LARGE EDDY SIMULATION OF E10 GRADE BIOFUEL IN AN INTERNAL COMBUSTION ENGINE

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES OF COVENANT UNIVERSITY, OTA, OGUN STATE, NIGERIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ENGINEERING (M.Eng.) DEGREE IN MECHANICAL ENGINEERING, IN THE DEPARTMENT OF MECHANICAL ENGINEERING, COLLEGE OF ENGINEERING, COVENANT UNIVERSITY, OTA.

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ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfillment of the requirements for the award of Master of Engineering (M.Eng.) degree in Mechanical Engineering, Department of Mechanical Engineering, College of Engineering, Covenant University,Ota, Ogun State, Nigeria.

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DECLARATION

I, **ALAO, ADEYINKA OLADIPO (20PCM02338)** declare that this research work titled **"LARGE EDDY SIMULATION OF E10 GRADE BIOFUEL IN AN INTERNAL COMBUSTION ENGINE"** was carried out by me under the supervision of Dr. Kilanko Oluwaseun of the Department of Mechanical Engineering, College of Engineering, Covenant University, Ota, Nigeria. I attest that this dissertation has not been presented either wholly or partially for the award of any degree elsewhere, and the results of this research were originally obtained. All information cited from published and unpublished literature has been duly referenced.

ALAO, ADEYINKA OLADPIO

Signature and Date

CERTIFICATION

This is to certify that the research work titled "**LARGE EDDY SIMULATION OF E10 GRADE BIOFUEL IN AN IC ENGINE**" is an original research work carried out by **ALAO, ADEYINKA OLADIPO (20PCM02338)** meets the requirements and regulations governing the award of Master of Engineering (M.Eng.) degree in Mechanical Engineering, from the Department of Mechanical Engineering, College of Engineering, Covenant University, Ota, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to God Almighty. My parents, Mr and Mrs ALAO, for their support and continuous prayers towards my work. Thank you and God bless you abundantly.

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TABLE OF CONTENTS

LIST OF TABLES

TABLES **LIST OF TABLES** **PAGES**

LIST OF FIGURES

LIST OF EQUATIONS

ABBRIEVATIONS, SYMBOLS AND NOMENCLATURE

BDC	Bottom dead centre
CFD	Computational fluid dynamics
CI	Compression ignition
DES	Detached eddy simulation
DNS	Direct numerical simulation
FDV	Finite difference method
FEM	Finite element method
FVM	Finite volume method
ICE	Internal combustion engine
LES	Large eddy simulation
ODC	Outer dead centre
RANS	Raynolds average navier strokes
SAS	Scale-Adaptive simulation
SI	Spark ignition
TDC	Top dead centre

ABSTRACT

The greatest significant advantage of fossil fuels is their energy density. Fossil fuels contain enough energy in a small enough space to make them highly useful for a variety of applications, the most essential of which is mobility. Considering various methods of showing biofuel combustion in an Internal Combustion Engine, Large Eddy Simulation (LES) is one of the best techniques used to observe how solids interact with fluids. It is a computational method using Finite Volume approach to solve Navier Stokes governing equations to determine results in turbulent models. This study uses Large Eddy Simulation turbulence model to compute the temperature, pressure, velocity and total energy of E10 grade biofuel. It was observed that the initial flow rate of E10 grade biofuel at the beginning of combustion causes a spike in total energy developed and temperature at initial stage of combustion. The biofuel produced a maximum energy of 1.2MJ during combustion, while gasoline produced 0.8MJ in the same second. This showed initial energy produced by E10 was greater than gasoline energy. The temperature difference between both fuel is also small. E10 biofuel produced a maximum temperature of 2300^{o}C at the end of combustion time while gasoline produced a temperature of 1700^{o}C during the same second. The study showed little change in energy and temperature outcome between both fuel and justified the deviation to renewable energy as a source of fuel for Internal Combustion engines.

Keywords: Biofuel, Bioethanol, Energy, Engines, IC Engine, Ansys, Simulation