Utilization of waste cooking oil for manufacture of sustainable biodiesel

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RESEARCH COMPLETION CERTIFICATE

Certified that the research work contained in this thesis titled, "**UTILIZATION OF WASTE COOKING OIL FOR MANUFACTURE OF SUSTAINABLE BIODIESEL"** has been carried out and completed by **HUMA SHAFIQ, I.D.15005140012.** The quality of the work contained in this thesis is adequate for the award of Degree of MS/M.Phil.

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DECLARATION

I **HUMA SHAFIQ** S/O **MUHAMMAD SHAFIQ** ID: **15005140012** Session **2015-2017** hereby declare that the matter printed in the thesis titled ***"UTILIZATION OF WASTE COOKING OIL FOR MANUFACTURE OF SUSTAINABLE BIODIESEL"*** is my own work and has not been printed, published and submitted as research work, thesis or publication in any form in any University, Research institution etc. in Pakistan or Abroad.

Dated: _____ _____

(Huma Shafiq)

DEDICATION

This thesis is dedicated to:
The sake of Allah, my Creator and my Master,
My homeland Pakistan, the warmest womb;
The great martyrs and prisoners, the symbol of sacrifice;
My great parents, who never stop giving of themselves in countless ways,
My beloved brothers and sister,
To all my family, the symbol of love,
My friends who encourage and support me,
All the people in my life who touch my heart,
I dedicate this research.

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HUMA SHAFIQ

ABSTRACT

Biodiesel is a renewable diesel, fuel of domestic source it is obtained from fats and oils either by chemical or bio-chemical means. Biodiesel consist of carbon, hydrogen and oxygen, the chemical formula and carbon/hydrogen ratio is different for each biodiesel and depends upon source from where it is obtained. There are four process by which oils and fats can be converted into biodiesel, namely, Trans esterification, blending, micro emulsions and pyrolysis. In this work biodiesel was manufactured from waste cooking oil by three steps method. Three samples of Waste cooking oil (WCO) were obtained from local restaurant of Lahore city of Pakistan. The acid value of used oil was 1.3. The first step was saponification, in which stoichiometric amount of NaOH was treated with oil. Second step was acidification in which soap solution was treated with stoichiometric amount of concentrated hydrochloric acid to produce free fatty acid. The last step was esterification, in which free fatty acid is reacted with methanol. All these reactions were performed at optimum temperature 70 ^{o}C. The best molar ratio of oil to methanol used was 1:6. Concentrated hydrochloric acid was used as catalyst and its concentration was 5% of free fatty acid. The maximum reaction yield was 85%. Finally several physical and chemical properties of biodiesel such as acid value, saponification value, ester value, viscosity, density, cloud point, and flash point were examined and compared with biodiesel standard values. The viscosity of produced biodiesel ranged from 5.7mm^2/s - 6.13mm^2/s. Saponification value found within the ranged from 182 - 188.2. The acid number limits were from 0.8 - 1.3. Densities of produced biodiesel were ranked from 0.67g/ml - 0.989g/ml. Cloud points ranged from -7 ^{o}C to – 8^{o}C. Flash points ranged from 89 ^{o}C - 170 ^{o}C and ester values ranged from 181.1-188.2. Values of properties of synthesized biodiesel were under the tolerable limit. The manufactured biodiesel from WCO in this research can be effectively used as diesel fuel for commercial application.

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1. Introduction

1.1. Biofuel :Overview

World energy demand had mainly dependent on the fossil fuels for more than two centuries and this demand is increasing day by day (Yacob *et al.*,2009). Because of its non-regenerate able characteristics, the utilization of fossil fuels may cause the drastic shortage of fossil fuels storage. Fossil fuels tremendously used and results in the shortage of its reserve due to its non-regenerate able nature. Additionally, there is an increased in temperature occurred and other environmental issues also happened, the main alarming factor is global warming (Asri *et al.*, 2013). Researchers are trying to develop an alternative energy because of rapid decreased in energy reserves. Over the last few years Biodiesel has become a most important alternative energy source because it has the ability to reduce pollutant related to the environment. (Asri *et al.*, 2013). The widely held of worldwide essential energy generation gets from fossil energy.