meanwhile, the calorific value increased by 4.12 % with CNT blends. However, the cetane number was remain with additional of the nanoparticles. The blend fuels were experimentally tested with YANMAR TF120M single cylinder four-stroke diesel engine at engine load of 0, 25, 50, 75 and 100 % of 5.9 bar brake main effective pressure (BMEP) at a constant 1500 rpm engine speed. The results revealed that the brake specific fuel consumption (BSFC) showed reduction up to 19.8 % while 18.8 % enhancement shown in brake thermal efficiency (BTE). Next, the model from response surface methodology (RSM) was used for optimization with an objective of minimizing the fuel consumption, CO, CO_2, NO_X and HC emissions. Utilizing this approach, the blend fuel with 100 ppm Al_2O_3 and 100 ppm CNT with 79.13 ppm SiO_2 was considered to deliver optimum emission and performance characteristics with a maximum desirability of 0.9846 at 25% engine load.

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