Sudan University of Science and Technology

College of Engineering

Mechanical Engineering Department (power)

Effect of Variable Turbocharger Pressure Ratio on Diesel Engine Emissions by Using Simulation Software

تأثير نسب الضغط المختلفة للشاحن التوربيني على إنبعاثات محرك الديزل باستخدام برنامج محأكاة

A project Submitted in Partial Fulfillment for the Requirements of the Degree of B.Eng. (Honor) In Mechanical Engineering

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الإستهلال

قال تعالى

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صدق الله العظيم

DEDICATION

To our parents

Who educated and enabled us to reach this level

To our families

Who supported us

To people who paved our way of science and knowledge

To all colleagues and friends

ACKNOWLEDGEMENT

This research would not have been possible without Allah then the help of many people. First of all, we would like to deeply thank our supervisor Dr. Eihab Abdelraouf Mustafa, he improved our experience, knowledge and skills. We have to say that we have been lucky to work with him, we wish him all the best. Also, we have to thank Department of mechanical engineering that supported us in this work. Lastly, Many thanks are should go to our colleagues in mechanical department.

These were the last words we wrote for our graduation project. We wish they would also be the best words, to acknowledge all who helped and supported us during this study.

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Abstract:

The phenomenon of global warming is one of the most important problems facing us at the present time, which has not been treated so far, and that the root cause of this phenomenon is the greenhouse gases surrounding the globe, and hence the aim was to reduce the rates of these gases and know the causes of the occurrence and attempts To reduce or minimize these causes.

Emissions from motor vehicles and power plants are one of the main reasons for the presence of greenhouse gases, so there has to be a solution that reduces these emissions, and here are the emissions from motor vehicles in general and diesel engine in particular. The engine was tested to reduce its emissions, and the method used was to use a turbocharger in the engine.

A comprehensive study of these emissions and their different types, causes and methods of reduction was done by changing the speed of the engine rotation without the use of a turbocharger. The same study was carried out using a turbocharger at different pressure ratios and speeds until the pressure ratio and the speed required to produce as little emissions as possible.

المستخلص

ان ظاهرة الاحتباس الحراري تعد من اهم المشاكل التي تواجهنا في الوقت الحالي ،والتي لم يتم علاجها الي الان والسبب الاساسي في هذه الظاهره هي الغازات الدفئيه المحيطه بالارض ومن هنا كان المنطلق الي تقليل نسب الغازات الدفيئه المحيطه بالارض ومعرفه اسبابها واجراء محاولات عديده للحد او التقليل من هذه الاسباب .

ومن اهم الاسباب في وجود الغازات الدفيئه هي الانبعاثات الصادره من المحطات النوويه ومحطات الطاقه ومن محركات السيارات فكان لابد من وجود حل يقلل من الانبعاثات. ومن هنا تم اخد الانبعاثات الصادره من محركات السيارات عموما ومن محرك الديزل بشكل خاص واجريت عليها دراسه لتقليل هذا النوع من الابنعاثات.

وكانت الطريقه المتبعه هنا هي استخدام شاحن توربيني في محرك الديزل حيث اجريت دراسه شامله لهذه الانبعاثات وانواعها المختلفه ومسبباتها وطرق الحد منها وقد اجريت هذه الدراسه عند نسب ضغط مختلفه في حاله استخدام شاحن توربيني وعند سرعات مختلفه وذالك لمعرفه نسبه الضغط المثاليه التي يكون عندها الانبعاث اقل ما يمكن وايضا معرفه السرعه المثاليه للمحرك وذالك للحصول علي اقل قيمه من الانبعاثات.

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List of Abbreviations

A/R	Aspect Ratio
BMEP	Brake Mean Effective Pressure [Bar]
BP	Brake Power [KW]
BSFC	Brake Specific Fuel Consumption [kg/kWh]
CI	Compression Ignition
CO	Carbon Monoxide
CO2	Carbon Dioxide
DI	Direct Injection
EGR	Exhaust Gas Recirculation
EU	European Union
GHG	Green House Gases
H_2CN	Dehydrogenate Cyanide
HC	Hydrocarbon
HCCI	Homogeneous Charge Compression Ignition
HCN	Hydrogen Cyanide
IC	Internal Combustion
ICE	Internal Combustion Engine
IMEP	Indicated Mean Effective Pressure [Bar]
ISFC	Indicate Specific Fuel Consumption
LHV	Lower Heating Value [kJ/kg]
LPG	Liquefied Petroleum Gas
N_2O	Nitrous Oxide
NH	Nitrogen Monohydrate
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_X	Nitrogen oxides
PAHs	Polycyclic Aromatic Hydrocarbons
PM	Particulate Matter
PR	Pressure Ratio
SCR	Selective Catalytic Reduction
SFC	Specific Fuel Consumption
SI	Spark Ignition
SO_2	Sulfur Dioxide
SO_X	sulfur Oxides
VGT	Variable Geometry Turbocharger

List of Symbols

CN	Cyanotic
Mf	Fuel mass flow rate [kg/s]
N	Engine speed [rpm]
O2	Oxygen
O_3	Ozone
P	Pressure [Pa]
T	Brake torque [Nm]
ηb	Brake Thermal Efficiency