PERFORMANCE ANALYSIS OF BIO DIESEL BLENDS EXTRACTED FROM NEWLY DEVELOPED BIODIESEL PROCESSOR

ADIB BIN RASHID
(*MSc Engg., MIST*)

A THESIS SUBMITTED FOR THE DEGREEE OF MASTER OF SCIENCE IN MECHANICAL ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY (MIST)

September 2019

CERTIFICATE OF APPROVAL

The thesis titled "**PERFORMANCE ANALYSIS OF BIO DIESEL BLENDS EXTRACTED FROM NEWLY DEVELOPED BIODIESEL PROCESSOR**" submitted by Adib Bin Rashid Roll No-1014180006, Session: October 2014 the Mechanical Engineering Department of Military institute of Science and Technology has been accepted as satisfactory for partial fulfillment of the requirements for the degree of Master of Science in Mechanical Engineering on 19 September, 2019.

BOARD OF EXAMINERS

…………………………………………….

1. Maj Md. Faisal Kader, PhD — Chairman (Supervisor)
   Associate Professor, Department of Mechanical Engineering,
   MIST, Dhaka-1216, Bangladesh

…………………………………………….

2. Col Md. Humayun Kabir Bhuiyan, psc — Member (Ex-Officio)
   Head, Department of Mechanical Engineering, MIST,
   Dhaka-1216, Bangladesh

…………………………………………….

3. Professor Dr. Dipak Kanti Das — Member
   Department of Mechanical Engineering, MIST,
   Dhaka-1216, Bangladesh

…………………………………………….

4. Professor Dr. Md. Mahbubul Alam — Member
   Department of Mechanical Engineering, MIST,
   Dhaka-1216, Bangladesh

…………………………………………….

5. Professor Dr. Md. Ehsan — Member (External)
   Department of Mechanical Engineering, BUET,
   Dhaka-1000, Bangladesh

CERTIFICATE OF RESEARCH

This is to certify that the work presented in this thesis was carried out by the author under the supervision of Maj Md. Faisal Kader, Associate Professor, Department of Mechanical Engineering, Military Institute of Science & Technology, Dhaka.

-------------------------------------	-------------------------------------
Maj Md. Faisal Kader, PhD	Adib Bin Rashid

CANDIDATE'S DECLARATION

I hereby declare that this thesis is my original work and it has been written by me in its entirety. I have duly acknowledged all the sources of information which have been used in the thesis.

The thesis (fully or partially) has not been submitted for any degree or diploma in any university or institute previously.

Adib Bin Rashid
19 September, 2019

ACKNOWLEDGEMENT

The author would like to express his sincerest gratitude and deepest reverence to his thesis supervisor **Maj Md. Faisal kader, PhD,** Associate professor, Department of Mechanical Engineering, MIST for his continuous guidance, constructive criticism, encouragement and careful supervision throughout this research work without which this thesis would not have been possible.

The Author would like to thank his parents and wife for their unfailing support and encouragement. Special thanks to M.A. Matin, Manager, Service and Maintenance, Sterling Multi technologies Ltd, Uttara Dhaka for providing the author tremendous support and encouragement throughout the research work. The Author would like to thank the department of mechanical engineering, MIST for providing with the financial support and the lab assistances for their co-operation. The author would also like to express his sincere appreciation to all who have helped in one way or the other to get this research work done.

DEDICATION

This thesis is dedicated to my beloved parents and wife who have always been a source of inspiration, encouragement and stamina to undertake my higher studies and to face the eventualities of life with zeal, enthusiasm and fear of Allah.

ABSTRACT

Under the ever looming threat of energy crisis production and use of biodiesel promises a relievable and environment friendly solution. In this light, design and construction of an automated biodiesel plant can crank up and simplify the production process. Extraction of biodiesel from vegetable oil is time consuming and requires human involvement to perform and keep track of chemical titration, stirring and washing the product for each batch of production. A well designed system can significantly eliminate human interaction and expedite the whole process. For meeting our energy demand, Bangladesh is mostly dependent on natural gas and import of fossil fuels from foreign countries. This dependency leaves our economy vulnerable and susceptible to international market shocks and supply upset. The concept of using biodiesel is still in its infancy in Bangladesh though she grows many different kinds of crops suitable for biofuel production. Construction of an inexpensive automated biodiesel plant can help produce biodiesel in large scale and make a breakthrough in our economy as no such effort has been undertaken so far. It is a novel endeavor that seeks to make biodiesel production cheaper, easier and popularize in our country. To achieve the desired aim this paper focuses on implementation of the construction of a cheap, compact and automatic system that will exhaustively reduce human interactions as well as the processing time and increase the biodiesel yield. For this reason an automated biodiesel processor was designed and built utilizing a programmable logic controller (PLC) in conjunction with pumps, solenoid valves, level sensors, temperature sensors, etc. Upon the completion of a full cycle the automatic biodiesel production plant delivers certified biodiesel product to the end users and the leftover byproducts are collected for further recycling. Different batches of biodiesel were produced and a comparative study of the physical properties such as the density, kinematic viscosity, flash point, calorific value etc. were measured and result found satisfactory. The performance characteristics such as Brake Power (BP), Specific fuel consumption (SFC), mass of fuel consumed (mf), Brake Thermal Efficiency (BTE), exhaust gas emissions etc. of the diesel engine by these fuel samples were determined and the results were thoroughly studied.

TABLES OF CONTENTS

CHAPTER – 5 RESULTS AND DISCUSSION 60-81

LIST OF FIGURES

LIST OF TABLES

LIST OF NOMENCLATURE

A/F	Ratio Air Fuel Ratio
ASTM	American Society for Testing Materials
API	American Petroleum Institute
B	Waste Soybean Oil
BHP	Brake Horse Power
BSFC	Brake Specific Fuel Consumption
BTE	Brake Thermal Efficiency
BMEP	Brake Mean Effective Pressure
BARC	Bangladesh Agriculture Research Council
BARI	Bangladesh Agriculture Research Institute
BP	Brake Power
CI Engine	Compression Ignition Engine
CO	Carbon mono oxide
CO_2	Carbon dioxide
Dbt	Dry bulb Temperature
D 100	Pure Diesel Fuel
FAME	Fatty acid methyl ester
FFA	Free fatty acid
FC	Fuel Consumption
GHG	Greenhouse gas
HC	Hydro Carbon
IC	Internal Combustion
LHV	Lower Heating Value of Fuels, MJ/Kg
M	Mustard Oil
mbd	millions barrels per day
MT	Metric Ton
MOD	Mustard Oil Diesel
MW	Megawatts
NOx	Nitrogen Oxides
P	Palm Oil
PM	Particulate Material

POD	Palm Oil Diesel
POL	Port of Loading
RPM	Revolution Per Minute
SAE	Society of Automotive Engineers
SIT	Self-Ignition Temperature
SUS	Saybolt Universal Second
S	Soybean Oil
SVO	Straight Vegetable Oils
SOD	Soybean Oil Diesel
SO_2	Sulpher dioxide
T	Temperature, ° C
% vol.	Percentage of Volume
η_b	Brake Thermal efficiency, %
WVO	Waste vegetable oil
WCO	Waste cooking oil