EVALUATION OF PRODUCED BIO-DIESEL FROM FISH WASTES OIL

By

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B.Sc. Agricultural Engineering, Fac. Argic., Cairo Univ., 2013

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APPROVAL SHEET

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ABSTRACT

The search on alternative fuels for compression ignition engine has become essential due to depletion of petroleum products, their increasing costs and its major contribution for pollutants. Biodiesel has become one of the most versatile alternative fuel options for diesel engine applications. Most researchs on biodiesel have focused on using plant based oils as feed stocks. There have been much less researchs on converting animal-based oils into biodiesel. One potential source of biodiesel is fish oil. The objective of this study was to produce and evaluate using Tilapia viscera biodiesel as a substitute for petrodiesel in compression ignition engine. Experiments were designed to investigate three points, the first was to study the applicability of producing and characterizing of oil from Tilapia viscera, the second point was to investigate the applicability of producing biodiesel from Tilapia visceral oil and characterizing and the third was to study the performance characteristics as fuel consumption, brake specific fuel consumption, brake thermal efficiency and the opacity of a six cylinder, direct injection diesel engine using B20 (20%Tilaipia viscera biodiesel with 80% petrodiesel). The results showed that fish waste (Tilapia viscera) can be converted to oil with percentage about 22%, and the characteristics of oil were a good indicator for the applicability of producing biodiesel. The results also reached that biodiesel can be produced from extracted oil from Tilapia viscera and this biodiesel was characterized by physicochemical properties and the properties were compared with international biodiesel standard specifications. The results revealed acceptable performance parameters of the engine by using B20. It was found that Fuel Consumption increases as the load increases. The Fuel Consumption of B20 was slightly higher than petrodiesel with average differance 2.4%. Brake Specific Fuel Consumption for B20 was higher than petrodiesel nearly 6.73% as average. Brake thermal efficiency for B20 was slightly lower than petrodiesel with average differance 5.2%. The results of environmental assessment showed that The Opacity of petrodiesel and B20 was 3.75% and 2.85% respectively, opacity of B20 was 24% lower than petrodiesel. Costs of using B20 increased nearly by 80 piasters (4.5 cents) comparing with petrodiesel for one liter.

Keywords: Fish waste, Biodiesel, Alternative fuel, Diesel engine, Opacity.

DEDICATION

I would like to take this opportunity to thank all the persons who helped me in completing this work , but first I would like to praise and give a great thank to ALLAH who granted me to complete this work . My special gratitude goes to my father "may his soul rest in peace" for his love, encouragement and who is the person that I owe for him that I became in this work , he always says to me "I hope to be better than me and achieve what I couldn't achieve through my life". There are no words to express my love and gratitude to my mother for her support, sympathy. She always asks ALLAH to help me to carry out this work , I also hope to thank brothers , my sisters and my fiance for all the support they lovely offered during my post-graduate studies and to my best friends.

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LIST OF ABBRIVIATIONS

ANOVA	Analysis of variance
ASTM	American Society for Testing and Materials
ASTM D6751	Biodiesel standard ASTM D6751 (United States)
B5	Biodiesel with 5% biodiesel in blend with petrodiesel
B10	Biodiesel with 10 % biodiesel in blend with petrodiesel
B20	Biodiesel with 20%biodiesel in blend with petrodiesel
B25	Biodiesel with 25 % biodiesel in blend with petrodiese
B50	Biodiesel with 50 % biodiesel in blend with petrodiesel
B60	Biodiesel with 60 % biodiesel in blend with petrodiese
B75	Biodiesel with 75 % biodiesel in blend with petrodiese
B80	Biodiesel with 80 % biodiesel in blend with petrodiese
B100	Biodiesel with 100% biodiesel in blend with petrodiesel
BSFC	Brake specific fuel consumption
C	Carbone
CI	compression ignition
CN	Cetane number
CO	Carbone monoxide
CO2	Carbone dioxide
cp	Centi Poise
cSt	Centi stock
D2	Diesel no. 2
DHA	Docosahexaenoic acid
EN 14213	European biodiesel standard (EN 14213)
EN 14214	European biodiesel standard (EN 14214)
EPA	Eicosapentaenoic acid
EPA	Environmental Protection Agency
FAME	Fatty acid methyl ester
FAO	Food and agricultural organization
FC	Fuel Consumption
FFA	Free fatty acid
FIN	Fishmeal Information Network
GAFRD	General Authority for Fisheries Resource Development
GC	Gas chromatography
HC	Hydrocarbons
IFFO	International Fishmeal and Fish Oil Organization

IFOMA	International Fish Meal and Oil Manufacturers Association
ISCT	Illinois Sustainable Technology Center
KOH	Potassium Hydroxide
LC	Long chain
LHV	lower heating value
NaOH	Sodium Hydroxide
NO_x	Nitrogen dioxides
PM	Particulate matter
PUFA	Polyunsaturated fatty acid
S	Sulfur
SCFE	supercritical fluid extraction
SI	spark ignition
SO_2	Sulfur dioxides
UHC	unburned hydrocarbons
USA	United States of America
WFO	Waste fish oil
75D20B5E	75 petrodiesel, 20 % biodiesel and 5% ethanol

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INTRODUCTION

The world is on the brink of energy crisis. The need for energy is increasing with the development of technology. This needed energy should be supplied from fossil based sources (coal, petroleum and natural gas) or from other alternative sources (solar, wind, geothermal, biogas, hydrogen). The limited fossil fuel sources are unable to cover for the continuously increasing demand of energy. This associated with increasing price of fossil fuels and the awareness of the impacts of environmental pollution and global warming, has forced a search for an alternative source of energy, which is renewable, safe and non-polluting.

Almost all countries are dependent on petroleum fuel to fulfil their energy requirements. Increase in energy demand due to growth in population has affected the underground fossil fuel resources. Since compression ignition (CI) engines are more widely used compared to spark ignition (SI) engines, greater attention is being devoted to develop an alternative source of fuel for the same.

Biodiesel is one of the potential alternatives to petrodiesel, as its properties are very comparable to petrodiesel. It is derived from the transesterification of vegetable oils, animal fats, or waste frying oils with alcohols to give the corresponding fatty acid methyl esters.

The most preferred raw materials for biodiesel are vegetable oil, animal oil and waste oil. Producing biodiesel from edible oils

may leave negative effect on agriculture in terms of scarcity of food crops so non-edible oils are preferred for production of biodiesel. Used cooking oil collected from restaurants is cheaper but it is a limited and unstable source for biodiesel production. Algae have promising potential however, it is still under study. The search for different kinds of low-cost feed stocks is the first step towards establishing a long-term commercially viable and sustainable biodiesel industry (Xiaohu *et al*., 2010).

The fish processing industry generates large quantities of tissue waste and by-products which tend to be either discarded or retailed at low value for fertilizer or animal feed. Another way to utilize from these by products is to transesterify the fish oils for the purpose of using in internal combustion engines. Many studies were carried out for fish oil as fuel for diesel engines (Lin and Li, 2009a).

Fish is an important source of high quality animal protein, essential fatty acids, and micronutrients, which are found at much higher level in fish than in terrestrial animals source foods. The fish sector is very important not only to ensure food security but also to improve employment and income for poverty elimination especially in developing countries. Egypt is the largest aquaculture producer in Africa and the 8th largest globally. The Egyptian aquaculture increased from 367,000 tonnes in year 2002 to 1,018,000 tonnes in year 2012, to 1.48 million tonnes in 2014, and to 1.53 million tonnes in 2015 (GAFRD, 2002-2015) .