STUDY ON THE PERFORMANCE OF BIODIESEL BLEND JATHROPA OIL IN A COMBUSTION SYSTEM

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To my beloved mother and father, my wife and my son.

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ABSTRAK

Dalam kajian ini, minyak Jathropa mentah (minyak sayuran tidak boleh dimakan) yang ditukar kepada biodiesel (Jathropa Methyl-Ester atau JME) menggunakan proses pengesteran dan proses trans pengesteran telah dicampur dengan diesel di bahagian tertentu bagi menghasilkan empat komposisi yang mempunyai jumlah yang berbeza, nisbah minyak Jathropa kepada nisbah diesel, 5/95% (B5), 10/90% (B10), 15/85% (B15) dan 20/80% (B20) setiap satunya. Setiap satu daripada campuran ini akan dibandingkan dengan diesel untuk mengkaji prestasi mereka berhubung dengan sifat bahan api, profil suhu dan pelepasan gas (NOx dan CO,) mengunakan tiga muncung yang berbeza yang setiapnya mempunyai kadar aliran yang berbeza dan sudut semburan yang sama pada lima nisbah setara yang berbeza. Hasil dari kajian ini mendapatkan rumusan berikut, berkenaan dengan profil suhu untuk kesemua campuran tidak akan melebihi nilai diesel dan akan menghasilkan pelepasan pembakaran yang rendah (NOx dan CO). Ini mungkin disebabkan oleh sifat-sifat yang berbeza dalam bahan api, profil suhu dan kadar aliran yang berbeza.

ABSTRACT

In this study, pure Jathropa oil (a non-edible vegetable oil) being converted to biodiesel (Jathropa Methyl-Ester or JME) using esterification and trans esterification process and blended with diesel in a certain proportion to produce four different volume composition of Jathropa oil/diesel ratios , 5/95% (B5), 10/90% (B10), 15/85% (B15) and 20/80% (B20) respectively. Each of the blends are compared with diesel to study their performance concerning its fuel properties, its temperature profile and gas emission (NOx and CO) in three different nozzle which has different flow rate and spray angle at five different equivalent ratio. Based on the result, regarding to its temperature profile each of the blends didn't exceed the value of diesel and produce lower emission (NOx and CO) compare to diesel. This might be due to different in its fuel properties, its temperature profile and different flow rate.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

ρ	-	Density of liquid (kg/m3)
μ	-	Dynamic viscosity (kg/m.s)
σ	-	Surface tension (N/m)
ϕ	-	Equivalent Ratio
A/F	-	Actual Air-Fuel Ratio
(A/F)sthoi	-	Stoichiometric Air-Fuel Ratio

LIST OF ABBREVIATIONS

ASTM	-	American Standard of Testing Materials
AV	-	Acid Value
B0	-	Diesel
B5	-	5% Jathropa Biodiesel + 95% Petroleum Diesel
B10	-	10% Jathropa Biodiesel + 90% Petroleum Diesel
B15	-	15% Jathropa Biodiesel + 85% Petroleum Diesel
B20	-	20% Jathropa Biodiesel + 80% Petroleum Diesel
B100	-	100% Jathropa Biodiesel
CJO	-	Crude Jathropa curcas oil
CO	-	Carbon Monoxide
FAME	-	Fatty Acid Methyl Ester
FDF	-	Fossil Diesel Fuel
FFA	-	Free Fatty Acid
H_2SO_4	-	Sulphuric Acid
IC	-	Internal Combustion
ICE	-	Internal Combustion Engine
JME	-	Jathropa Methyl Ester
NOx	-	Nitrogen Oxide

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background Study

How blessed are we to been living in this blessed country, report claim that Malaysia ranked 28th for oil production in this world. The alarming issue that we faced now is when the price of oil increase gradually each coming year. By looking at the price trend of diesel in Malaysia, before 90's the price of diesel is RM65.1 (Sen/Litre) , the current price now for diesel is RM200(Sen/Litre) with an increase value of approximately RM134.9 (Sen/Litre) and the price will surely increase in each coming year. Surprisingly, Malaysian people can be described as a 'seasonal alarming people', this is when the issue become viral, all the citizen will come out expressing their concern toward the situation, in this case concerning without having any thought on preventing the situation from happening again. The awareness and their concern will then depleted respectable with time.

Although majority of Malaysian citizens are being diverged from this issue, gratitude must be given to the minority (academician, researchers and etc.) whom dedicated their time to find the solution of energy depletion for a better sustainable life, thus lead to contribute in research on alternative fuel, such as the use of on Natural Gas Vehicle (NGV) and Biofuel. Bio-diesel is considered to be a replacement for

diesel, the term implemented the process of trans- esterification of any vegetable oil with ethanol or methanol.

The use of bio-diesel as a replacement for diesel comes with several advantages, biodiesel can be directly used in any internal combustion engine (ICE) directly or with a minimal modification whether in its pure form or in its blended form (biodiesel can be blend with different proportion with diesel). Used of biodiesel allows for fuller combustion process due to its composition thus reduce the emission of GHG (Green House Gaseous) and for handling process ,biodiesel can be stored and transport as a regular diesel.

1.2 Problem Statement

Non-edible plant is plant that are not meant for eating, it was considered useful in Malaysia because of the need to differentiate the two sector from having to collide between each other thus by individually state that it is by far important that edible plant are not consider as alternative for biodiesel because of the need to sustain the constant supply and most importantly to control the cost. For this reason, Jatropha is chosen.

It is necessary to study the performance of various biodiesel Jatropha blends (BJO) then compares the finding with Conventional Diesel Fuel (CDF).

1.3 Objectives

The purpose of this research is to study the effect of various blend of Biodiesel Jathropa Oil (BJO) by changing its nozzle under various operating condition and to study its performance in a combustion system.

1.4 Scope of Study

This research will mainly focus on the scopes listed below:

- Conducting literature review on previous research that focused on Jathropha curcas oil.
- Producing Biodiesel Jatropha oil from crude Jatropha curcas oil (from CJO to BJO).
- Produce blends of biodiesel Jatropha oil.
- Measure and study the physical properties for various blend of BJO.
- Setup rig of experiment and conduct study for combustion system test.
- Analysing and comparing the result with Conventional Diesel Fuel (CDF) or Fossil Diesel Fuel (FDF).

1.5 Significance of Study

Jatropha has already been make known and its use for biodiesel has been studied extensively, the significance for this study to add more information in its field of study toward how the various blend of Jathropha oil and how will it affect the result of combustion system interrelationship of its physical properties and fuel flow rate.

1.6 Limitation of Study

The limitation concerning the research for this study are listed as below:

- The fuel flow rate used for the testing are based on the nozzle, 1.25 US gal/hr, 1.5 US gal/hr and 1.75 US gal/hr
- The catalyst used for conversion from crude Jathropa Oil to Jathropa Methyl-Ester are methanol, potassium and acid hydrochloric.

1.7 Gantt Chart

For Gantt chart please refer to Appendix A.

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