بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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MONA MAGHRABY

FACULTY OF ENGINEERING
ELECTRICAL POWER AND
MACHINES DEPARTMENT

Application of Electrostatic Fields in the Separation of Emulsified Oil Products

M.Sc. Thesis Presented By

Eng. Mohamed Abdullah Mohamed Abou mosalam

Submitted in Partial Fulfillment of the Requirements of
The Degree of Master of Science in Electrical Engineering

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2020

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STATEMENT

This Thesis is submitted to Ain Shams University in partial fulfillment of the requirements of Master of Science degree in Electrical Engineering.

Thesis Title: Application of Electrostatic Fields in the Separation of Emulsified Oil Products

The work in this thesis has been carried out by the author at the Department of Electrical Power and Machines, Ain Shams University. No part of this thesis has been submitted for a degree or qualification at any other university or institution.

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Dedication

To the soul of my beloved father who taught me the meaning of life.

It is to my mother that my success goes. Special thanks to my wife for providing support and encourage during this work.

I have to thank Allah for choosing them to be my family.

Abstract

Energy resources are among the most essential inputs to the global economic system. The majority of energy consumption worldwide comes from fossil fuels, which are derived from fossil materials such as coal, oil, natural gas, etc. These sources will eventually vanish and, more significantly, they are not environment-friendly. Many researchers have explored alternative sources of energy such as: wind, solar, tidal, and biodiesel, which are considered renewable energies and are industrially desirable.

Biodiesel is a biofuel that has suitable features to replace, or be blended with, the petroleum diesel. It is produced from the blend of a vegetable oil and an alcohol in the presence of a catalyst. Such chemical reaction leaves the biodiesel in an emulsion state with glycerol. This thesis studies the acceleration of separating glycerol from the biodiesel using electrostatic forces.

A series of experimental investigations have been conducted to explore the effect of the employed electrode Pairs, electrode distance, and concentration of emulsifier, voltage magnitude and polarity on the separation rate of glycerol. A 25-stage Cockcroft-Walton voltage multiplier has been implemented to generate high DC voltage up to 7000 V.

The time taken by the glycerol to settle down from the biodiesel under the sole effect of gravity has been compared to that attained under the influence of high electrostatic fields. Results showed that the time taken to achieve 100% separation completeness under gravity reached 30000 seconds (8.3 hours). However, when an electrode Pairs was submerged to the proper height (4 cm apart) and the voltage was set to 2000 V, 99.02% separation completeness was reached within 1800 seconds (0.5 hour). When the effect of the employed electrode Pairs was studied, the obtained results revealed that the electrode Pairs of different diameters gave the highest percentage 115.49% separation completeness and the shortest separation time reached within 1083 seconds (0.301 hour) under the influence of applying 4000 V.

Similar results were obtained with excessive concentration of emulsifier that resulted in a significant retardation in the glycerol separation by gravity. For instance, the separation time decreased from 17, 18, 20, and 25.19 hr to 0.5, 0.52, 0.61, and 0.67 hr after applying 2000 V to samples with 4.0, 5.0, 6.0 and 7.0 gm of emulsifier, respectively.

Gas chromatography (GC) analysis was performed to biodiesel samples before and after applying the high voltage.

The chromatogram did not indicate the appearance of any foreign peaks confirming that applying the high voltage has not create, or even initiate, any chemical reaction.

CONTENTS