Major Project II

UTILISATION OF 1-OCTANOL AND DIESEL IN A SINGLE CYLINDER CI ENGINE

Submitted to **Delhi Technological University** in Partial fulfilment of the requirement for the award of the Degree of

Master of Technology

In

Thermal Engineering

By

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July-2013

DECLARATION

I, hereby declare that the work embodied in the dissertation entitled **"UTILISATION OF 1-OCTANOL AND DIESEL IN A SINGLE CYLINDER CI ENGINE"** in partial fulfilment for the award of degree of MASTER of TECHNOLOGY in "THERMAL ENGINEERING", is an original piece of work carried out by me under the supervision of Prof. Naveen Kumar, Mechanical Engineering Department, Delhi Technological University. The matter of this work either full or in part have not been submitted to any other institution or University for the award of any other Diploma or Degree or any other purpose what so ever.

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CERTIFICATE

This is to certify that the work embodied in the dissertation entitled **"UTILISATION OF 1-OCTANOL AND DIESEL IN A SINGLE CYLINDER CI ENGINE"** by **RASHI KOUL, (**Roll No.-**2K11/THE/14)** in partial fulfilment of requirements for the award of **Degree of Master of Technology (M.Tech) in Thermal Engineering**, is an authentic record of student's own work carried by him under my supervision.

This is also certified that this work has not been submitted to any other Institute or University for the award of any other diploma or degree.

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ACKNOWLEDGEMENT

It gives me distinct pleasure to acknowledge my deep sense of gratitude and indebtedness to my learned guide Dr. Naveen Kumar, Head, Mechanical Engineering Department, Delhi College of Engineering, Delhi for his invaluable guidance, patient review and encouraging attitude throughout the project work. In spite of his busy schedule, he could find time to provide me his precious guidance. I also take this opportunity to thank Mechanical Engineering Department and other faculty members of the department for their encouragement and guidance.

I would very much like to extend my sincere thanks to CASRAE lab attendant Mr. Manoj Kadiyan for assisting me in a lab work.

My sincere thanks to my fellow friends especially Vipul Vibhanshu, Chinmay Mishra and Ashish Singh who were always there to lend a helping hand in the hour of need.

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ABSTRACT

The use of alcohols provides an attractive alternative fuel option for internal combustion engines. Alcohol can be produced using bio-refineries and may reduce the burden on fossil fuel resources due to renewable nature. There is a growing interest on using alcohols to substitute diesel fuel, as the use of oxygenated fuels involves oxygen enrichment leading to enhancement of premixed combustion phase and improved emissions. Various research related to the use of alcohols so far as alternative fuels for internal combustion engines has been focused on the employment of short chain alcohols, mainly methanol and ethanol, blended with fossil fuels. And long chain alcohols like butanol or Octanol have been barely investigated. The present study deals with the utilisation of octanol and diesel blends on a single cylinder diesel engine to evaluate performance and emissions parameters. The blend of octanol in 5%, 10%, 15% and 20% proportion with mineral diesel (v/v) were prepared. Evaluation of various physico-chemical properties of different test fuels was carried out. The characterisation results indicated reduced viscosity, density and calorific values for various Octanol-diesel blends compared to the baseline diesel fuel. However, the cold flow properties of the blends were found to be better than neat diesel.

The experimental engine trial results showed an increase in brake thermal efficiency (BTE) with increase in volume percentage of 1-octanol in octanol-diesel blends. The increase in brake thermal efficiency was due to the oxygenated nature of octanol and reduced kinematic viscosity, leading to higher combustion efficiency and improved atomization. The brake specific energy consumption (BSEC) of OC 20 was found to be lowest.

The emission analysis focused on all regulated pollutants, i.e. particulate matter, nitrogen oxides, carbon monoxide, carbon-dioxide and unburnt hydrocarbons. However, there was an increase in the carbon-dioxide emission with the increase in the volume of octanol added to octanol-diesel blend. The variation of NOx emissions for all the test increased for various octanol-diesel blends till 60% engine load and thereafter a downward trend was observed. Carbon-monoxide and Unburnt hydrocarbon and smoke opacity was found out to be lower than the baseline data of neat diesel.

The experiment results clearly show that the engine performance has improved with the addition of 1-octanol in diesel to the neat diesel. It can also be concluded that 1-octanol is a potential alternative fuel to be blended with the neat diesel for diesel engine application.

CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

NOMENCLATURE

GDP	Gross Domestic Product
OECD	Organisation for Economic and Co-operation Development
KGOE	Kilogram of Oil Equivalent
Btoe	Billion tonnes of oil equivalent
Mtoe	Millions tonnes of oil equivalent
CO_2	Carbon Dioxide
UNFCCC	United Nations Framework Convention on Climate Change
GHGs	Greenhouse gases
N_2O	Nitrous Oxide
O_3	Ozone
RET	Renewable Energy Technologies
MNES	Ministry of Non-Conventional Energy Sources
MNRE	Ministry of New & Renewable Energy
CFCs	Chlorofluorocarbons
IC	Internal Combustion
CO	Carbon monoxide
NOx	Nitrogen oxides
PM	Particulate matter
UBHC	Un-burnt hydrocarbon
CI	Compression Ignition
DI	Direct Injection
MJ/Kg	Mega Joules per Kilo gram
g	Grams
kWh	Kilowatt hour
$^{\circ}$ K	Degree Kelvin

atm	Atmospheric
$^{\circ}$C	Degree Celsius
TDC	Top dead centre
rpm	Revolutions per minute
TDI	Turbocharged Direct Injection
NCV	Net calorific value
PD	Petro-diesel
M	Methanol
$^{\circ}$F	Degree Fahrenheit
THC	Total hydrocarbon
m/s	Meters per second
Btu/lb	British thermal unit/ pound
Gal	Gallon
SCF	Standard cubic foot
NREL	National Renewable Energy Laboratory
~	Nearly
CNG	Compressed Natural Gas
v/v	volume/volume ratio
ASTM	American Society of Testing and Materials
kJ	Kilojoules
mm	Millimetres
bhp	Brake horsepower
kVA	Kilovolt ampere
AC	Alternating current
Min	Minutes
nm	Nanometre
D100	Pure diesel

OC5	5% Octanol in diesel (v/v)
OC10	10% Octanol in diesel (v/v)
OC 15	15% Octanol in diesel (v/v)
OC 20	20% Octanol in diesel (v/v)