International Journal of Research in Advent Technology, Vol.3, No.11, November 2015
E-ISSN: 2321-9637
Available online at www.ijrat.org

Review on Turbo Charging Of Diesel Engine and Effect of Its Performance Insulated Diesel Engine

Ghanshyam pradhan[1], Gopal Sahu[2], Prakash Kumar Sen[3], Ritesh Sharma[4], Shailendra Bohidar[5]
[1]*Student,Mechanical Engineering, Kirodimal Institute of Technology, Raigarh (C.G.)*
[2,3,4,5]*lecturer,Mechanical Engineering, Kirodimal Institute of Technology, Raigarh (C.G.)*

Abstract- The purpose of this paper was to analyze a turbocharger system in a diesel engine and working of turbocharged system. The fuel economy of diesel engine is improving the power of the engine and effect of volumetric efficiency. The volumetric efficiency drop is compensated by turbo charging in the present experimental work. This gave the better performance with reduction in smoke. With the turbo, charging the intake boost pressure is raised and its effect on the engine performance is also studied. In the diesel engines for about 30% of the total energy is lost to the cooling water. This lost energy can be recovered in the form of useful energy by expanding gases in the turbines

Key ward: Diesel Engine, Turbocharger, Intercooler, Turbine, Compressor.

1. INTRODUCTION

The turbocharger is used to increase engine power. The turbocharger improve to engine performance and emission.[1] Improving the fuel economy of diesel engine for automotive application has a higher priority this decade. The driver of this strong focus is concern over Global warming and the connection between fuel consumption and emission of the green house gas,CO_2 and CO.[2] One way to improve an engine is to use a turbocharger is a pair of fans that harness waste exhaust power from the back of an engine to cram more air into the front, delivering more "oomph" than you'd otherwise get. One way to make a car go faster is to add more cylinders. That's why super-fast sports cars typically have eight and twelve cylinders instead of the four or six cylinders in a conventional family car. Another option is to use a turbocharger, which forces more air into the cylinders each second so they can burn fuel at a faster rate. A turbocharger is a simple, relatively cheap, extra bit of kit that can get more power from the same engine. . A turbocharger consists of a turbine and a compressor connected by a shaft. The turbine section is mounted to the exhaust line from the engine. The compressor is connected to the turbine by a shaft and its outlet is routed to the engine air intake. Exhaust gas from the engine enters the turbine and expands, performing work on the turbine. The turbine spins the shaft connected to the compressor. The compressor draws in ambient air and compresses it. [1] The basic idea is that the exhaust drives the turbine (the red fan), which is directly connected to (and powers) the compressor (the blue fan), which rams air into the engine. For simplicity, we're showing only one cylinder. Here then, in summary is how the whole thing works:

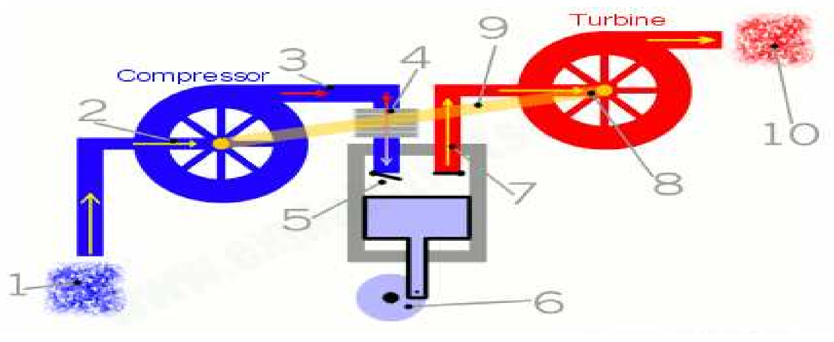

Figure1: Working of Turbocharger [10]

1. Cool air enters the engine's air intake and heads toward the compressor.
2. The compressor fan helps to suck air in.
3. The compressor squeezes and heats up the incoming air and blows it out again.
4. Hot, compressed air from the compressor passes through the heat exchanger, which cools it down.
5. Cooled, compressed air enters the cylinder's air intake. The extra oxygen helps to burn fuel in the cylinder at a faster rate.
6. Since the cylinder burns more fuel, it produces energy more quickly and can send more power to the wheels via the piston, shafts, and gears.
7. Waste gas from the cylinder exits through the exhaust outlet.
8. The hot exhaust gases blowing past the turbine fan make it rotate at high speed.
9. The spinning turbine is mounted on the same shaft as the compressor (shown here as a pale orange line). So, as the turbine spins, the compressor spins too.
10. The exhaust gas leaves the car, wasting less energy than it would otherwise.[7]

2. TURBOCHARGER

The mathematical representation of compressor and turbine characteristics is necessary to calculate the interaction between turbocharger and diesel engine. The majority of transient diesel engine simulations, either quasi-linear or filling and emptying, have adopted the use of compressor and turbine performance characteristics, as provided by the manufacturer or measured in-house. These give the interdependence between isentropic efficiency (η_{is}), pressure ratio (r), mass flow rate (m) and rotational speed (N). [3]

3. TURBOCHARGING EQUIPMENT

To pressurize the inlet air, internally powered turbo charging equipment with closed loop lubrication is fabricated. The schematic diagram of the turbo charging equipment is shown in Fig: 3.1 in the turbo charging the high temperature exhaust gases are expanded in a low-pressure turbine for the power generation and this is further coupled to motor of the compressor [4]. This compressor compresses the inlet air and supplies to the engine at slightly higher pressure. By controlling the inlet air, the engine is turbocharged at different inlet pressures.

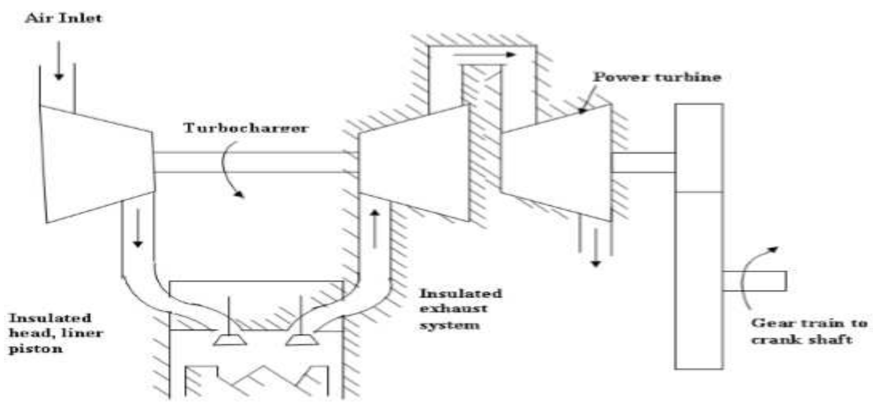

Figure 2: Turbocharged Insulated Diesel Engine [6]

4. TURBOCHARGER SYSTEM

. A turbocharger consists of a turbine and a compressor connected by a shaft. The turbine section is mounted to the exhaust line from the engine. The compressor is connected to the turbine by a shaft and its outlet is routed to the engine air intake. Exhaust gas from the engine enters the turbine and expands, performing work on the turbine. The turbine spins the shaft connected to the compressor.

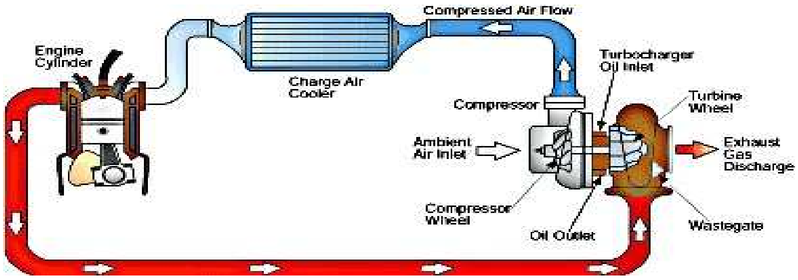

Figure 3: Arrangement of turbocharging system

5. VARIABLE GEOMETRY OF TURBOCHARGER

1. Control exhausts pressure to Driver EGR flow

2. Variable position vanes allow toileted Performance

3. Customer Value

- Faster Response
- More Torque
- Improved fuel Economy

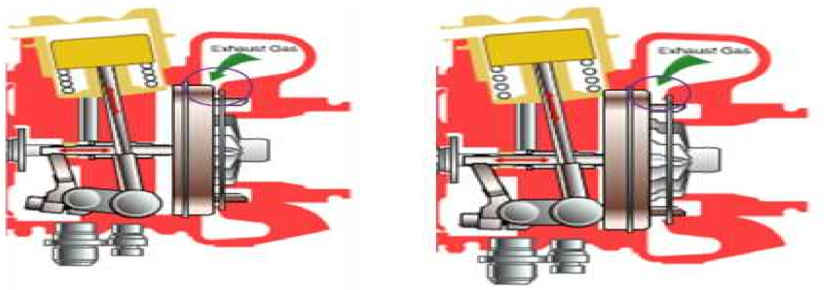

Figure 4: Variable geometry of turbine

5.1. Fixed Geometry

This refers to a turbocharger without boosts control the housing & component has unchanging dimensioning.

5.2. Wastegated

This turbocharger has an exhaust bypass valve allowing exhaust gases to bypass the turbine levelling some exhaust energy unused. Allowing the exhaust gases to bypass the turbine wastes some of the exhaust gases energy thus water gated turbocharger.

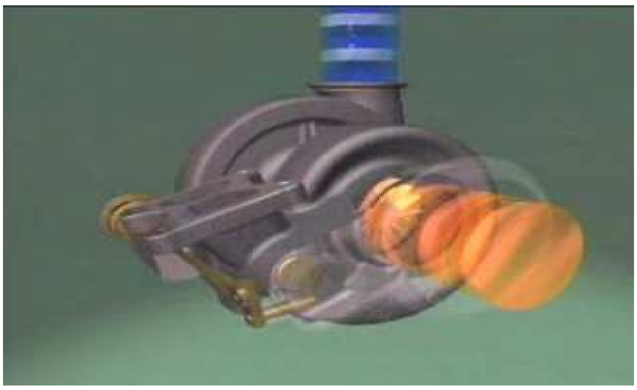

Figure 5: Wastegated of turbocharger

6. EFFECT OF TURBOCHARGING ON THE VOLUMETRIC EFFICIENCY

The variation of volumetric efficiency with power output with intake boost pressure is shown in Fig: 5. With the increase of boost pressure more air is available for the combustion which further increases the combustion efficiency. At higher boost pressures excess air doesn't improve the combustion efficiency [8]. So it is concluded that 790 mm of Hg is the optimum boost pressure at which the drop in volumetric efficiency is compensated with turbocharger. Because of the increased backpressure with turbocharging conditions, the inlet boost pressures are higher for compensating the volumetric efficiency drop in normal engine. It requires nearly 4% of intake boost pressure under turbocharging conditions for compensating the maximum efficiency drop of 10% in the normal engine. Comparison of percentage of boost pressure required for volumetric efficiency compensation with power output is shown in Figure 6

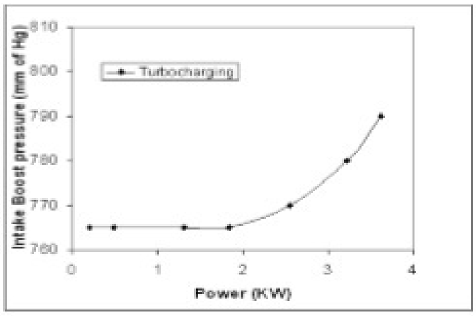

Fig: 6 Comparison of Intake Boost Pressure Required for Volumetric Efficiency Compensation with Power Output in Turbocharging

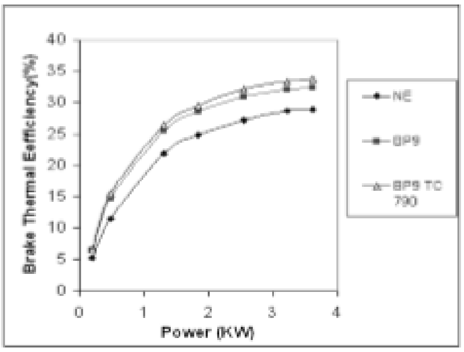

Fig: 7 Comparison of Brake thermal Efficiency with Power Output for Volumetric Efficiency Compensation with Turbocharging

7. BRAKE THERMAL EFFICIENCY

The variation of brake thermal efficiency with power output for turbocharged condition . When the engine is turbocharged with volumetric efficiency compensation thermal efficiency is improved continuously with load.

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A fully instrumented test bed installation has been set up in order to study the transient performance and emissions of a bus/truck turbocharged diesel engine during hot starting improvement is about 4.3% over insulated engine.[9]

8. COMBUSTION PARAMETERS

With the turbo charging more air will be available for the combustion and this will change the combustion parameters.

8.1 Peak Pressure

The peak pressure variation of turbocharging with power output. The peak pressures of normal engine, Insulated engine and turbocharged Insulated engines are compared in the same figure. It is observed that the peak pressures are higher with turbocharged engine and is about 82 bar at the rated load.

9. CONCLUSION

A fully instrumented test bed installation has been set up in order to study the transient performance and emissions of a bus/truck turbocharged diesel engine during hot starting. Due to the complete combustion of alcohol at higher temperatures the smoke emissions are also marginal. The higher temperatures are available in the combustion chamber due to insulation, the increase in exhaust gas temperature. This is attributed to the higher latent heat of vaporization of alcohol. For the compensation of drop in volumetric efficiency of the insulated engine 4% intake boost pressure is required for turbocharging. Therefore, for improving the thermal efficiency of insulated engine, the volumetric efficiency drop is compensated by turbo charging in the present experimental work. This gave the better performance with reduction in smoke. With the turbo, charging the intake boost pressure is raised and its effect on the engine performance is also studied.

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