Experimental Investigation of Performance Characteristics on a Single Cylinder CI Engine for Various Fuel Injection Pressure

P. L. Navaneetha Krishnan1 M. Gowtham2
1Assistant Professor 2Student
1,2Department of Mechanical Engineering
1,2Adithya Institute of Technology, Coimbatore, India

Abstract—Experimental work has been carried out to analyze the performance characteristics of a single cylinder 3.67 kW, compression ignition engine fuelled with diesel at fuel injection pressures of 180 bar, 200 bar and 220 bar. The main objective of this study is to investigate the brake thermal efficiency, specific fuel consumption (SFC) are Calculated. The performance characteristics were presented and concluded that brake thermal efficiency increases with increase in injection pressure; Specific Fuel Consumption decreases with increase in injection pressure significantly.

Key words: Compression Ignition Engine, Brake Thermal Efficiency, Specific Fuel Consumption

I. INTRODUCTION

The definition of engine is to convert heat in to work called heat engine. In this heat is low grade energy and work is high grade energy. Heat engines are either external combustion engines or internal combustion engines. The Internal combustion engines having higher efficiency than the external combustion engines and emits fewer pollutants in this diesel used as a fuel. The emissive pollutants are high for large engines than that of small engines and these pollutants are disposed into the atmosphere mainly depend on the vehicle population. The total human beings are 7 million in the world. Out of the total population the number of vehicles which we are having 1 billion i.e., every 7th person having vehicle in the world. The daily population of human beings will be increasing 4% for every year. But number of vehicles is increasing 24%. The total energy which world is having petroleum products, USA using 50% but there population is 4% of the world. We people are consuming 1.5% but our population is 121 crore. When we people are consuming 1.5% of petroleum products only but still we saying pollution of India is very high. At present the Indian people having 15% of vehicles. But in USA every person has a vehicle. The Indian people have per capital income is one thousand dollar. In India 40 crore people are earning less than 1 dollar and 10% are earning people who are richer than the USA that much difference we people are having. The efficiency of petroleum engine is 11% only then remaining 89% destroy the environment but in the case of Diesel engines the efficiency is 30 to 35%. In many countries these vehicles banned because there emit large number of pollutants.

II. INJECTION PRESSURE VARIATION

To acquire high degree of fuel atomization needs high injection pressure in the fuel injection system. For the purpose of sufficient evaporation of fuel in very short time. From that the fuel particles achieve sufficient spray penetration in order to exploit the fuel air charge in the cylinder. The fuel injection system should have measured the amount fuel desired, depending upon engine load and speed, and inject the fuel at desired rate in correct time. The appropriate shape and size of fuel particle obtained based on the particular combustion chamber. Generally, a supply pump withdraws the fuel from fuel tank and carries it’s via a filter to the fuel injector. In present investigation the injection pressure varied from 180 to 220 bar. Normally the injection pressure is 200 bar for high speed diesel engines. In this the injection pressure is varying by tightening or loosening the screw provided top of the injector as shown in fig.1. For measurement of fuel injection pressure on fuel injector system by using fuel injector pressure tester as shown in fig.2.

III. EXPERIMENTAL SETUP

The experimental work had conducted on 4-stroke diesel engine. In diesel engine four strokes are utilized namely suction, compression, power and exhaust strokes for completion of cycle. The 4-stroke diesel engine consist s of two valves i.e., inlet valve and exhaust valve. In this the inlet valve is used for sucking the fuel charge or pure air in to the
Experimental Investigation of Performance Characteristics on a Single Cylinder CI Engine for Various Fuel Injection Pressure

(IJSRD/ Vol. 5/Issue 12/2018/256)

chamber at beginning of the suction stroke and the exhaust valve is used for removal of exhaust gases from engine cylinder at the end of combustion stroke. The piston is moving from top dead centre to bottom dead centre at starting the cycle. The piston begins from TDC to BDC at suction stroke the inlet valve opens and the fuel charge is sucked in to the combustion chamber then compressed at compression stroke between piston and cylinder head until piston reaches TDC at end of compression stroke. At end of compression stroke spray of fuel injected in to the cylinder the fuel complete combustion obtained in cylinder at power stroke. End of power stroke the exhaust gases are releases. The exhaust gases are sent to out through exhaust manifold at exhaust stroke. This cycle follows by 4-stroke diesel engine.

<table>
<thead>
<tr>
<th>Make</th>
<th>Kirloskar AV-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Single cylinder, water cooled.</td>
</tr>
<tr>
<td>Max. power</td>
<td>3.7 kW at 1500 rpm</td>
</tr>
<tr>
<td>Displacement</td>
<td>550 CC</td>
</tr>
<tr>
<td>Bore x Stroke</td>
<td>80 x 110 mm</td>
</tr>
<tr>
<td>Compression ratio</td>
<td>16.5:1</td>
</tr>
<tr>
<td>Loading device</td>
<td>Eddy current</td>
</tr>
</tbody>
</table>

Table 1: Specification of Test Engine

A single cylinder 4-stroke water cooled diesel engine having 5 hp as rated power at 1500 rpm was used for the research work. The engine was coupled to an electrical dynamometer for loading it. The engine equipment is completely digital system. The speed and different temperatures are note down from the digital indicator. The experimental set-up of the engine is shown in figure 1.

Fig. 3: Engine Test Rig

IV. RESULT & DISCUSSIONS

A. Specific Fuel Consumption (SFC)

The variation of specific fuel consumption with injection pressure for diesel shown in the fig 2. It is observed that the specific fuel consumption has decreased with increase in injection pressure till 220bar and increases when pressure is increased. The lowest SFC was recorded at 220 bar injection pressure. Increase in injection pressure from 180 to 220bar leads to reduction in SFC. It can be concluded that, 220 bar is the optimum injection pressure. At higher injection pressure, the reduction in SFC may be due to improved atomization resulting in better combustion.

Fig. 4: Variation of Specific Fuel Consumption with Injection Pressure

Mechanical Efficiency The variation of Mechanical efficiency with injection pressure for diesel are shown in the fig-3. This can be attributed to the increase of viscosity and thereby resulting in increase of friction power.

Fig. 5: Variation of Mechanical Efficiency with Injection Pressure

Brake Thermal Efficiency The variation of brake thermal efficiency with load at three injection pressures are shown in fig-4. It is observed that the maximum efficiency obtained at 220bar injection pressure. At this pressure the maximum efficiency is obtained as 22.49% at full load condition. This may be attributed to better spray characteristics in the combustion chamber which leads to effective utilization of air resulting in more complete combustion.

Fig. 6: Variation of Brake Thermal Efficiency with Injection Pressure

Indicated Thermal Efficiency The variation of Indicated Thermal Efficiency with load at three injection pressures are shown in fig-5. It is observed that the maximum efficiency obtained at 220bar injection pressure. At this
pressure the maximum efficiency is obtained as 37.04% at full load condition.

![Graph](image)

Fig. 7: Variation of Indicated Thermal Efficiency with Injection Pressure

V. CONCLUSION

Based on the results and the investigations, it may summarize as follows.

- The BSFC taken was minimum at 220 bar injection pressure.
- The brake thermal efficiency from 180 to 220 bar, was minimum at 220 bar injection pressure.
- The mechanical efficiency is higher at 220 bar than 180 and 200 bar.

REFERENCES


