

# **AN INVESTIGATION ON THE PERFORMANCE OF GAS TURBINE RUNNING ON SYNGAS**

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## **APPROVAL**


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A project dissertation submitted to the  
Faculty of Engineering and Quantity Surveying  
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## DECLARATION

I, the undersigned, hereby declare that this report is my own independent work except as specified in the references and acknowledgements. I have not committed plagiarism in the accomplishment of this work, nor have I falsified and/or invented the data in my work. I am aware of the University regulations on Plagiarism. I accept the academic penalties that may be imposed for any violation.

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## ABSTRACT

The increase in global energy demand which coincided with the depletion of natural reserves for fossil fuels combined with the reports of global warming and climatic changes has garnered an interest in researchers and developers to bring forth alternative sources of energy as well as develop alternative fuels in order to substitute fossil fuel in the short term as well as in the long term to tackle these issues. Power generation is the largest industry in the world which uses fossil fuel to generate electricity by using engines, one such engine used in power generation is the gas turbine which is mainly run on fossil fuels. Due to the governments initiatives on emission and mostly due to the increase in concern for global warming the industry has been doing extensive studies on using alternative fuel to run the gas turbines. One such alternative fuel is the syngas. In this paper, a background on gas turbine and syngas is provided together with a review of recent studies and development in the gas turbine industry. The focus is on analyzing the performance gas turbine run on syngas by using previously published studies and to use this data to create mathematical model for prediction purpose using MATLAB and validate using experimental data obtained from literature.

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## DEDICATION

*This thesis is dedicated to my beloved parents*

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## NOMENCLATURE

<i>Symbol</i>	<i>Definition</i>
<i>kg</i>	<i>kilogram</i>
<i>KJ</i>	<i>Kilojoules</i>
<i>KW</i>	<i>Kilowatt</i>
<i>m<sup>3</sup></i>	<i>Cubic meter</i>
<i>MJ</i>	<i>Mega joules</i>
<i>N</i>	<i>Newton</i>
<i>P</i>	<i>pressure</i>
<i>Q<sub>in</sub></i>	<i>Heat entering</i>
<i>Q<sub>out</sub></i>	<i>Heat expelled</i>
<i>s</i>	<i>Entropy</i>
<i>T</i>	<i>Temperature</i>
<i>V</i>	<i>Volume</i>

# CHAPTER 1

## INTRODUCTION

### 1.1. Background

In the last few decades scientists have discovered the harmful effects of global warming and how it has impacted on the environment. Global warming is mainly caused by the amount of greenhouse gas such as CO<sub>2</sub> released excessively into the atmosphere, the main culprit for this excessive release of these GHGs is the burning of fossil fuels. Fossil fuel is the main or common source of energy used by most of the countries. However due to the recent developments in awareness and the depletion of reserves, many countries are looking for other alternative source for energy (Sumner, et al., 2017). Most research is done towards obtaining renewable source of energy such as Solar, Wind, Biomass etc.

Gas turbines used in power generation are now experimented with fuels other than fossil fuels. One such fuel is Syngas obtained from biomass. The abundance in availability and the reduced harmful effect on the environment has been a major factor in using syngas as an alternative for fossil fuel

The most important factors to consider in the energy sector in these days is the effects of climate changes due to the imbalance in GHGs in the environment and the effectiveness of the energy demand reduction. According to the researches carried out researchers has found renewable energy to have the potential and the capability to counter the energy demand as well as the greenhouse effect which ultimately causes global warming (Brusca, et al., 2015). As such many researches have been focused to find a way to utilise renewable sources (alternative sources other than fossil fuel) as the energy production for the future in the power industries.

## **1.2. Problem Statement**

The effect of climatic change has been a major factor for countries to consider alternatives other than fossil fuels as the main energy source. To mitigate this problem while maintaining the global energy demands countries are giving dramatic attention to substitute fossil fuel in the short and long-term plan. One such alternative is the biomass waste, which is widely available and is largely considered as the fourth highest energy source for electric power generation. In the last decade, the production of syngas has been largely contributed by biomass. As such, syngas has the potential to mitigate the energy security by using biomass waste in the future along with enhanced quality of life and reduced emission.

## **1.3. Objectives of the Research**

The objectives of this research are as follows:

- To investigate the performance and emission of gas turbine running on syngas.
- To develop a mathematical model for prediction using MATLAB.
- To validate the experimental results

## **1.4. Scope of the Research**

The thermodynamic modelling for gas turbine during this study is to be made using the MATLAB software. The validation of the model is to be done by using experimental data obtained by literature published. The injection of syngas is considered as the fuel to be run on the system, different constituents and varieties of syngas are to be simulated in different conditions. The study done by H. saadig, et al is taken as a reference. In this research micro gas turbine (MGT) is considered the primary device.

## **1.5. Report Organization**

This report contains of five main chapters. Each chapter tackles different aspects of the final year project. Which gives a proper understanding of the work carried out and how results were obtained.

Chapter 1 Provides an understanding of the important aspects of this research. It gives some background information about gas turbine, especially gas turbine run on syngas. After some