Biodiesel Production of WCO by Hydrodynamic Cavitation and Its Performance Testing on a CI Engine

A Major project report

submitted in partial fulfillment of the requirements for the award of the degree

of

MASTER OF TECHNOLOGY

IN

THERMAL ENGINEERING

Submitted By

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Certificate

This is to certify that the thesis entitled **" Biodiesel Production of WCO by Hydrodynamic Cavitation and Its Performance Testing on a CI Engine",** which is being submitted by Ms. Manisha Rani to the Department of Mechanical Engineering , Delhi Technological University, Delhi for the award of Master of Technology in Thermal Engineering, is a record of bonafide research work carried out by her under my guidance and has fulfilled the requirements for the submission of thesis, which is to my knowledge has reached requisite standard.

To the best of my knowledge, the results contained in this dissertation have not been submitted in part or in full to any university or institute for the award or any degree.

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STUDENT DECLARATION

I hereby certify that the work which is being presented in the dissertation entitled "**Biodiesel Production of WCO by Hydrodynamic Cavitation and Its Performance Testing on a CI Engine"** submitted to the Department of Mechanical Engineering, is an authentic record of my own work carried under the supervision of **Dr. Amit Pal, Associate professor** Mechanical Engineering Department, Delhi Technological University, Delhi.

I have not submitted the matter embodied in this major project as whole or in part to any university or institute for the award of any other degree.

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ABSTRACT

Rapid depletion in petroleum reserves, and increasing cost of fuels and increasing pollution in the environment due to these fossil fuels have stimulated the search for the alternatives to petroleum based fuels. Biomass derived vegetable oils are quite promising alternative fuels for agriculture and transport diesel engines. Different type of vegetable oils like jatropha oil, waste cooking oil, linseed oil, sunflower oil, coconut oil, karanja oil etc. can be converted into biodiesel to be used as a bio-fuel. Only problem with Waste Cooking Oil is its high viscosity and low volatility. To overcome these problems esterification is done. Transesterification is the process in which Vegetable oil is treated with ethyl/methyl alcohol in presence of as a catalyst.

In this experimental investigation we have prepared the biodiesel from waste cooking oil by conventional and advanced methods (e.g. mechanical stirring method, ultrasonic cavitation method and hydrodynamic cavitation methods) and studied the effect of different parameters like reaction time, change in catalyst percentage and change in molar ratio on the yield of biodiesel produced.

Max yield is obtained for catalyst-0.5% and molar ratio 6:1 for 60 min reaction time. Yield obtain is higher for Hydrodynamic Cavitation than Ultrasonic Cavitation and conventional Mechanical Stirring method.

Further experimental work is conducted on a single cylinder four-stroke water-cooled direct injection, constant speed diesel engine that was operated on different blends of waste cooking oil based bio-diesel and diesel. Load on the engine was varied to study their influence on performance, emission and combustion. It is observed that with increase in biodiesel in the blend brake thermal efficiency increases and a decrease in CO and hydrocarbon (HC) and smoke emission is also observed.

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LIST OF ABBREVIATIONS

BTHE	Brake thermal efficiency
BHP	Brake Horse power
BSFC	Brake specific fuel consumption
BSEC	Brake specific energy consumption
BP	Brake power
WCOME	Waste Cooking Oil Methyl Ester
WCO	Waste cooking oil
FP	Frictional power
IP	Indicated power
IThE	Indicated thermal efficiency
MechE	Mechanical efficiency
A/F	Air fuel ratio
BMEP	Brake mean effective pressure
PPM	Parts Per Million
PM	Particulate Matter
FFA	Free fatty acid
UCME	Used cooking oil methyl ester
WFO	Waste frying oil
CN	Cetane Number
FAME	Fatty acid methyl ester
WCO-BXX	Waste cooking oil Blend with XX% of bio-diesel
THC	Total hydrocarbon emission
HC	Hydrocarbon
UHBC	Unburnt hydrocarbon
B-XX	Blend with XX % of bio-diesel