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ENGINE AND EMISSIONS, FUELS AND LUBRICANTS

Experimental Research on the Carbon Dioxides Reduction Potential by Substitution Gasoline with Ethanol and Propane Under Reactivity Controlled Compression Ignition in a Single Cylinder Engine

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Abstract
In this experiment, it was experimentally investigated the combustion and exhaust characteristics, as well as the thermal efficiency, of RCCI combustion using gasoline, ethanol, and propane as low-reactivity fuels under four operating conditions. For each operating condition, gISNO$_x$ was limited to 0.15 g/kWh, and gISSmoke was limited to below 15 mg/kWh. The experiment was conducted by determining the operating conditions that satisfied these limitations and resulted in the highest city thermal efficiency. The low-reactivity fuels were supplied by port injection, while diesel was directly injected into the combustion chamber using a diesel injector. As a result, when gasoline is replaced with low-carbon fuels like ethanol and propane, the reduction in CO_2 emissions occurred. Under maximum power conditions, using ethanol allowed for a maximum reduction in CO_2 emissions of 6.81%. Depending on the driving conditions, ethanol showed a reduction ranging from 3.60 to 6.81%, while propane exhibited a reduction ranging from 3.10 to 5.64%. Additionally, by substituting with ethanol and propane, the GIE could be improved up to 44.73 and 43.56%, respectively.

Keywords Carbon dioxides (CO_2) · Dual-fuel combustion · Ethanol · Gasoline · Propane · Reactivity controlled compression ignition (RCCI)

List of Symbols

AFR	Air to fuel ratio
ºATDC	After top dead center
ºBTDC	Before top dead center
CI	Compression ignition
CN	Cetane number
CNG	Compressed natural gas
CO	Carbon monoxide
CO_2	Carbon dioxides
CR	Compression ratio
EGR	Exhaust gas recirculation
FC	Fuel-cell
GIE	Gross indicated thermal efficiency
gIMEP	Gross indicated mean effective pressure
gISxx	Gross indicated specific xx emissions
HR	Heat release
HRR	Heat release rate
ICE	Internal combustion engine
ID	Ignition delay
LHV	Low heating value
MFB$_x$	Mass fraction burned x%
NO$_x$	Nitrogen oxides
PCI	Premixed compression ignition
PFI	Port fuel injection
P_{in}	Intake pressure
P_{max}	The maximum in-cylinder pressure
PRR$_{max}$	(The) Maximum in-cylinder pressure rise rate
RCCI	Reactivity controlled compression ignition
RON	Research Octane number
SI	Spark ignition
SOC	Start of combustion
SOI	Start of (diesel) injection
THC	Total hydrocarbon
Φ	Equivalence ratio

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