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A Review Analysis of Effect of Variable Compression Ratio in Engine Using Turbocharger

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ABSTRACT

The effect of variable compression ratio at different loads with turbocharger is used to analyse the performance and to improve the performance of an I.C engine and to increase the efficiency of the single cylinder four stroke diesel engines. The turbocharger is uses to the energy of exhaust gas to force more air-fuel mixture into cylinder to increase the engine power. The two chambers contain a turbine wheel and a compressor wheel connected by a shaft which passes through the centre housing. The performance characteristics of the engine are used to determine the brake power, specific fuel consumption, thermal efficiency, etc.

Keywords : Four Stroke Diesel Engine, Turbocharger, Performance Analysis, Variable Compression Ratio.

I. INTRODUCTION

Now a day, researches were being a lot of doing work in I.C engine to improve the engine efficiency. Diesel engine were used in natural gas for economic and environment control advantages. This paper will review the variable compression ratio for different load using single cylinder four stroke diesel engines to determine the parameter and produced the maximum energy efficiency.

Diesel engines characterized are low fuel consumption and low emission for CO and NOx will be high. A major problem in NOx emission is higher for the pollution control. Due to friction loss and exhaust loss of the performance at affect the efficiency. It seems that a fuel consumption rate is lower compare to compression ratio is high in the part load.

II. METHODS AND MATERIAL

1. Literature Review

A research on diesel engine have a better design can be improve the compression quality and brake thermal efficiency and saves the fuel. The present work deals for finding the compression ratio in better from of the diesel fuelled at variable load ratio and constant speed. It represents the volume ratio in combustion chamber is high capacity to lower capacity. A turbocharger is means the charging compressor is driven by an exhaust gas driven turbine. It will be increased the performance efficiency of the engine. The result were showed by theoretical calculate of the brake power, brake specific fuel consumption, thermal efficiency, etc. From this review paper, the parameter is calculated due to variable compression ratio for single cylinder four stroke diesel engine.

2. Experimental Setup

The engine setup consists of a single cylinder, four strokes, variable compression ratio connected to eddy current dynamometer. A kirloskar engine is modifying to variable compression ratio diesel engine. The main components of the system are fuel injection pump, dynamometer, turbocharger, exhaust gas analyser. A necessary instrument is a combustion pressure, air flow, temperature, crank angle, piston, fuel flow and load measurements. The rota meter is uses to cooling water and calorimeter water flow are measured. The engine performance were setup study includes of torque, brake power, indicated power, friction power, brake specific fuel consumption, indicated specific fuel consumption, brake thermal efficiency, indicated thermal efficiency and thermal efficiency.

Figure 1. Experimental Setup of VCR Diesel Engine

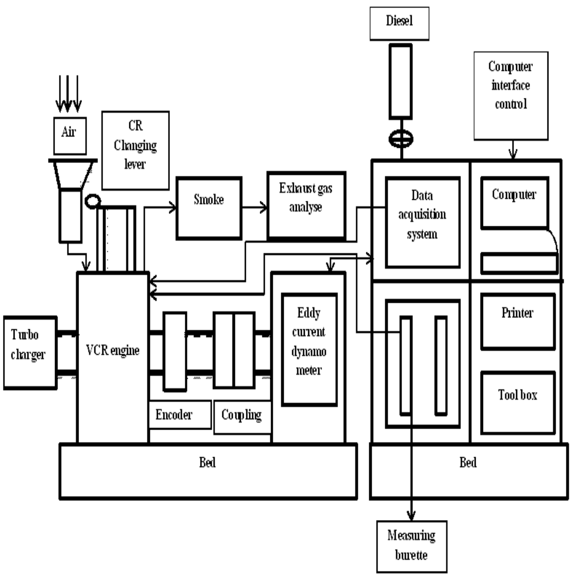

Figure 2. Block Diagram of VCR Diesel Engine

2.1 Variable compression ratio of an I.C engine

In IC engine, a fuel gas will not be expanding fully in the cylinder. Fuel energy is exhaust and it will be waste to the environment. The exhaust gas will be energy distribution to the diesel engine for the air fuel inlet injection by using turbocharger. The I.C energy exhaust energy is containing to the thermal energy and pressure energy. The I.C energy of the compression ratio is the ratio of the volume of the combustion chamber and it's from a largest capacity to the smallest capacity. It is a fundamental specification for this common combustion engine. The main concept of variable compression ratio is uses to improve the engine performance, efficiency and emissions will be reduced. The high cylinder pressures and temperatures during the early part of the combustion and small residual gas fraction over to high compression ratio give faster laminar flame speed. Ignition delay period is shorter. At a low loads, the compression ratio is greater, and the combustion time is shorter. Subsequently, time loss is reduced. The fuel consumption rate is lower with high compression ratios at part load.

2.2 Variable compression ratio diesel engine using with turbocharger

A turbocharger is a device used to allow more power to be produced for an engine of a given size. Its purpose is uses to increase the volumetric efficiency of the combustion chamber. The first concept of the exhaust turbocharger is well known to reuse the I.C engine exhaust energy. In an exhaust turbocharger system, the I.C engine will be exhaust expands to turbine and an output is a shaft work to drive an air compressor. It means that exhaust energy will be used to boost an IC engine intake pressure. A turbine is directly couples to the I.C engine exhaust pipe to uses to run the exhaust for working medium without any mechanical connection between the I.C engine and turbine. The main faults of the exhaust turbocharger can be summarised to follows: due to the throttling exhaust of the turbine, there will be a higher exhaust back pressure and a larger exhaust loss in exhaust turbocharger engine. By using Single cylinder diesel engine gives one power stroke per crank revolution (2-Stroke) and two revolutions (4-stroke). The torque pulses are widely spaced and engine vibration and smoothness are significant problems. Used in small engine application where engine size is more important. Engine weight will increase and engine cost will increase. Engine power is proportional to the amount of air and fuel that can get into the cylinders. The power and performance of an engine can be increased by the turbocharger.

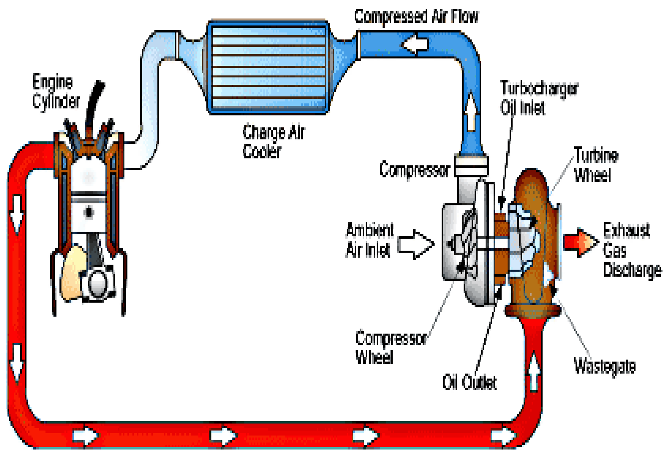

Figure 3. Engine with using Turbocharger

III. RESULTS AND DISCUSSION

1. Theoretical Calculations

1.1 Compression Ratio

It is the ratio of the total volume of the combustion chamber if the piston moved at bottom dead centre to the total volume of the combustion chamber if the piston moved at top dead centre.

$$r_c = \frac{\text{Total volume at BDC}}{\text{total volume at TDC}}$$

1.2 Friction Power

The link between the output of brake power and the output of indicated power of an engine.

$$FP = IP - BP$$

1.3 Indicated Power

It may be the power developed by combustion of fuel in the combustion chamber. It is the sum of friction power and brake power.

$$IP = \frac{ImepLAN}{60}$$

1.4 Indicated Mean Effective Pressure

It may be the average pressure acting on a piston during a power stroke of its cycle.

$$Imep = \frac{60IP}{LAN}$$

1.5 Brake Specific Fuel Consumption

It may be thought of as fuel consumption per unit of thrust of the brake power.

$$BSFC = \frac{M}{BP}$$

1.6 Indicated Specific Fuel Consumption

It may be thought of as fuel consumption per unit of thrust of the indicated power.

$$ISFC = \frac{M}{IP}$$

1.7 Brake Thermal Efficiency

It is defined as brake power of a heat engine as a function of the thermal input from the fuel.

$$BTE = \frac{BP * 3600}{M * CV}$$

1.8 Indicated Thermal Efficiency

It is defined as the ratio between the indicated power output of an engine and the rate of supply of energy in the fuel.

$$ITE = \frac{IP * 3600}{M * CV}$$

1.9 Mechanical Efficiency

It is measured as a ratio of the measured performance of an ideal machine.

$$ME = \frac{BP}{IP}$$

2. Nomenclature

CR	–	Compression Ratio
BP	–	Brake Power
IP	–	Indicated Power
FP	–	Friction Power
BTE	–	Brake Thermal Efficiency
BSFC	–	Brake Specific Fuel Consumption
VCR	–	Variable Compression Ratio
IMEP	–	Indicated Mean Effective Power
BMEP	–	Brake Mean Effective Power
TE	–	Thermal Efficiency

3. Performance Analysis

The effect of compression ratio on brake thermal efficiency, volumetric efficiency and mechanical efficiency. It is observed that irrespective of the compression ratio the volumetric efficiency of the engine is almost constant but the mechanical efficiency decreases between compression ratios 15 and 16 due to more friction power. At compression ratio of the brake thermal efficiency of the engine is low and it slightly increases. It is used to analysis the valve of the variable compression ratio engine with the turbocharger.

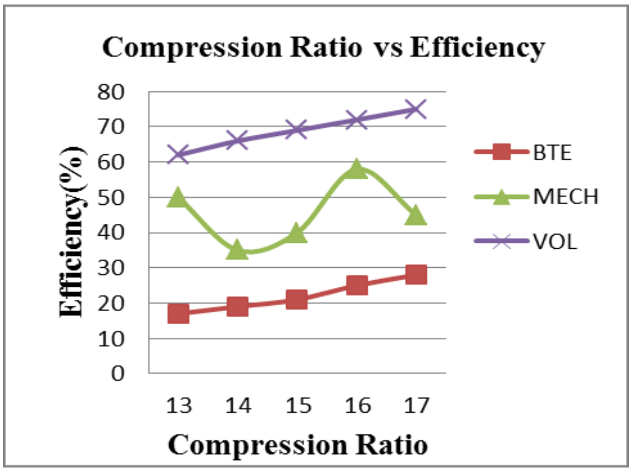

Figure 4. Effect of compression ratio on Brake Thermal Efficiency, Mechanical Efficiency and Volumetric Efficiency

IV. CONCLUSION

Now a day, it is good for applications of a new technology regard to economic considerations and engine efficiency. A variable compression ratio concept has also been evaluated by means of the simulation of a turbocharged diesel engine. The effect of compression ratio on the engine performance at fixed loads will be presented. The principal benefits are a reduction in fuel consumption at part load and a reduction in ignition delay. The increase in the intake boost pressure improves the brake thermal efficiency of the engine. For the compensation of drop in volumetric efficiency of the insulated engine 4% intake boost pressure is required for turbocharging.

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