

**FINAL PROJECT  
ENERGY CONVERSION FIELD**

**EXPERIMENTAL STUDY OF PERFORMANCE OF  
THE DIESEL ENGINE OF TOYOTA 2L TYPE**

Submitted as a Requirement to Accomplish The Bachelor Degree of Mechanical  
Engineering

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PADANG, 2008**

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## ABSTRACT

The development of applied diesel engine is required in process of understanding its characteristic. The characteristic can be analyzed from performance parameter of diesel combustion engine by carrying out an experimental works (performance test). The used engine which is used is Four Cylinder 2L Type of Toyota Diesel Combustion Engine which is commonly known as LF80 or Kijang Krista. The experiment is carried out by modifying some parts of the engine, mainly at flywheel to measure rotation and give load. Testing method that is used in this experiment is giving a constant load at varied rotation. Some parameters which are measured in performance test are as follows: Rotation ( $n$ ), Temperature of Inlet Air ( $T_1$ ), Temperature of Exhaust Air ( $T_2$ ), Inlet Cooling Water ( $T_3$ ), Outlet Cooling Water ( $T_4$ ), Period of Fuel Consumption ( $t$ ), Volume of Fuel, and Volume of Cooling Water.

Testing is ranging from rotation 800 rpm to 2800 rpm with increment of 200 rpm. This machine is constant as loaded at 50 psi. The rotation is controlled by adjusting the accelerator gas pedal. The data which are obtained and calculated are used as an experimental data. Thus as the performance parameter of diesel combustion engine. Those data which are obtained are Brake Power ( $bp$ ), Mean Effective Pressure ( $MEP$ ), Volumetric Efficiency ( $\eta_v$ ), Thermal Efficiency ( $\eta_{th}$ ), Fuel-Air Ratio ( $F/A$ ), and Specific Fuel Consumption ( $sfc$ ). The highest Brake Power ( $bp$ ) is obtained at the rotation of 2800 rpm which is 44.61 kW and the lowest one at the rotation 800 rpm which is 12.75 kW. The Mean Effective Pressure ( $MEP$ ) are remain constant at any level of rotation speed is 123.05 kPa. While Volumetric Efficiency ( $\eta_v$ ) has the highest efficiency at the rotation of 1600 rpm which is 63.972 % and the lowest one at the rotation of 1000 rpm which is 32.348 %. The highest Thermal Efficiency ( $\eta_{th}$ ) is at the rotation of 1000 rpm which is 67.24 % while the lowest at the rotation 800 rpm is 53.104 %. Fuel-Air Ratio ( $F/A$ ), higher ratio at rotation 1200 rpm is 0.199, lower at rotation 1600 rpm is 0.1102. The highest Specific Fuel Consumption ( $sfc$ ) is at the rotation of 1800 rpm which is 0.063 kg/kWh and the lower at the rotation of 1000 rpm which is 0.05 kg/kWh.

**Keyword:** Four Cylinder 2L Type of Toyota Diesel Combustion Engine, performance parameter, and performance test.

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## CHAPTER I INTRODUCTION

### **1.1 Background**

Diesel engine as we already know, is found by Rudolf diesel. Recently, there are many development of it, such as its' applications in industries, transportation, and farming equipment. Several indicators show that the diesel engine has been widely used. Based on this, we should understand characteristic of the diesel engine. In order to analyze the characteristic, it is required some experimental work in the field of diesel engine, such as performance test of the diesel engine.

The characteristic of the diesel engine is easy to learn, one of them is by analyzing through the equipment test. Hence, the equipment test is designed and then used to get performance data of the diesel engine. Not only as the final project, the equipment is also used for the practice of the engine performance in conversion laboratory of Mechanical Engineering of Andalas University.

This performance test uses four cylinder diesel engine 2 L type that are usually used as motor engine in Toyota type LF70 and LF80 which are known as Kijang Krista.

### **1.2 Aims**

The main aims of this project are:

1. To know the characteristic of the diesel engine Toyota 2 L. Type,
2. To know the performance of the engine based on rotation by using several performance parameters, those are:
  - a. Mean effective pressure
  - b. Volumetric efficiency
  - c. Thermal efficiency
  - d. Brake power
  - e. Fuel usage and specific fuel usage
  - f. Fuel-Air ratio

This project are also intended to get some benefits, they are as mentioned below:

1. To obtain the characteristic of the diesel engine Toyota 2 L. type.
2. To be able to predict the performance of diesel engine and parameters that influential in all work condition.

### **1.3 Limitation**

The engine test uses four cylinder 2 L. type of toyota diesel combustion engine and is carried out at rotation with the range of 800 rpm to 2800 rpm at constant load.

### **1.4 Outline**

The systematic procedure of writing this final project consists of five chapters. Introduction of the project, that are divided into background, aims, benefits, limitation, and outline of the project is explained in chapter one. The analysis of project is strenghten by work principle, the classification of diesel engine, thermodynamic air fuel mixture, fuel system, fuel spray, high pressure fuel pump, combustion chamber, fuel and combustion process, lubrication system, and cooling system of performance parametric. These review of related literarure are mentioned in chapter two. Furthermore, chapter three describes Methodology, that consists of equipment test, measurement tool, testing method, tested parameter and test procedure. Results and Discussion of this project are presented by using graphic and analysis in chapter four. A general discussion leading to conclusion and suggestion for future work is presented in chapter five. This final research is completed by bibliography and appendixes. They present refrence of project, engine test specification, documentation of performing test, and parameters of performance.

## CHAPTER 5

### CONCLUSION AND SUGGESTION

#### 5.1 General Discussion

Performance parameter is important in measuring the engine characteristic. The four cylinder 2L type of the diesel combustion engine is modified into testing engine which is used to analyze the performance engine at constant load (50 Psi). Parameter that is obtained through viewing the speed of rotation engine is started from 800 rpm to 2800 rpm. From the performance test, it is obtained that maximum thermal efficiency which is 67.24% is obtained at the engine condition of 1000 rpm in speed rotation and 44.61kW in brake power.

#### 5.2 Conclusion

The conclusion that can be drawn from this final project is that by carrying out the experimental study of performance of the diesel engine of Toyota 2L type would be obtained the characteristic of the diesel combustion engine which consist of several performance parameters. Those parameters are as follow:

- a. The highest Brake Power (bp) is obtained at the rotation of 2800 rpm which is 44.61 kW and the lowest one at the rotation of 800 rpm which is 12.75 kW.
- b. The Mean Effective Pressure (MEP) are remain constant at any level of rotation speed which is 123.05 kPa.
- c. The Volumetric Efficiency ( $\eta_v$ ) has the highest efficiency at the rotation of 1600 rpm which is 63.972 % and the lowest one at the rotation of 1000 rpm which is 32.348 %.
- d. The highest Thermal Efficiency ( $\eta_{th}$ ) is at the rotation of 1000 rpm which is 67.24 % while the lowest one at the rotation of 800 rpm which is 53.104 %.
- e. The highest Fuel-Air Ratio (F/A) is at the rotation of 1200 rpm which is 0.199 and the lowest one at the rotation of 1600 rpm which is 0.1102.
- f. The highest Specific Fuel Consumption (sfc) is at the rotation of 1800 rpm which is 0.063 kg/kWh and the lowest one at the rotation of 1000 rpm which is 0.05 kg/kWh.

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