INVESTIGATION OF THE EFFECT OF BUTANOL AND ETHANOL ALCOHOLS ON THE COMBUSTION, PERFORMANCE AND EMISSION OF DIESEL-BIODIESEL BLENDS

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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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LIST OF SYMBOLS

T_i	engine indicated torque [Nm]
A_c	cylinder area [m^2]
L	stroke length [m]
z	1 (for 2 stroke engines), 2 (for 4 stroke engines)
n	number of cylinders
θ	crank shaft angle [1/s]
imep	indicated mean effective pressure [N/m^2]
A_c	cylinder area [m^2]
L	stroke length [m]
z	1 (for 2 stroke engines), 2 (for 4 stroke engines)
n	number of cylinders
θ	crank shaft angle [1/s]
T_i	engine indicated torque [Nm]
T_a	293 K (20°C)
V	Air flow rate
V_b	Minimum size of inbox
V_s	Swept volume
η_v	0.8
ω	Engine speed
ρ	relative density fuel [kg/L]
Q	net heat release rate (J/deg)
P	is the cylinder pressure (Psi)
V	cylinder volume (m^3)
N	is the revolution speed of the crank shaft (rpm)

LIST OF ABBREVIATIONS

ASTM	American Standard of Testing Methods
CI	Compression Ignition
CN	Cetane Number
CNC	Computer Numerical Control
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CP	Cylinder Pressure
CV	Calorific Value
DAQ	Data Acquisition System
EGR	Exhaust Gas Recirculation
EGT	Exhaust Gas Temperature
EU	European Union
GHG	Greenhouse Gas
HC	Hydrocarbon
HRR	Heat Release Rate
HV	Heating Value
ICE	Internal combustion Engine
ID	Ignition Delay
IT	Indicated Torque
IP	Indicated Power
ITE	Indicated Thermal Efficiency
IMEP	Indicated Mean Effective Pressure
ITE	Indicated Thermal Efficiency
NO_X	Nitrogen Oxides
PDF	Plastic Derived Fuel
PM	Particulate Matter
SAE	Society of Automotive Engineers
SO_2	Sulphur Dioxide
TDC	Top Dead Center
IEA	International Energy Agency
RPM	Revolution Per Minute

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ABSTRAK

Baru-baru ini, penggunaan bahan api yang boleh diperbaharui dalam enjin pencucuhan mampatan semakin mendapat perhatian untuk mengurangkan kebergantungan pada sumber tenaga berasaskan minyak fosil di seluruh dunia. Keselamatan tenaga dan pemanasan global yang merupakan dua punca utama untuk pembangunan tenaga global pada masa kini. Kini bahan api campuran alkohol sedang cuba untuk memenuhi permintaan ini. Dalam kajian ini, siasatan eksperimen mengenai kesan dua penambahan alkohol dalam campuran diesel-biodiesel pada pembakaran, prestasi, dan pelepasan enjin diesel suntikan terus. Selain itu, campuran diesel-biodiesel juga disiasat. Bahan api alternatif yang digunakan adalah: B5 (diesel -95%, biodiesel-5%), B20 (diesel -80%, biodiesel-20%), D80PB5BU15 (diesel -80%, biodiesel-5%, Butanol -15%) dan D80PB5E15 (diesel -80%, biodiesel-5%, Ethanol -15%), untuk membandingkan prestasinya dengan diesel tulen (D100). Bahan api alternatif telah dikenal pasti, dan sifatnya diuji untuk analisis kualiti bahan api. Semua eksperimen diuji menggunakan enjin diesel Yanmar TF-120M silinder tunggal telah digunakan dengan memvariasikan beban enjin (beban rendah, beban separuh dan beban penuh) pada kelajuan 2400 rpm dan kelajuan enjin yang berubah-ubah (1200 rpm, 1800 rpm, 2100 rpm) pada beban separuh. Perbincangan bertumpu kepada ciri-ciri pembakaran, prestasi dan pelepasan. Hasilnya menunjukkan campuran alkohol butanol dan etanol mempunyai kesan yang menjanjikan khususnya dalam pelepasan. Dari analisis prestasi kecekapan termal telah meningkat sebanyak 1.13%, sedangkan penggunaan bahan bakar 1.86% untuk D80PB5BU15. EGT juga menunjukkan beberapa kesan semasa menggunakan campuran alkohol. Tambahan pula, hasil telah menunjukkan bahawa enjin diesel telah mengurangkan pelepasan NOx (8.02-36) %, CO dikurangkan (16.6-40) % dan CO2 dikurangkan (8.02-36) % pelepasan di bawah beban enjin yang berbeza dan kelajuan semasa menggunakan campuran alkohol butanol dan etanol dalam campuran diesel bio diesel. Oleh itu, didapati bahawa campuran alkohol menunjukkan hasil yang menjanjikan yang boleh memberi impak positif sama ada sebagai bahan bakar alternatif dan aspek alam sekitar.

ABSTRACT

Recently the use of renewable fuels in the compression-ignition engine is getting more and more attention to reduce the dependency on fossil oil-based energy resources all over the world. Energy security and global warming alarm which are the two main driving forces for the global energy development nowadays. Alcohol blend fuels are now trying to fill in these demands. In this research work, the experimental investigation on the effect two alcohol additions in the diesel-biodiesel blends on combustion, performance, and emission of a direct injection diesel engine is stated. Moreover, the diesel-biodiesel blends are also investigated. These alternative fuels are employed: B5 (diesel -95%, biodiesel-5%), B20 (diesel -80%, biodiesel-20 %), D80PB5BU15 (diesel -80%, biodiesel-5 %, Butanol-15%) and D80PB5E15 (diesel -80%, biodiesel-5 %, Ethanol-15%), to compare their performance against (D100) pure diesel. The alternative fuels were identified, and their properties were tested to analyse the fuel quality. All the experimental tests were conducted by a single cylinder Yanmar TF-120M diesel engine was used by varying the engine loads (low load, half load and full load) at constant speed of 2400 rpm and variable engine speeds (1200 rpm, 1800 rpm, 2100 rpm) at constant half load conditions. The discussion will focus on combustion characteristics, performance and emissions. The results show the alcohol blends of butanol and ethanol has promising impact especially in the emissions. From performance analysis the thermal efficiency had increased by 1.13%, while fuel consumption 1.86% for D80PB5BU15.The EGT also shown some impacts while using the alcohol blends. Furthermore, results have reported that the diesel engine has reduced the emission NOx reduced (8.02-36) %, CO reduced (16.6-40) % and CO2 reduced (8.02-36) % emissions under different ranging engine load and speed influence while using the butanol and ethanol alcohol blends at diesel bio diesel blending. So, it was found that the alcohol blends shown the promising result which can be positive impact both as an alternative fuel and the environmental aspect.

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