

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 (NO_x dan CO,) menggunakan 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 (NO_x 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 (NO_x 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 (NO_x 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

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENTS	iv
	ABSTRAK	v
	ABSTRACT	vi
	TABLE OF CONTENTES	vii
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF SYMBOLS	xv
	LIST OF ABBREVIATIONS	xvi
	LIST OF APPENDICES	xvii
1	INTRODUCTION	1
	1.1 Background Study	1
	1.2 Problem Statement	2
	1.3 Objectives	3

	1.4	Scope of Study	3
	1.5	Significance of Study	4
	1.6	Limitation of Study	4
	1.7	Gantt Chart	4
2		LITERATURE REVIEW	5
	2.1	Introduction	5
	2.2	Biodiesel	5
	2.2.1	Problem concerning Biodiesel	6
	2.3	Jatropha	
	2.3.1	Jatropha in Malaysia	7
	2.3.2	Properties of Jatropha Curcas Oil	8
	2.4	Previous study	9
	2.5	Performance of Biodiesel on ICE (Internal Combustion Engine)	10
	2.5.1	Combustion Process	10
	2.5.2	Stoichiometry	11
	2.5.3	Air Fuel Ratio	11
	2.5.4	Emission from combustion system	12
3		METHODOLOGY	13
	3.1	Introduction	13
	3.2	Conversion from Crude Jathropa Oil to Biodiesel	13
	3.2.1	Conversion Process (Crude to Biodiesel)	14
	3.2.2	Blending Process	16
	3.3	Determining Fuel Physical Properties	17
	3.3.1	Kinematic Viscosity@40°C	18
	3.3.2	Surface Tension	19
	3.3.3	Density	20
	3.3.4	Specific Gravity	22
	3.3.5	Acid Value	23
	3.4	Combustion Set-Up	25

4	RESULTS AND DISCUSSION	28
	4.1 Introduction	28
	4.2 Conversion into Biodiesel	28
	4.3 Blending Process	31
	4.4 Physical properties of Jathropa Biodiesel	31
	4.4.1 Density	31
	4.4.2 Acid Value	32
	4.4.3 Kinematic Viscosity	33
	4.4.4 Surface Tension	33
	4.4.5 Calorific Value	34
	4.4.6 Physical properties summary	35
	4.5 Performance of Fossil Diesel (FDF) and Biodiesel Blends at various fuel flow rate	35
	4.5.1 Fuel flow rate of 1.25 US gal/hr	36
	4.5.1.1.1 Wall Temperature profile at Rich condition	36
	4.5.1.1.2 Wall Temperature profile at Stoichiometric condition	38
	4.5.1.1.3 Wall Temperature profile at Lean condition	38
	4.5.1.2 Gas Emission for Diesel and Biodiesel	40
	4.5.1.2.1 Nitrogen Oxide (NO _x)	40
	4.5.1.2.2 Carbon Monoxide (CO)	41
	4.5.2 Fuel flow rate of 1.5 US gal/hr	42
	4.5.2.1.1 Wall Temperature profile at Rich condition	43
	4.5.2.1.2 Wall Temperature profile at Stoichiometric condition	44
	4.5.2.1.3 Wall Temperature profile at Lean condition	45
	4.5.2.2 Gas Emission for Diesel and Biodiesel	47
	4.5.2.2.1 Nitrogen Oxide (NO _x)	47
	4.5.2.2.2 Carbon Monoxide (CO)	48
	4.5.3 Fuel flow rate of 1.75 US gal/hr	49

4.5.3.1.1	Wall Temperature profile at Rich condition	50
4.5.3.1.2	Wall Temperature profile at Stoichiometric condition	51
4.5.3.1.3	Wall Temperature profile at Lean condition	52
4.5.3.2	Gas Emission for Diesel and Biodiesel	54
4.5.3.2.1	Nitrogen Oxide (NO _x)	54
4.5.3.2.2	Carbon Monoxide (CO)	55
4.6	Relationship between Gas Emission and Nozzle Types for several Blends	56
4.6.1	NO _x Emissions	56
4.6.2	CO Emissions	58
4.7	Relationship between Gas Emission and Equivalent Ratio for different type of nozzle	59
4.7.1	NO _x Emissions	59
4.7.2	CO Emissions	60
5	CONCLUSION AND RECOMMENDATIONS	62
5.1	Conclusion	62
5.2	Recommendation	64
	REFERENCES	65
	Appendices A	70

LIST OF TABLES

TABLE NO.	TITLE	PAGE
2.1	Properties of CJO	8
3.1	Properties of CJO	14
3.2	Important Parameter for esterification	15
3.3	Important Parameter for Trans esterification	16
3.4	Various blend composition	17
4.1	Blends Composition	31
4.2	Density of Jathropa biodiesel blends	32
4.3	Number of Acid Value for each blends	33
4.4	Value of kinematic viscosity for each blends	33
4.5	Value for surface tension for each blends	34
4.6	Number of calorific value for each blends	34
4.7	Summarize value of properties for each blends	35

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
3.1	Experiment Rig Setup	16
3.2	Fuel mixture and finish blend product	17
3.3	Apparatus used	19
3.4	Kruss Tensionmeter	20
3.5	Pycnometer and weight scale	21
3.6	Hydrometer Used	22
3.7	Acid Value Titration Process	24
3.8	Thermocouple with reader	25
3.9	Gas Analyser (KM9106 Quintox)	25
3.10	Air Speed Indicator (LCA 6000)	26
3.11	Combustion chamber	26
3.12	Apparatus setup diagram	26
4.1	Conversion process from CJO to JME	30
4.2	Wall Temperature profile at ϕ 1.4	37
4.3	Wall Temperature profile at ϕ 1.2	37
4.4	Wall Temperature profile at ϕ 1.0	38

4.5	Wall Temperature profile at ϕ 0.8	39
4.6	Wall Temperature profile at ϕ 0.9	40
4.7	NOx Emissions at various equivalent Ratio	41
4.8	CO Emissions at various equivalent Ratio	42
4.9	Wall Temperature profile at ϕ 1.4	43
4.10	Wall Temperature profile at ϕ 1.2	44
4.11	Wall Temperature profile at ϕ 1.0	45
4.12	Wall Temperature profile at ϕ 0.8	46
4.13	Wall Temperature profile at ϕ 0.9	46
4.14	NOx Emissions at various equivalent Ratio	48
4.15	CO Emissions at various equivalent Ratio	49
4.16	Wall Temperature profile at ϕ 1.4	50
4.17	Wall Temperature profile at ϕ 1.2	51
4.18	Wall Temperature profile at ϕ 1.0	52
4.19	Wall Temperature profile at ϕ 0.8	53
4.20	Wall Temperature profile at ϕ 0.9	53
4.21	NOx Emissions at various equivalent Ratio	55
4.22	CO Emissions at various equivalent Ratio	56
4.23	NOx Emissions for lean condition	57

4.24	NOx Emissions for stoichiometric condition	57
4.25	NOx Emission for rich condition	57
4.26	CO Emissions for lean condition	58
4.27	CO Emissions for stoichiometric condition	58
4.28	CO Emission for rich condition	59
4.29	NOx Emissions for Diesel and B5	59
4.30	NOx Emissions for B10 and B15	60
4.31	NOx Emission for B20 and B100	60
4.32	CO Emissions for Diesel and B5	61
4.33	CO Emissions for B10 and B15	61
4.34	CO Emission for B20 and B100	61

LIST OF SYMBOLS

ρ	-	Density of liquid (kg/m ³)
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 ₂ SO ₄	-	Sulphuric Acid
IC	-	Internal Combustion
ICE	-	Internal Combustion Engine
JME	-	Jathropa Methyl Ester
NO _x	-	Nitrogen Oxide

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Gantt chart	70

CHAPTER 1

INTRODUCTION

1.1 Background Study

How blessed are we to be living in this blessed country, reports claim that Malaysia ranked 28th for oil production in this world. The alarming issue that we face now is when the price of oil increases 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 becomes viral, all the citizens 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 be depleted respectably with time.

Although the 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 leading to contribute in research on alternative fuel, such as the use of 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 Jathropa curcas oil.
- Producing Biodiesel Jathropa oil from crude Jathropa curcas oil (from CJO to BJO).
- Produce blends of biodiesel Jathropa 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 Jathropa 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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