BIODIESEL AS ORGANIC ADDITIVES TO IMPROVE THE ENVIRONMENTAL IMPACTS OF DIESEL FUEL

Submitted By

Gamal Abd El Salam Abd Allah Abou El Fotouh

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Master of Environmental Science, Institute of Environmental Studies & Research

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A thesis submitted in Partial Fulfillment
Of
The Requirement for the Doctor of Philosophy Degree
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Environmental Sciences

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APPROVAL SHEET

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This Thesis Towards a Doctor of Philosophy Degree in Environmental Sciences Has been Approved by:

Name

Signature

1-Pof. Dr. Youssef Barakat Youssef
Emeritus Prof. of Petroleum Chemistry
Head of Fuel Research Unit
Egyptian Petroleum Research Institute

2-Prof. Dr. Mostafa Mohamed Hassan Khalil
Prof. of Analytical Chemistry
Faculty of Science
Ain Shams University

3-Pof. Dr. Mohamed Youssef El Kady
Emeritus Prof. of Organic Chemistry
Faculty of Science
Ain Shams University

4-Pof. Dr. Mahmoud Ahmed Ibrahim Hewhey
Prof. of Public Health and Air Pollution
Department of Environmental Basic Sciences
Institute of Environmental Studies & Research
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Under The Supervision of:

1-Pof. Dr. Mohamed Youssef El Kady
Emeritus Prof. of Organic Chemistry
Faculty of Science
Ain Shams University

2-Pof. Dr. Mahmoud Ahmed Ibrahim Hewhey
Prof. of Public Health and Air Pollution
Department of Environmental Basic Sciences
Institute of Environmental Studies & Research
Ain Shams University

3-Dr. Taha Abd El Azzem Mohamed Abd El- Razek
Associate Prof. Environmental Chemistry
Head of Department of Environmental Basic Sciences
Institute of Environmental Studies & Research
Ain Shams University

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ABSTRACT

The rise in percentage of importing gas oil in Egypt and the need for renewable and environmentally friendly gas oil has led to carry out some research in this area. Palm kernel oil extracted from Egyptian Kernel Date and Apricot kernel was purchased from local market and the two oils were reacted with methyl alcohol in presence of sulfuric acid for esterification and transesterification with methanol in the presence of sodium hydroxide. The products were separated and purified to be used as additives for gas oil to produce biodiesel fuel blends. The chemical composition of (Palm Kernel Oil Biodiesel) and (Apricot Kernel Oil Biodiesel) were investigated using FTIR, ^{1}HNMR spectroscopy and GC-MS. The GC-MS scan of palm kernel oil biodiesel indicated that it is composed of saturated methyl esters (19 .25 %), total monounsaturated methyl esters (72.103 %), total diunsaturated saturated methyl esters (2.816 %) and total triunsaturated methyl esters (1.787 %). The GC-MS scan of Apricot kernel oil biodiesel showed that it is composed of saturated methyl esters (35.50 %), total monounsaturated methyl esters (62.42 %).The quality of B100 (Palm Kernel Oil Biodiesel), (Apricot Kernel Oil Biodiesel) and the blends B10, B20 were characterized according to ASTM standard methods and Egyptian Standard. The results of the (Palm Kernel Oil Biodiesel) properties showed a Density @ 15 ˚ C of 0.9103, kinematic viscosity at 40˚ C of 16.37 CSt, pour point of 0˚ C, cetane index of 47, and flash point of 108˚C .The (Apricot Kernel Oil Biodiesel) properties showed a Density @ 15 ˚ C of 0.8932, kinematic viscosity at 40˚ C of 9.10 CSt, pour point of - 6˚ C, cetane index of 55, and flash point of 135 ˚C. These results revealed that Palm Kernel Oil biodiesel and Apricot Kernel Oil biodiesel can be used as additives for gas oil as indicated by results of B10 and B20 blends. The (Opacity %) of gas oil and B20 blend (Palm Kernel Oil Fatty Acid Methyl Ester 20 % Vol. with gas oil) was measured and indicated a (- 20.7 %) improvement .The (Opacity %) of gas oil and B20 blend (Apricot Kernel Oil Fatty Acid Methyl Ester 20 % Vol. with gas oil) was measured and showed increase of smoke opacity by a (+12.2 %).

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LIST OF ABBREVIATIONS.

AGQM	German Association for Quality Management of Biodiesel
AKB10	Apricot Kernel Blend(10 %Akbd+90 %Vol. Gas Oil).
AKB100	Apricot Kernel Neat Biodiesel.
AKB20	Apricot Kernel Blend(20 %Akbd+80 %Vol. Gas Oil).
AKME	Apricot Kernel Methyl Esters.
AKO	Apricot Kernel Oil.
AOCS	American Oil Chemical Society.
ASTM	American Society for Testing and Materials.
ASTM/D-02	Technical Subcommitte of the American Society for Testing and Materials.
B100	Neat Biodiesel.
BBL/DAY	Barrel per Day.
CAN.	Canola.
CEN	European Committee Standardization.
CEN/ TC	Technical Committee of European Committee for Standardization.
CFPP	Cold Filter Plugging Point.
CI	Cetane Index.
CN	Cetane Number.
CONCAWE	Conservation of Clean Air and Water in Europe.
CP	Cloud Point.
DU	Degree of Unsaturation.
EN	European Fuel Quality Specification.
ES	Egyptian Standards.
FAAE,s	Fatty Acid Alkyl Esters.
FAEE,s	Fatty Acids Ethyl Esters.
FAME,s	Fatty Acids Methyl Esters.
FFA,s	Free Fatty Acids.
FP	Flash Point.
GC-MS	Gas Chromatography-Mass Spectrometry.
HVO	Hydrogenated Vegetable Oil.
IBF	International Biofuels Forum.

ID	Ignition Delay.
ICCT	International Council on Clean Transportation.
IEA	International Energy Agency
ISO	International Organization for Standardization.
ISO/TC	Technical Committe of the International Organization for the Standardization.
TAG	Tri-Acyl Glycerides.
JAT.	Jatropha.
JAMA	The Japan Automobile Manufacturers Association.
LCSF	Long Chain Saturation Factor.
NOx	Nitrogen Oxides
OSI	Oxidation Stability Index
PKB10	Palm Kernel Blend(10 %Pkbd+90 %Vol. Gas Oil).
PKB100	Palm Kernel Neat Biodiesel.
PKB10	Palm Kernel Blend(10 %Akbd+80 %Vol. Gas Oil).
PKB20	Palm Kernel Blend (20 %Akbd+80 %Vol. Gas Oil).
PKME	Palm Kernel Methyl Ester.
PP	Pour Point.
prEN	Draft European Standards.
PUFA	Poly Unsaturated Fatty Acids.
SAE	Society of Automotive Engineering
SAFF	Safflower.
TAG	Tri-Acyl Glycerides.
T10	The Temperature at which 10 % of fuel distilled.
T50	The Temperature at which 50 % of fuel distilled.
T90	The Temperature at which 90 % of fuel distilled.
TTF	Tripartite Task Force.
TR	TechnicalReports.
TS	Technical Specifications.
WK	Work Items.
WWFC	Worldwide Fuel Charter Committee.

Introduction

INTRODUCTION

In Egypt there is a great shortage in gas oil (diesel fuel) and the country imports around 31 % of gas oil demands from different countries **(Digital Aharam, 2012).** The production of gas oil at 2010 was146.6 thousand barrels and the consumptionwas231.9 thousand barrels. The gap between production and consumption reach 85.3 thousand barrels **(Alghytani, 2012).**

Diesel fuels have an essential function in the industrial economy of a developing country and used for transport of industrial and agricultural goods and operation of diesel tractor and pump sets in agricultural sector.

Economic growth is always accompanied by commensurate increase in the transport. The high energy demand in the industrialized world as well as in the domestic sector, and pollution problems caused due to the widespread use of fossil fuels make it increasingly necessary to develop the renewable energy sources of limitless duration and smaller environmental impact than the traditional one **(Canakci and Van Gerpen 2001).** This has stimulated recent interest in alternative sources for petroleum-based fuels. An alternative fuel must be technically feasible, economically competitive, environmentally acceptable, and readily available. One possible alternative to fossil fuel is the use of oils of plant origin like vegetable oils and tree borne oil seeds. This alternative diesel fuel can be termed as biodiesel. This fuel is biodegradable and non-toxic and has low emission profiles as compared to petroleum diesel. Usage of biodiesel will allow a balance to besought between agriculture, economic development and the environment **(Meher, 2006).**

From environmental point of view, combustion of fossil fuels contributes most to emissions of greenhouse gases, which lead to - atmospheric pollution and global warming .The transportation system depends mainly upon petroleum derived fuels **(Bankovi´c-Ili´c et al. (2012) .**